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Socio-technical factors impacting youth perspectives on digital transformation in resource-constrained environments: A study of Diepsloot youth

By

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Submitted in accordance with the requirements for the degree of

Master of Arts in the field of ICT Policy and Regulation

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February 2023

DECLARATION

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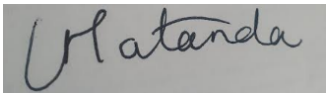
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Socio-technical factors impacting youth perspectives on digital transformation in resource-constrained environments: A study of Diepsloot youth

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I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.



19 June 2023

Signature Date

ABSTRACT

There has been a proliferation of tech hubs in Africa, with more than 80 in South Africa, forming a foundation for more inclusive digital innovation. However, we do not sufficiently understand the relationships between tech hubs, digital inclusiveness and poverty. This study explores the sociotechnical factors influencing access and use of the Internet to achieve social inclusion in resource-constrained environments. The literature reviewed focused on social influences on digital adoption, tech hub infrastructure, digital skills, and trends in Information Communication Technologies (ICT) policies.

The study's findings are categorised into themes using the sociotechnical systems (STS) theoretical framework. Each of the seven STS theoretical components (goals, culture, people, processes, infrastructure, technology and environment) were used as a lens to explore the social and technical factors that influence the perspectives of the youth on digital transformation. These themes were then mapped to the four dimensions of the research questions (social influence of digital adoption, institutional infrastructure for access, digital skills, and ICT policies for digital enablement) to highlight key findings and interpretations of the study.

Under social influences, the youth demonstrated resilience driven by a need to improve their standard of living in a challenging environment. The institutional infrastructure, designed to support youth to access digital technologies, is constrained by a lack of resources. Tech hubs are using creative ways with the limited resources to cater to all their patrons, although there is room for improvement. In terms of digital skills, four youth profiles are highlighted to demonstrate a solid existence of digital skills and pursuit of tangible outcomes among the youth. In addition, the youth want to pursue entrepreneurship, meaning that tech hubs can potentially become mass training centres for digital entrepreneurship. Finally, a review of ICT policies revealed a chasm between the ICT policy objectives and activities on the ground, pointing to a lack of implementation and monitoring of ICT policies. Acting as a platform for digital foundations, tech hubs in marginalised environments must engage policymakers and reinforce their role in digital empowerment to influence policy development.

This research is located in the qualitative interpretivist paradigm. A total of 21 in-depth interviews were conducted with 18 youth, with an equal representation of male and female, and three tech hub managers. Based on the researcher's analysis, access to the Internet offers the resilient youth a view into "a new world" that makes them feel they can achieve anything they want. The high literacy level among the youth puts them in good stead for digital upskilling, and they are motivated to participate in the digital economy. However, ICT

policy objectives concerning universal access look good on paper, but in reality, poor people are still offline. They are still excluded.

Keywords: Digital transformation, tech hubs, youth, poverty, sociotechnical theory, social inclusion

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Most importantly, to God be the glory, for according to Deuteronomy 8:18, “it is He who gives the ability to produce wealth.”

DEDICATION

I dedicate this dissertation to my daughters - Sophie-Rose, Samia, and Alyssa. This dissertation is an example that hard work, perseverance, and focus produce great results. As you grow older and find your own ways in the world, may you always aim to get to the extra mile. The extra mile requires hard work, perseverance, and focus. Take these within your stride and you will be successful.

ABBREVIATIONS

4IR	Fourth Industrial Revolution
AI	Artificial intelligence
CA	Capability Approach
Covid-19	Coronavirus disease of 2019
DSD	Department of Social Development
DT	Digital Transformation
e-Gov	Electronic government
ICASA	Independent Communications Authority South Africa
ICT	Information Communication Technology
ICT4D	Information Communication Technology for Development
ITU	International Telecommunications Union
NDP	National Development Plan
PC4IR	Presidential Commission on Fourth Industrial Revolution
RDP	Reconstruction and Development Programme
SONA	State of the Nation Address
SSA	Sub Saharan Africa
STS	Socio-technical system
TAM	Technology Acceptance Model
Tech hubs	Technology hubs

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CHAPTER 1: BACKGROUND: SOCIOTECHNICAL FACTORS INFLUENCING PERSPECTIVES OF YOUTH ON DIGITAL TRANSFORMATION

1.0 Introduction to the study

This research investigates the sociotechnical factors that influence the youth's adoption and use of digital technologies in technology hubs (tech hubs) located in resource-poor environments. This study utilises a case study of Diepsloot, an informal settlement in South Africa's Gauteng province characterised by high unemployment and poverty. This research explores the relationship between poverty, tech hubs and digital innovation inclusiveness by focusing on social influences driving digital adoption, institutional infrastructure, digital skills and Information Communication Technologies (ICT) policies that enable digital empowerment.

Pollio (2022) points out the disappointing reality of the benefits of accelerated technology among the poor and calls for a future study that explores the reality of what he calls technological profit amongst the poor. Lose (2021) suggests that further research should focus on the success of tech hub patrons and the value they create instead of the funds invested into the various programs. Lose further adds that research is needed to evaluate whether those who need the incubators' support the most are provided with the proper support. This research, therefore, explores the adoption and use of technology by youth in resource-constrained areas and considers the outcomes of their technology use.

1.1 Research Problem Statement

The lack of Internet in resource-poor environments gave rise to Wi-Fi hotspots in public facilities and tech hubs, which act as institutional infrastructure to provide Internet access and opportunities for digital entrepreneurship. Tech hubs in impoverished areas have created a foundation for more inclusive digital innovation. Four important dimensions of digital innovation inclusiveness are social influences on digital adoption, institutional infrastructure, digital skills and ICT policies for digital enablement, understanding that digital technologies are embedded in each of these four dimensions. However, the knowledge gap is that we do not sufficiently understand the relationship between digital inclusiveness, tech hubs, and poverty. We neither know the digital skills applied, the outcomes achieved, nor the effectiveness of ICT policies on access and use of technology in poor environments. This study explores the sociotechnical factors influencing access and use of the Internet to achieve social inclusion by youth in Diepsloot.

1.2 Research Purpose Statement

This study seeks to investigate the sociotechnical factors influencing the use of digital technologies by youth in resource poor environments.

1.3 Research Questions

Main research question:

What are the sociotechnical factors influencing access and use of digital technologies by youth in Diepsloot to promote social inclusion?

Research sub-questions:

1. How do social influences affect the perspectives of youth towards adopting digital technologies?
2. How does the available institutional infrastructure established to support access to digital technologies enable the Diepsloot youth to access the Internet and digital opportunities?
3. What digital skills do the Diepsloot youth possess to use digital technologies?
4. To what extent do current ICT policies embed the promotion of digital technologies in support of social inclusion?

1.4 Research Aim and Objectives

This study aims to explore and understand the sociotechnical factors influencing access and use of digital technologies by youth in Diepsloot to promote social inclusion. To address this aim, the key objectives are:

- To determine the impact of social influences shaping the perspectives of youth towards adapting to technology.
- To evaluate the available institutional infrastructure established to support access to digital technologies and how it enables Diepsloot youth to use the Internet and get digital opportunities.
- To assess the digital skills the Diepsloot youth possess that allow them to use digital technologies.
- To evaluate the current ICT policies on embedding the promotion of digital technologies in support of social inclusion

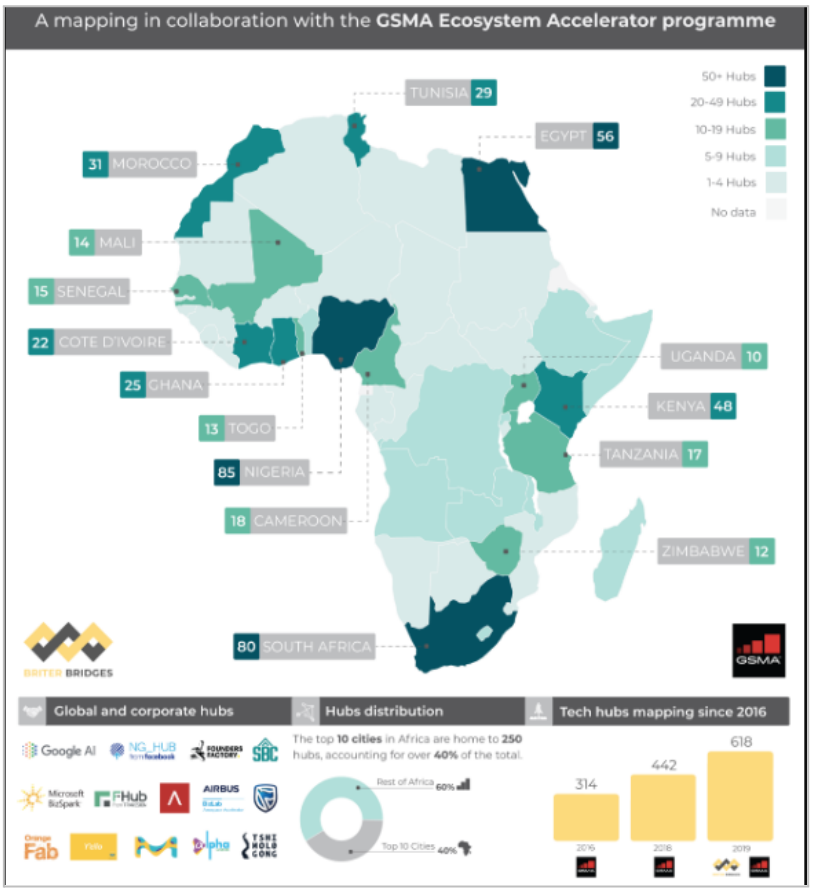
1.5 Background discussion on the evolution of tech hubs in Africa

Using digital technologies in resource-constrained environments requires access to the Internet. This is offered by tech hubs whose establishment in poor communities emerges from the historical trend of information communication technology for development (ICT4D). ICT4D is found at the intersection of ICT, development, and the transformative process by

which ICT should lead to growth (Sein, Thapa, Hatakka & Sæbø, 2019). However, the tech hub phenomenon has gone beyond the technical focus of ICT4D to incorporate social capital in its design. Noticeably, tech hubs provide a channel for the generation of ICT-related skills and solutions to address local challenges and foster a culture of innovation that empowers communities (Amankwah-Amoah, 2016). Atiase et al. (2020) concur that tech hubs are well positioned to create economic and social value in poor environments.

In Africa, there has been a massive adoption of technology hubs creating a pattern of innovation, a rise in innovative technologies and a digital market on the continent. A report by Giuliani and Ajadi (2019) recorded the existence of 618 active tech hubs in Africa, with 80 in South Africa (refer to figure 1). The Internet is the core infrastructure driving innovation on the continent (Ochara, 2020). Atiase et al. (2020) group the services of tech hubs into three main areas: knowledge production, employment generation, and the creation of value. Because tech hubs enable skills development through training and use of the Internet, they can play a significant role in helping youth participate and benefit from the digital economy.

Figure 1: Tech hubs mapping in Africa



Source: Giuliani and Ajadi (2019)

The youth are leading internet adoption, with 70% of 15 to 24-year-olds online globally (ITU, 2017). According to InternetWorldStats (2020), over 32 million Internet users in South Africa, equating to 55% of the population are using the Internet. Van Greunen and Veldsman (2016) state that technology has significantly changed how young people interact as they use the Internet. Pew Research (2016) found that in South Africa, less than six-in-ten millennials have access to the Internet. The report further states that 21 million South Africans subscribe to Facebook. Cele (2019) confirms that while Facebook is the most visited social media site in South Africa, WhatsApp has 38 million unique mobile users. Instagram has five million users, with women constituting 53% of South African digital users on Instagram (InternetWorldStats, 2020). Google.co.za and google.com are the top two websites visited by users. From an e-commerce perspective, the value of the digital economy in Africa is estimated to be USD180 billion by 2025 (IFC, 2020), while in South East Asia, the digital economy is expected to reach USD 363 billion by 2025 (Bloomberg, 2021). In South Africa, 18 million people are purchasing consumer goods via e-commerce (Cele, 2019), with online sales of USD1.8 billion (ZAR30 billion) (International Trade Administration, 2021).

The National Broadband Policy (2013) was developed to guide the delivery of universal access to all citizens through mobile and fixed broadband infrastructure. However, 61.8% of households had access to the Internet through mobile devices (StatsSA, GHS 2017) and smartphone penetration was 51% (Pew Research Centre, 2018). Smartphones are the entry point to digital technology and the low penetration points to the likelihood of limited access for poor people. This gap in access gave rise to the establishment of tech hubs and free Wi-Fi hotspots in public spaces, particularly in poor areas. The South African government has started investing in digital infrastructure in schools; however, there is limited investment in equipping the learners with digital skills.

1.6 Context of the study: The social and economical environment in Diepsloot

Diepsloot is an informal settlement in Region A of the City of Johannesburg Metropolitan Municipality and falls under the Gauteng province of South Africa, which is regarded as the country's economic hub. Diepsloot was established in 1995 as a temporary transit settlement for people evicted from other informal settlements in the city. Diepsloot is densely populated with a growing population estimated at 350 000 on five square kilometres (South Africa History Online). The population of Diepsloot is primarily black African and ethnically mixed. Diepsloot is also a melting pot for foreign nationals from neighbouring countries looking for business opportunities in Gauteng (Brown University, 2009). Diepsloot is an Afrikaans word loosely translated as a deep ditch.

The national unemployment rate in South Africa is at an all-time high of 35.3% (Stats SA, 2022) and is concentrated amongst the youth (15-34 years). The unemployment rate for Diepsloot is estimated between 44% to 47% (News 24, 2020). The Housing Development Agency (2013) found that unemployment rates are higher in informal settlements because they mainly act as 'arrival cities' for migrants from rural areas. Cross and Chitiga-Mabugu (2013) point out that urban migration is an employment strategy that results in high levels of rural-to-urban migration and unemployment in Diepsloot. From this perspective, Diepsloot serves an essential function as a cheap entry point and accessible location, a stepping-stone to the labour market, and possibly a better future for aspiring young people (Cross, 2010). While Diepsloot is riddled with its social challenges, such as poverty, crime and violent protests, it still attracts people from rural areas and illegal immigrants looking to enter the job market. Once they settle in their jobs, they move on to better housing elsewhere. Therefore, social mobility is inevitable due to the constant movement of people. As described by Muller and Pollak (2015), social mobility is how, over a period, individuals or families will move to a social position that is more satisfying to their status and needs in a society.

From an educational perspective, 66.5% of Diepsloot residents had not completed matric (Stats SA, 2011). van Greunen and Veldsman (2016) found that academic underachievement contributes to a vicious cycle of failure that manifests in behavioural, unemployment, and social problems. Stats SA (2011) reported that 52.7% of Diepsloot residents earn less than R3, 183 per month. The basic wage in South Africa is R3, 470.40 (Department of Employment and Labour, 2022). The streets of Diepsloot are dotted with informal traders selling different products on the roadside, from vegetables, cool drink, cooked food, live chickens, blankets, kitchenware, second-hand clothing, electronics, and hair salons, among others. Other traders are running spaza shops and taverns from the extensions of their dwellings. There is a shopping mall in Diepsloot called the Diepsloot Mall, which a Shoprite store anchors, plus other value-for-money clothing brands such as Pep, Jet, Ackermans, and fast-food outlet Kentucky Fried Chicken (KFC).

There are three primary forms of shelter in Diepsloot. The first is referred to as a shack made from corrugated sheets, scrap, wood, metal, or plastic. The second is the government-funded social housing project with brick walls and iron sheets as roofing, referred to as Reconstruction and Development Programme (RDP). The third form of shelter is bank-financed houses built with brick and tiled roofing. Diepsloot is subdivided into 13 extensions and housing structures in extensions 1, 12, and 13 consist of shacks only (Brown University, 2009). A few bridges link the sections; however, these bridges are low, leaving people at risk of being washed away when flooding occurs. In addition, the people whose

houses are by the streams are in more danger of their housing structures being swept away by flash floods during the rainy seasons (Brown University, 2009). In Diepsloot, there is roadside litter of items such as plastic bags, empty containers, broken glass, rotten food, and hair. Most of the time, there is an unpleasant smell due to burst sewers flowing on the roads, which seems a common feature in the area.

In Diepsloot, 60% of the residents use electricity for cooking, while 37.3% use paraffin. In addition, 76.1% of the residents have no access to the Internet, though cell phone penetration is high at 92.1% (Stats SA, 2011). Diepsloot is notorious for illegal electricity connections. In 2020, The Citizen (2020) reported that Diepsloot residents went for months without electricity after Eskom, the national power supplier, removed illegal connections from the area. Further, media reports on the impact of Covid-19 in Diepsloot revealed that more people lost their incomes due to the pandemic. The impact of Covid-19 exacerbated the existing challenges that residents had to contend with as they, among other things, lamented the proximity of their houses to each other, highlighting that they could not socially distance themselves, even if they wanted to (News 24, 2020).

Diepsloot has four tech hubs currently operating: Southern African Youth Project, Wot-If? Trust, Safe-Hub Diepsloot and Riversands. These tech hubs are focused on employment creation through knowledge sharing facilitated by open access to training, learning, and mentoring for the Diepsloot community. The Southern Africa Youth Project is mainly geared towards skills development by equipping the youth with digital skills such as Microsoft Office, Business Administration, Call Centre, and Life Skills in HIV/AIDS Awareness courses. The Wot-If? Trust tech hub is more focused on broader spectrum initiatives geared to address the social challenges in Diepsloot. They run digital skills projects such as ICT training programs, i.e., 4IR, and partner with corporates on specific programs on entrepreneurship. Safe-Hub is mainly focused on providing a safe environment for children while exposing them to various sporting activities and providing access to the Internet. Riversands is focused on fostering innovation and entrepreneurship; however, it is inaccessible to the residents of Diepsloot who have to use public transport to get to the tech hub.

The Johannesburg Development Agency (2012) states that the City of Johannesburg recognises Diepsloot as a priority development area in line with the Growth and Development Strategy Joburg 2040, the Growth Management Strategy, and the Upgrading of Marginalised Areas Programme. JDA further states that, in 2010, the City of Johannesburg approved an urban development framework for Diepsloot that restated the commitment to establish the area as a socially and economically viable human settlement

with access to essential services and opportunities for social mobility and economic development. However, today, ten years later, there is still a long way to go in providing basic services to the area to meet the needs of a growing and transiting population. Though plagued by its socio-economic challenges, with the majority of residents living in poverty, Diepsloot has a vibrant neighbourhood and residents who are hopeful and determined to improve their lives (The Diepsloot Youth Programme, 2022). Pfigu (2014) who found that the youth of Diepsloot desire a better life and want to improve their livelihoods, echoes this insight. Diepsloot was selected for its uniqueness as an arrival and transitory place for migrants in search of better opportunities. This demonstrates that the people in Diepsloot have solid ambitions and aspire for a better life. Therefore, their hopes and dreams must be highlighted for the right support to be directed towards nurturing these ambitions and bringing them to fruition.

Figure 2: A picture of Diepsloot



Source: The Diepsloot Youth Programme, 2022

1.6.1 Evolution of ICT policies for digital enablement in South Africa

ICT policies are crucial determinants of how people access and use technology to ensure economic inclusion. The United Nations (2016) identified policy as pivotal in the inclusive digital transformation of societies, businesses, and governments. The first policy in the post-apartheid government of South Africa that included ICT as an instrument to address the

inequalities of the apartheid era was the Reconstruction and Development Plan (RDP) (Van Audenhove, 1999). This was followed by a number of policies such as the National Development Plan (NDP) which articulated the government's objectives on ICT as an instrument of development and social inclusion. The National Broadband Act of 2013 (SA Connect) and The Integrated National ICT White Paper (2016) promoted social inclusion. From the white paper, the National Skills and Future Skills Strategy (2017) was developed to provide a roadmap for the digital upskilling of citizens. In the same year, South Africa's National e-Strategy (2017) was launched to propel the nation towards a robust and socially inclusive digital future through accelerating the adoption of ICTs in social and economic sectors. The national e-strategy builds on the previous ICT policies and fulfills the National Development Plan Vision 2030, which states, "a single cohesive national e-strategy is essential to ensure the diffusion of ICTs in all areas of society and the economy." To this end, in 2019, a Presidential Commission on the Fourth Industrial Revolution (PC4IR) was established with a mandate to identify and recommend policies and strategies required for South Africa to optimise benefits from the 4IR.

1.6.2 Digital skills landscape in South Africa

The fourth industrial revolution (4IR) has ushered in a convergence of emerging technologies resulting in an increased demand for specialised ICT skills. The JCSE-IITPSA ICT Skills Survey highlighted a significant digital skills gap in South Africa (JCSE, 2019). The National Digital and Future Skills Strategy (2017) acknowledges the digital skills gap in South Africa. It outlines the plans for bridging the gap between supply-side skills (developing digital skills at institutions of learning) and demand-side skills (readiness skills for the workplace and communities) through its eight interconnected strategy elements. These strategic elements are aimed at building digital capabilities in research and innovation at institutions of higher and tertiary learning, tech hubs, and in the private and public sectors. Tech hubs are identified in the first strategy element of digital foundations as playing an active role in training people on basic and digital skills (The National Digital and Future Skills Strategy, 2017).

This investigation will utilise a case study of Diepsloot informal settlement in Gauteng Province, South Africa, to explore the sociotechnical factors influencing the use of digital technologies among youth in poor communities.

1.7 Delimitations of the Study

The sociotechnical theory was selected and used to understand the youth perspectives on digital transformation in Diepsloot. This study is delimited to the social and technology concepts, in line with the theory. These concepts provide the lens through which we can understand how the social environment influences the use of technology among youth in Diepsloot. The focus of the study is in a context that is characterised by high levels of poverty and unemployment.

1.8 Conceptual descriptions of the study

This study contains a few key concepts used throughout the paper. This section provides definitions of these terms and includes the context within which they have been characterised. Accordingly, the descriptions are as follows:

1.8.1 Youth

The government of South Africa broadly defines the youth as those aged 14 years to 35 years old, considering that a young person's transition into becoming independent and self-sufficient could span a relatively long time (National Youth Policy, 2020-2030). On the other hand, the African Union (AU) defines youth or young people as between 15 – 35 years (African Union, 2006). The young people who participated in this study fall within this age group.

1.8.2 Poverty

In broad terms, poverty is expressed as the deprivation of opportunities and choices that are most basic for human development in leading a healthy lifestyle and enjoying the freedom, dignity, and respect from others (Studies in Poverty and Inequality Institute, 2007). Poverty is defined in this study as the lack of resources to fulfil human needs such as decent housing, sanitation, food, and digital communication to reach the subsistence standard of living.

1.8.3 Resource-constrained environments

Resource-constrained environments in relation to technology are broadly defined by Anderson et al. (2012) as low-income communities with limited resources and constrained in a number of ways, such as scarce network connectivity, limited power supply and low bandwidth. This definition is applied in this study to describe the context of this research.

1.8.4 Digital transformation (DT)

DT is a phenomenon of the digital era. Stolterman and Fors (2004) introduced DT as the change process associated with digital technologies in all aspects of society. Vial (2019) defines DT as a process by which various technologies in information, computing, communication, and connectivity activate significant changes to an entity – society or

organisation - as it tries to adapt and improve to survive. In this study, DT is viewed as an adaptation and learning process driven by the youth's desire to participate in the digital economy and be socially included.

1.8.5 Tech hubs

Technology hubs, mainly referred to as tech hubs, are characterised as collaborative spaces where different people with varying digital expertise and interests come together to share knowledge and skills, and develop their ideas through a community network (Jimenez & Zheng, 2017). Graham (2019) describes the physical spaces as consisting of a Wi-Fi-connected space with hot desks primarily used for laptop-based work. In this study, tech hubs are characterised as socio-technical spaces that allow for digital enablement and innovation through the cultivation of digital skills among the youth of Diepsloot. These spaces are open to anyone, in particular those who may be excluded from participating and engaging in innovation. The most advanced tech hubs have robust digital innovation with some form of production and/or are selling their products/expertise and typically integrated with the economy. The more early-stage tech hubs, which characterise this study, are still at the digital empowerment stage of digital innovation and mostly focused on digital skills training.

1.8.6 Digital skills

(UNESCO, 2018) refers to digital skills beyond just the ability to perform a task online to encompass other aspects such as expertise, ethics, and cognitive behaviours. This is the definition followed in this study.

1.8.7 Social inclusion

The World Bank (2020) broadly defines social inclusion as ensuring that individuals who may have been disadvantaged based on their identity can participate in society to improve their abilities, receive equal opportunities and preserve their dignity. In this paper, social inclusion refers to the ability of youth from a disadvantaged community and background to have equal access to opportunities and participate in the digital economy to achieve their full potential and excel in life within their society.

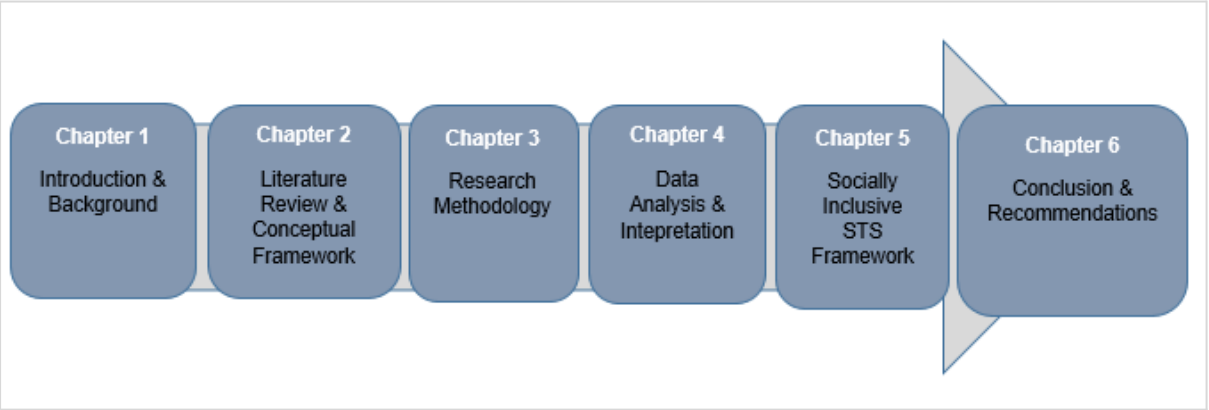
1.8.8 Digital economies

UNCTAD (2019) refers to digital economies as economies that are driven by digital technologies across all the dimensions; from business, industry, social, political, healthcare,and cultural among others. Digital information technologies are employed to develop, market and sell or consume products and services in a digital economy.

1.9 Research report outline

This study is organised into six chapters, with the outline of each chapter illustrated in figure 3 below:

Figure 3: Research report outline



Source: Matanda, 2023

Chapter 1: The introduction and background to the study. The problem statement, the research questions, and the study's rationale are provided in this chapter. The research context gives a detailed overview of Diepsloot informal settlements. The chapter ends with definitions of key concepts used throughout the paper.

Chapter 2: The literature on the key concepts of youth, digital transformation, tech hubs, digital skills, and social inclusion. These concepts are explored through the literature to provide a clear understanding of the problem. The selected theoretical framework, the sociotechnical theory, is introduced and a conceptual framework is developed.

Chapter 3: Provides an outline of the process, methods, and tools used to gather data. The chapter also shows the philosophical research paradigms that this research is based on, including sampling, data collection, and analysis.

Chapter 4: The analysis and interpretation of the data collected using the analytical lens discussed in chapter 3. The data is organised into themes, which correlate with the research questions.

Chapter 5: The socially inclusive framework for tech hubs is introduced.

Chapter 6: The conclusion, recommendations, limitations and suggestions for future research.

1.10 Summary of the chapter

Chapter 1 provides an introduction and background of the study. The statement of the problem, research questions, and objectives were outlined before the research context was provided. The rationale is included in this chapter to justify the study. To provide clarity of key concepts throughout the paper, definitions within the context of this paper, such as youth, digital transformation, tech hubs, and poverty, were provided. This chapter ends with an overview of the organisation of this paper.

CHAPTER 2: LITERATURE REVIEW ON DIGITAL TRANSFORMATION AND SOCIOTECHNICAL INFLUENCES ON TECHNOLOGY ADOPTION

2.0 Overview of the chapter

This chapter provides the literature review on digital transformation in resource-constrained environments. It is aligned with the research purpose statement that seeks to explore the influence of socio technical factors on the adoption and use of technology through the four dimensions of social influences on digital adoption, institutional infrastructure, digital skills, and ICT policies for digital enablement. These dimensions are unpacked to clarify how young people in poor environments access and use digital technologies and if they achieve tangible outcomes.

2.1 Conceptualising Digital Transformation (DT)

DT is a phenomenon of the digital epoch, which has progressively been defined by various scholars. Stolterman and Fors (2004) introduced DT as the change process associated with digital technologies in all aspects of society. Ebert and Duarte (2016) call DT a convergence of complex (technology) and soft forces (people and businesses) movements from which increased value should emerge. Martin (2008) described DT as the ultimate stage in using ICTs where significant new digital competencies and usage capabilities across societies, businesses, and governments enable innovation and creativity. Schnasse et al. (2021) view digital transformation as a "holistic sociotechnical challenge" with unprecedented consequences on individuals, societies, organisations, and economies. In the context of this study, these perspectives point to joint optimisation, a concept of the sociotechnical systems (STS) coined by (Appelbaum, 1997) which seeks to establish mutual gains between people and systems for digital transformation to occur.

In the context of DT, the following discussion expands upon the four dimensions chosen for this study, namely social influences on digital adoption, institutional infrastructure, digital skills and ICT policies for digital enablement.

2.2 Social influences affecting adoption of technology

The social influences that influence the adoption and use of digital technologies are discussed in this section. Social influences of friends and relatives concerning the socialisation of ICT in poor communities significantly impact technology adoption and use (Avilés et al., 2016). Their study revealed that people have presumptions about uses of the Internet and will construct imaginary uses for it, regardless of their ability to access it. Winocur (2007) puts forward a similar reflection as cited by (Avilés et al., 2016) that poor

people view the Internet as a strategy for social mobility. Avilés et al. (2016) conclude that in low-income environments, the use of ICT and the potential thereof rests with children and youth who use the Internet as a part of their strategy toward social mobility. The desire to escape hardship drives the youth towards social mobility, and they see the Internet as a stepping-stone. A common factor among the youth in Diepsloot is to escape their current circumstances and the existence of the tech hub instills a sense of hope that they can, one day, equipped with digital skills, competitively participate in the digital economy. The section below discusses the following social influences: poverty, literacy, and the environmental context, which impact the way people adopt and use technologies in poor environments.

2.2.1 The people's context, a fundamental social factor for DT

Understanding the context and social environment is crucial when planting infrastructure in resource-poor environments. Zhang et al. (2018) highlight that social influences on human behaviour, such as people's history, culture, and values have a significant impact on how they adapt to technology, transform and innovate. Waema and Miroro (2018) add that context influences access and usage of the Internet. It is fundamental to consider the appropriateness of the technology and the people's context in terms of what technology represents to them, as these act as determinants to the adoption of digital technologies. Soriano (2007) found that telecentres that failed to consider the history and culture of the community could not deliver significant benefits to the people; they could not empower them to use the technology because they did not know what was important to the community. The appropriateness of digital technologies and their meaning determine the value the community derives and the extent to which they will use the technologies.

2.2.2 Poverty excludes the poor from using digital technology

Broader resource limitations and persistent struggles associated with poverty influence the use of digital technologies in low-income environments (Gonzales, 2016). Van Deursen, Helsper, Eynon, et al. (2017) affirm that those marginalized in life's physical needs are likely to be marginalized in their uses of technology. Poverty plays a significant role in the adoption and use of digital technologies. The poor do not have ready access to digital technologies, they have no ownership and consequently they are excluded from the opportunities and benefits that digital technologies bring. As reiterated by Leye (2009), those who lack capabilities in acquiring tools and content to use the Internet are excluded from its benefits.

Chetty et al. (2017) point out that young people from poor environments have a debilitating fear of failure that prevents them from trying new things, mainly digital technology. PWC (2019) confirms that lower levels of education and limited opportunities make people fearful

of learning new digital skills. The fear of using technology leads to low self-esteem. Twinomurinzi and Msweli, 2019; Cázares, 2010) affirm that individuals with a low ICT self-efficacy are intimidated and less likely to use ICT. Kanniainen, Kiili, Tolvanen, et al. (2019) suggest that low literacy levels indicate that a person will struggle with comprehension when conducting online research. The fear of technology and the low self-esteem within a poor environment significantly contribute to the youth's attitude towards technology. Challenges people face in poor environments in accessing the internet influence their attitudes towards technologies (Gonzales, 2016).

2.3 Institutional infrastructure - tech hubs, the sociotechnical spaces

Scholars have described tech hubs as collaborative and safe innovative spaces that provide opportunities for individuals to become part of a community; developing ideas and technologies, acquiring and imparting digital skills toward self-sufficiency and employment creation (AfriLabs & Briter Bridges, 2019; Dosso et al., 2021; Abrahams & Kedama, 2017; World Bank, 2017; Atiase et al., 2020). Based on their purpose, tech hubs are categorised in various ways such as incubators, accelerators, innovation hubs, labs, telecentres, hackerspaces and in the context of this study, as sociotechnical spaces. The rise of innovative technologies and a digital market on the continent is driving the proliferation of tech hubs across Africa estimated to be at 643, including 78 in South Africa (AfriLabs & Briter Bridges, 2019). Developments in tech hubs by companies like Facebook and Google, demonstrate the interest and potential in tech adoption characterising the continent. The evolution of tech hubs is happening in the context of rural-urban migration as people search for employment opportunities (Dosso et al., 2021). Africa's urban population increased from 27 million in 1950 to 567 million in 2015 (OECD, 2020). A similar pattern of rural-urban migration exists in South Africa, where people seeking better employment opportunities in the city settle in places like Diepsloot.

This section discusses tech hubs as sociotechnical spaces that enable the youth to learn digital skills through the use of the Internet, without any form of payment. It also looks at tech hubs as catalysts of economic and digital inclusion, explores the challenges experienced by tech hubs, and ways that tech hubs can be made to be resilient.

2.3.1 Tech hubs, a bridge to Internet access

Accessing the Internet has become increasingly important for communication, information, and productivity. The Internet is the core infrastructure of the digital economy in Africa (Ochara, 2019) and, as such, represents digital transformation (Ndule et al., 2021). Frankfurter, Kokoszka, Newhouse, et al. (2020) stressed the significance of accessing and

using the Internet for economic inclusion in marginalised environments. Ndule et al. (2021) confirm the extent to which the Internet is used provides a more accurate view of the progress in digital transformation and its subsequent impact on livelihoods. Stretching this idea, Van Deursen and van Dijk (2019) suggest that access to the Internet is a process that begins with a positive attitude towards the Internet and progresses to ownership of material and physical access. In the Diepsloot context, the Internet is the key element that connects the youth to the world and therefore a precious resource in the tech hub.

In impoverished environments, resources are limited, and poor people can barely afford to buy Internet data. The marginalised are excluded from using digital technologies due to the cost of accessing the Internet. A4AI (2020) reported that South Africa does not meet the affordability of internet access standards as the average cost of 1GB of mobile data equates to 2.17% of the average monthly income. Gillwald and Chair (2016) highlighted that people in the lower-income category were spending approximately 20% of their income on small amounts of data, as the data prices remained significantly high. In the Eastern Cape Province, Chisango and Lesame (2017) found that affordability was one of the main challenges to adopting ICT. Free Internet or affordable data is a politically charged subject in South Africa. Social movements such as the #DataMustFall Campaign were activated as online protests against the high mobile data prices. In a study of 400 households, Waema and Miroro (2014) found that tech hubs provided access relief as people from poor households could access and use the Internet, although the extent of use varied based on factors such as education level. The tech hubs in Diepsloot were specifically set up to alleviate the financial burden associated with connecting to the Internet among the poor young people. The set-up of common areas for people to access ICTs provides relief for the marginalised and allows them to be socially included and participate in the digital economy.

2.3.2 Tech hubs as catalysts of economic and digital inclusion

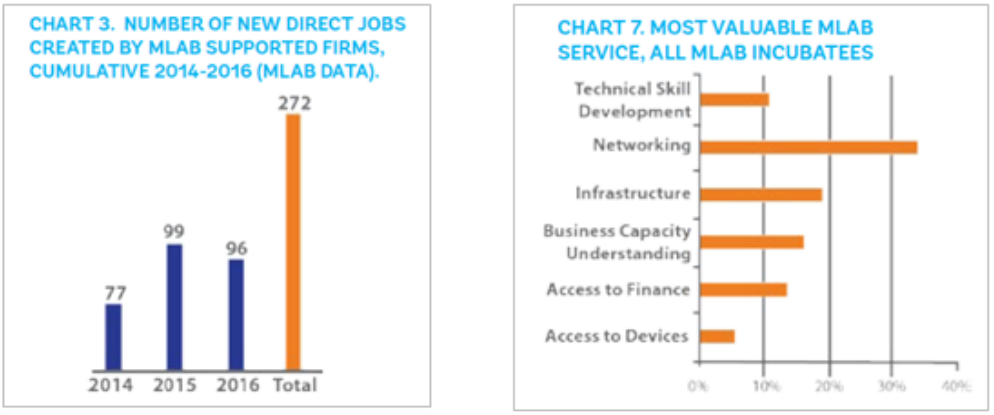
In Wua'an, China, Soriano (2007) analysed the role of community telecentres in enhancing the livelihood strategies of 30 poor rural households. The telecentres played a crucial role in disseminating relevant information to people. The information enabled them to get farming techniques on using pesticides, negotiate the best prices and find new markets for their products. The villagers declared an increase in average annual income, attributed their success, and broadened knowledge to the existence of the telecentres. The telecentres empowered them to use technology and open new avenues for their products and additional forms of livelihood. Tech hubs play a vital role in the entrepreneurship ecosystem in creating new supply and value chains for the youth (Atiase et al., 2020). Confirming this finding, Faye (2020) states that the impact made by a tech hub is the extent to which it generates jobs.

A study by Dosso et al. (2021) of five tech hubs in West Africa showed a rise in innovative technologies and a digital market on the continent driven by entrepreneurship. Across these tech hubs, young people are leading innovation and entrepreneurship while creating employment opportunities. For example, in Ivory Coast, a social innovation community embracing digital technologies and tools, had 150 young budding entrepreneurs under its wings, and approximately 40 projects were brought to maturity (Dosso et al., 2021). The WakatLab in Burkina Faso focused on social innovation by developing health, education, and agriculture solutions. The lab operates at different levels of the value chain, from idea creation, prototyping and incubation, to go-to-market. Every year since 2016, the lab nurtures ten youth projects and examples of these projects include developing a seeds drying system, a wind turbine built from a hub of a motorcycle wheel, and 3D printers built up from recycled parts (Dosso et al., 2021). Similarly, in Mali, the Bamako Incubator focused on creating entrepreneurship and employment opportunities for youth and trained 60 people in food, green, health and edutech (Dosso et al., 2021). This training has improved youth employability and readiness for the labour market.

The Eastern and Southern parts of Africa have also witnessed a rise of tech hubs. Kenya, Uganda and South Africa are ranked highly in tech hub rankings (Atiase et al., 2020). The iHub in Kenya was one of Africa's first tech hubs and focuses on technology entrepreneurs seeking to collaborate, share, co-create and produce knowledge (iHub Kenya, 2019). iHub played an instrumental role in the establishment of several startups as follows, 90% in ICT, 73% in finance, 52% in retail services, 44% in tourism, and 40% in social work services (iHub, 2014). The Innovation Village in Uganda is driving innovation with an excess of 2000 program members, and over 10,000 visitors, the Innovation Village has hosted 140 startups (The Innovation Village, 2022). In South Africa, MLab has successfully accelerated startups using mobile applications (mLab, 2019). MLab has supported over 70 digital startups since 2016 and trained 1.7 million students in digital skills necessary to enter into venture creation, positively contributing to the development of the Southern African economy (World Bank, 2017). From enabling local farmers to use mobile applications to monitor their yield, an estimated income of USD 2.7 million per annum is expected in the agriculture sector in Southern Africa with 272 direct employment opportunities created as shown in Figure 4 (MLab, 2019). The most valuable service by MLab is networking which confirms the positioning of tech hubs as key collaborative spaces that nurture ideas and encourage learning.

The above findings are in line with Kelly and Firestone (2016), and Jiménez and Zheng (2017) who affirm that tech hubs play a crucial role in modernising society and contributing to economic growth.

Figure 4: Direct jobs created and valuable tech hub services



Source: MLab, 2019

The case studies of tech hubs presented above are typical of more advanced tech spaces with robust digital innovation processes which include some form of production and integration with the economy. On the other hand, the tech hub spaces in Diepsloot are positioned to be socially inclusive and ultimately provide a bridge to the digital economy. Although the tech hubs are considered to still be early stages of digital innovation, they are focusing on digital empowerment through digital skills training.

2.3.4 Challenges encountered by tech hubs

Tech hubs face various challenges, regardless of their categorisation as a tech hub, incubator, accelerator, or working space. The main and primary challenge confronting tech hubs is access to funding (World Bank, 2017; AfriLabs & Briter Bridges, 2019). A significant number of tech hubs in Africa are dependent on some form of external funding. Some hubs are more self-sufficient and make money from consulting fees and membership fees (Atiase et al., 2020). However, funding remains a considerable challenge for tech hubs when considering the cost of infrastructure and technology transfer (Dosso et al., 2021).

The second challenge is the inadequate level of skill and business acumen in the management structure of the tech hubs in ways that provide value to the founders and benefit the patrons (InfoDev, 2017; AfriLabs & Briter Bridges, 2019). Consequently, tech hubs fail to build the right ecosystems to support the knowledge production and value creation processes (Akanle et al., 2019). Atiase et al. (2017) confirm that creating

connections with external collaborators is cumbersome for some tech hubs. As a result, the hubs fail to connect their patrons to external forms of knowledge and expertise, limiting their ability to create economic value. This lack of integration between tech hubs and essential stakeholders such as universities and policymakers manifests in a broken ecosystem that does not produce mutual benefit.

In South Africa, the energy sector has experienced challenges such as aging equipment and mismanagement of resources over the past decade (Makgetla, 2017). These challenges have subjected the country to rolling power blackouts, negatively affecting the availability of the Internet (Freedom House, 2020). Rolling power blackouts resulted in a 3.1% reduction in real GDP growth, costing the economy up to 40,000 potential jobs (PWC, 2022). A constant supply of power is crucial to running a tech hub and critical to access to the Internet. Without electricity, one cannot switch on the computers, let alone use the Internet. In Africa, the low penetration of electricity and lack of adequate infrastructure negatively affect ICTs, as these technologies rely on a constant power supply (Ochara et al., 2008). The tech hubs in Diepsloot experience similar challenges such as a lack of funding and load shedding.

2.3.5 Bringing resilience to tech hubs

Tech hubs need to evolve and create new self-financing models for financial independence. AfriLabs & Briter Bridges (2019) recommend that tech hubs must look at consolidating and packaging their offerings as a way to boost their revenue streams to achieve financial sustainability. Tech hubs need to develop ways to monetize high-value services while improving their capacity to deliver these services (World Bank, 2017). The governments need to start purchasing products and services from tech hubs to improve local consumption and the mentorship of new startups (Akanle et al., 2019). Atiase et al. (2020) assert that financial independence and self-reliance enable tech hubs to create their strategies and expand their technical competencies to meet the needs of their environment.

Attwood, Diga, Braathen, et al. (2013) recommend that community development workers with expertise in empowerment, digital skills and administrative skills should be hired as facilitators to strengthen tech hub management processes. Tech hub empowerment strategies should be apparent to guide facilitators in managing complexities within their environment. Facilitators have a crucial role in providing relevant information and encouraging people to use digital technologies. Given this fundamental role tech hub managers play, Soriano (2007) reinforces that priority must be given to building their capacity.

A functional ecosystem lies at the heart of a booming tech hub. Collaboration with peer tech hubs, academia, communities, local ecosystems, entrepreneurs, businesses, and investors is crucial to get insights into experiences and best practices on the continent (AfriLabs & Briter Bridges, 2019). This engagement needs to be supported by enabling regulation, such as legislation to enable startups and infrastructure investment (Dosso et al., 2021). Graham (2019) highlights the need to investigate how tech hubs connect with entrepreneurs given Africa's challenging realities and produce better outcomes for technology entrepreneurs on the continent. Soriano (2007) calls for ICT interventions for telecentres in poor environments to be integrated into a broader poverty reduction framework. Interaction with technology will reap optimal benefits if the poor have access to education, finance, and electricity, among other essential services that enable self-sufficiency and an improved standard of living.

The World Bank (2017) partially attributes the successes of the tech hubs to their ability to evolve within their ecosystem context. However, they also caution that the future resilience of the tech hubs will be in their continuous ability to evolve while leveraging on new opportunities.

2.4 Digital skills overview and motivation

UNESCO (2018) refers to digital skills beyond just the ability to perform a task online to encompass other aspects such as expertise, ethics, and cognitive behaviours. As the world goes through the 4IR and digital technologies become ubiquitous, entering every sector of the economy and fundamentally changing the ways of work and life, digital skills have become a fundamental necessity. Most jobs today require digital competence and an ability to solve problems through creative thinking. Using the Internet requires a new set of technical, information skills, and high literacy (Veldsman & van Greunen, 2015). Studying the Malaysian youth, Foong (2018) confirmed that digital skills should not only be associated with technology but also incorporate the social, emotional, and interpersonal relationship effects of using technology, individually or with others. Accordingly, this section discusses 21st century digital skills, youth motivation to acquire skills, bridging the digital skills gap and ends with empowering the youth with digital skills.

Van Laar et al. (2017) affirm that the capacity to innovate and remain competitive requires more than just digital skills, but a layer of 21st century skills. These are a broader range of skills, not underpinned by technology, but imperative for the knowledge economy. Van Laar et al. (2017) developed a framework that combines 21st century skills and digital skills. The

framework has seven core skills and five contextual skills. The core skills are related to technical, information management, communication, collaboration, creativity, critical thinking, and problem solving. Contextual skills are involved with ethical awareness, cultural awareness, flexibility, self-direction, and lifelong learning. This framework will be utilised in the research questions to determine the 21st century digital skills among Diepsloot youth.

Motivation to learn digital skills is key. Gebhard, CEO of the Skills Development Corporation, highlighted the importance of motivation to learn and self–upskill to meet the evolution of the 4IR (Malinga, 2021). Twinomurinzi and Msweli (2019) maintain that motivation is rooted in a person's inherent belief that they have the power to produce what they desire. Eynon and Geniets (2016) explain that young people's motivations to learn digital skills are based on their current transitory life circumstances rather than the future. In a (PwC, 2019) study, 77% of South African respondents showed a willingness and motivation to learn new digital skills to improve their employability. Mariscal et al. (2016) point out that practical training and broadband access enable communities to develop new skills and find practical applications for existing and new abilities in poor environments. Among the young people in Diepsloot, there is an inherent desire to improve their life circumstances and their livelihoods which can be attained through digital upskilling.

2.4.1 Empowering the youth with digital skills

The emergence of tech hubs, incubators, and accelerators as drivers of innovation fuelling economic growth has contributed mainly to societies' digitalisation, bringing urgency to the need for digital skills training (ITU, 2016). In Malaysia, the mydigitalmaker initiative equips youth with digital skills and knowledge while empowering them to be producers of technology. Those who have become experts are trained to be champions and change agents with a long-term view of creating a sustainable pipeline of skilled digital workers (UNESCO, 2017). In 2016, 88.6% of Malaysian youth were digitally competent and could expand their ideas to become innovators and technology producers. This was achieved by galvanizing and building a solid ecosystem through the public and private sectors, NGOs, and universities (UNESCO, 2017).

In Africa, there are several interventions to develop digital literacy and skills among young people. In Nigeria, Andela, a company focused on training developers to advance human potential and digitize Africa using free online tools, surpassed its target of 100,000 learners in 2021 (Andela, 2021). Not only is Andela providing learnerships, but the company is also offering a platform to connect trained developers across all levels to employment opportunities through its job network initiative (Andela, 2021). In Ivory Coast, Kalaan, an

association founded by international footballer Didier Drogba and the Development of Education in Africa (ADEA) to promote and increase digital literacy, has trained 700,000 women and men in urban areas (Didier Drogba Foundation, 2019). The foundation aims to equip 10 million Africans with digital skills over five years. In Gabon, the Train My Generation – Gabon 5000 project works with the African Institute of Informatics to accredit the computer training courses where participants can get three levels of certification: Beginner, Intermediate, and Expert levels (UNESCO, 2017). Google launched Skills for Africa and within the first year, had trained one million young people in Africa from 27 countries with digital skills (ITWeb, 2017). Google is not only training young people in digital skills, it is also committed to helping small businesses thrive online. To catch them young and transform the national educational field, the government of Rwanda launched an innovative classroom initiative to equip schools with ICT infrastructure in the digitalization of learning and teaching processes (UNESCO, 2015).

The drive to equip the youth with digital skills is also evident in South Africa. Some initiatives by government and social organisations have led to the establishment of tech hubs and organisations such as WeThinkCode, SHARP Digital, Harambee Youth Employment Accelerator, Digify Africa, Cape IT Initiative (CITI), Vukuzenzele, Tech4Good, SkillsToSucceed, and the National Youth Development Agency (NYDA), among many others. The department of Communications and Digital Technologies' training institute National Electronic Media Institute of SA (Nemisa) collaborated with Coursera, an online educational platform to offer young people free digital courses. Through MLabs in South Africa, over 1.7 million students have been trained in digital skills to give them passage into venture creation (World Bank, 2017). IHubs, through their ICT hubs, is playing a significant role in providing digital skills (iHub, 2014). Entrepreneurs have also been trained on leveraging the digital opportunities provided by MLab (MLab, 2019). A survey of 102 people found that over 66 000 jobs in SA's ICT sector, two-thirds of which are entry-level, can potentially be created from the digital upskilling of people (Harambee, 2020). Facebook's partnership with Digify Africa has provided training to over 8 000 entrepreneurs since 2018 to help young people define and amplify their businesses online presence and integrate social media in their activities (Digify Africa, 2022). Microsoft collaborated with Public Service Sector Education and Training Authority (PSETA) and Afrika Tikkun to provide online opportunities for 20 000 young people (IOL, 2022).

2.5 Key approaches in policies and strategies for digital inclusiveness

Across the world, governments have focused on developing inclusive ICT policies and strategies with equal access and use of ICTs to ensure no one is left behind, particularly,

low-income groups (ITU, 2022). As a result, governments have had to reassess their ICT policies to ensure digital inclusiveness for their citizens and allow them to keep up with the developments of a changing world. Some key approaches to ICT policy strategies include universal access and affordability, addressing the digital skills gap, and advancing socio-economic rights. Lesotho is one of the few countries in Africa that has had success using their Universal Service Funds by taking the SADC policies and adopting a methodical approach to implementation (Gillwald et al., 2017). In addition, ensuring autonomy for the Lesotho Communications Authority and setting up a converged sector regulator for telecommunication, broadcasting, and postal services went a long way in using Lesotho's universal access funds (Gillwald et al., 2017). South Africa can certainly copy this method to provide universal access for citizens. Therefore, the approaches discussed in this section are universal access, addressing the skills gap, advancing socio-economic rights, and implementing ICT policy.

2.5.1 Addressing universal access through ICT policy and strategy

The universal provision of ICT services has become a critical policy intervention in developing countries (Lewis, 2017). The South Africa government employs the Constitutional Telecommunications Act (No 103 of 1996), the Telecommunications Amendment Act (No 64 of 2001), and the Electronic Communications Act (No 36 of 2005) as instruments that inform ICT policy towards universal access social inclusion (Lesame, 2005). These Acts form the basis for establishing initiatives such as the universal service and access fund and universal service obligations on mobile operators. The Universal Service and Access Fund (USAF) was established in terms of section 89(1) of the Electronic Communications Act (2005), for the provision of ICT equipment and services and to subsidise the construction and extension of electronic communications for people in underserved areas. From its inception until 2014, the USAF had a budget of R625 million, with approximately R400 million spent on telecentres which are hardly operational today (Lewis, 2015; Gillwald, 2020). Gillwald et al. (2017) found that these funds, earmarked to provide universal access and service, hardly reached the needy as half the population remains offline. This is confirmed by Chisango and Lesame (2017) who found access and availability as key challenges in adopting ICT among people in the Eastern Cape Province.

As per the Integrated National ICT Policy White Paper (2016), the USAF will be transformed into the Digital Development Fund (DDF) in 2023 to speed up the implementation of various initiatives, including infrastructure and skills development to address market failure and ensure access by all (South African Department of Telecommunications and Postal Services,

2016). It is envisaged that this will expedite processes and decision-making to close the access gap.

2.5.2 Addressing the digital skills gap through tech hubs

Tech hubs are identified as active role players in providing training for introductory and intermediate digital skills. Tech hubs in poor environments have a significant role in developing fundamental digital competencies among patrons. In the second and third strategy elements of building advanced digital skills and Industry 4.0 and the world of work, the Communications and Digital Technologies department has reached out to the private sector to unlock development opportunities for young people. In line with this policy, Microsoft announced that it had trained nearly 300 000 people in South Africa to gain access to digital skills (Microsoft, 2021). In conjunction with various training partners, Google launched the Digital Skills for Africa and has empowered over half a million young people with digital skills (Grow with Google, 2021). Facebook collaborated with Digify Africa to create Naledi, a WhatsApp learning bot that will enable young people across Africa to access digital skills programmes. This collaboration has trained over 100, 000 youth (Malinga, 2021). South African bank Nedbank launched the Nedbank DigiSkills online platform in partnership with Microsoft and Afrika Tikkun to help South Africans acquire the digital skills required in a more digital post-COVID-19 economy (The Skills Portal, 2020). The above are a few examples that paint a picture of the implementation of the skills strategy by the government and private sector in providing digital skills, particularly among the youth in South Africa.

2.5.3 Advancing socio-economic rights through ICT policies

According to the Universal Declaration of Human Rights (UDHR) socio-economic human rights include the right to education, housing, adequate standard of living, health and culture. In this section, the rights to education and adequate standard of living are discussed to demonstrate how tech hubs are advancing these socio-economic rights. The right to education is recognised as a right to free and equitable education for all, from primary school education to higher education. Due to social inequality, approximately 260 million children globally did not have access to school education in 2019 (UNICEF, 2021). In resource–poor environments, tech hubs are serving a functional purpose of digitally upskilling the youth by offering various programs and certifications in ICT courses at no cost to the participants. In this regard, the tech hub advances the right to free education for all. The accelerated development in ICTs are transforming human society from an information age to the digital age across all spheres (Mahlangu, 2018). By providing collaborative and innovative spaces

for the generation of ideas, facilitating prompt exchange of information, tech hubs create an environment to develop entrepreneurs who can create employment and contribute to improving the standard of living of the people in marginalised environments.

In 2016, in a non-binding resolution, the UN's Human Rights Council reinforced the importance of expanding access to the Internet through using a human rights-based approach. This holistic approach embraces the intersection of the Internet and the realisation of other human socio-economic rights as advocated by Faturoti (2022). Lesame (2014) affirms that access to ICT is a fundamental constitutional right in South Africa while Mfuphi (2020) argues that a lack of access to ICT denies citizens their constitutional right and increases the probability of digital illiteracy and the required skills to participate in the digital economy.

2.5.4 ICT policy implementation challenges

The implementation of ICT policies to achieve universal access and reach critical mass in digital upskilling of citizens has been met with challenges. The failure of the SA Connect project aimed at connecting people in underserved areas. Instead of connecting 6,135 government facilities to broadband, only 970 were connected (Department of Communication and Digital Technologies, 2017). In addition, the lack of coherence across government levels has led to unnecessary delays in the digital migration, delays in the spectrum allocation process, and misuse of the Universal Service and Access Funds. This fragmentation across the government levels has consequently resulted in disparity in access to the Internet, drawing back the objectives of universal access for all. In its five-year strategic plan, ICASA reiterated that it had failed to keep up to date with the rapid technological changes partly due to a lack of policy certainty and consistency on crucial regulatory matters and inadequate funding (ICASA, 2020). Lewis (2017) attributes this to a lack of clarity and direction from the government, governance issues, and institutional capabilities. Further, he points out that USAASA admitted to not being successful in providing universal service to every citizen (Lewis, 2017).

ICT policies should be anchored in human rights to ensure a just policy framework that leaves no one behind. Sanders and Scanlon (2021) point out that access to digital technology is a matter of socio-economic rights whose promotion has advanced the commitment to social inclusion. However, a lack of support from the government will delay incorporating these rights into policy and practice. Considering the role played by the Internet, the drive towards universal access needs to incorporate socio-economic rights.

The following section will review and discuss the theoretical framework underpinning this research.

2.6 Theoretical framework introduction

Theories are fundamental to research, and their selection is equally important to the studied phenomena. The theoretical framework guides the scope and focus of the study toward the achievement of the objectives (Green, 2014). Theories provide a structure upon which the research, problem statement, objectives, research questions, and contribution are based (Grant & Osanloo, 2014). For this study, three theories were identified as follows; Capability Approach (CA), Technology Acceptance Model (TAM), and the Sociotechnical theory (STS). These theories are reviewed and the most appropriate theory for this research is discussed in light of the research objectives.

2.6.1 The Technology Acceptance Model (TAM)

TAM theory falls under Information Systems and Information Technology spheres and replicates the process in which end users accept and use technology. To determine the attitude of users towards adopting new technologies, the TAM theory carries two central beliefs, namely perceived usefulness (PU) and perceived ease of use (PEOU) (Erasmus et al., 2015). PU measures how individuals believe they will benefit from using technology and PEOU is a concept that considers an individual's assessment of the effort required in using technology (Venkatesh, 2000). The PU and PEOU are vital factors determining whether individuals or groups decide to accept technology artefacts (Lee et al., 2003; Surendran, 2012). While TAM is a strong predictor of acceptance of technology, it does little to help our understanding of the actual usage of the technology artefact (Venkatesh, 2000). Lim, Osman, Salahuddin, et al. (2016) found that TAM showed weaknesses in explaining users' behaviour in technology use. Similarly, Napitupulu (2017) found that TAM failed to explain the social influences that drive user behaviour. These criticisms of TAM are primarily due to its deterministic approach. Therefore, while TAM could be appropriate for this research, the researcher did not select it because it is mainly designed to measure technology acceptance with minimal focus on actual use.

2.6.2 The Capability Approach (CA)

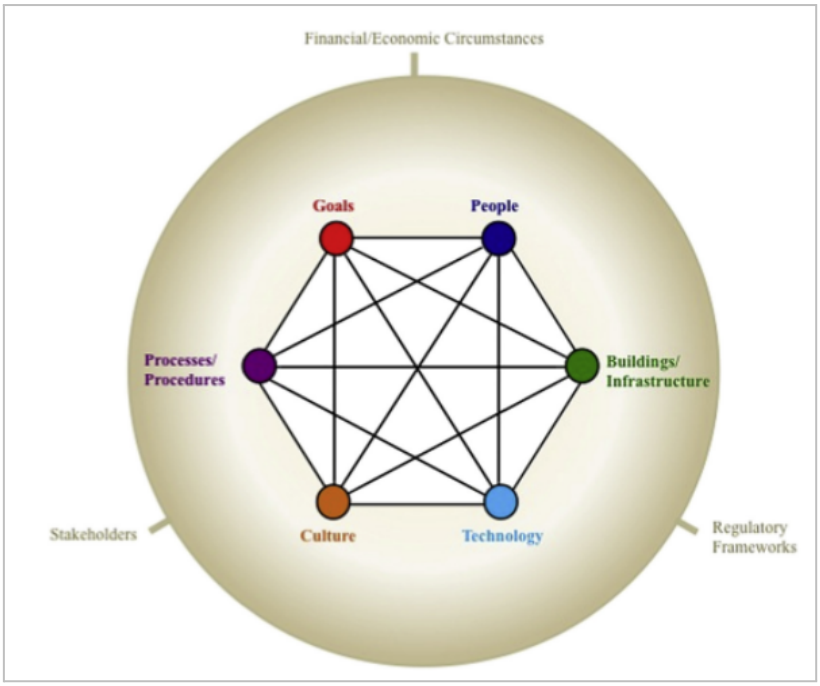
The CA is focused on what an individual can do and become, referred to as capabilities (Robeyns, 2005; Zheng & Walsham, 2008) while having the freedom to live the life one values (Sen, 1999). In the context of ICT4D, Madon (2004) introduced the CA approach as a framework to evaluate the impact of ICT4D interventions. Therefore, the CA

considers the end state, the local context, and the development process (Zheng & Walsham, 2008) and offers a way of conceptualising development not as economic growth but as individual freedom (Kleine, 2010). Tshivhase et al. (2016) highlighted that the CA is a powerful evaluative tool that places people at the centre of an ICT4D inquiry. While the CA approach has been used in ICT4D research and would be a sound theory in this study, the researcher decided not to select it. The CA framework does not consider variables such as access or usage but is concerned with the end state rather than the means. This research seeks to dig deeper into understanding those variables and the process of learning digital technologies.

2.6.3 Sociotechnical systems (STS) theory

The sociotechnical theory was first developed by Emery and Trist (1965) to analyse how social and technological factors impact the innovation and transformation of industries. Building on this thinking, Zhang et al. (2018) defined the STS from an interaction perspective of technology and human behaviour to achieve excellence in technical performance and quality in people's lives. Cummings (1994) adds the interdependence concept between and among people, technology, and the environment, highlighting the importance of all elements supporting each other. Trist, Higgin, Murray, et al. (1963) caution that the combination of social and technological elements must be open to their environment for an organization to function. The environment is contextual and includes factors like legislation and policies. Davis et al. (2014) adapted the STS framework to include six interrelated and inextricably linked components (technology, culture, processes, goals, people, and infrastructure) embedded within an external environment. This framework proposes that these components are interdependent and changes in one part necessitate changes in other parts leading to successful joint optimization. Joint optimisation is a concept where people, technology, and the environment work together to achieve a set objective (Appelbaum, 1997).

Figure 5: Socio-Technical Systems Theory Elements



Source: Davis et al. (2014)

This research adopts the STS theory by Davis et al. (2014). In this study, the interdependent components are used as theoretical lenses to guide understanding of Diepsloot youth perspectives regarding the role played by the tech hub in poor environments.

2.6.4 Conceptual Research Framework

Selecting the most appropriate theory is determined by the goals of the phenomena being studied (Sekgwelelo et al., 2017). Following the review of the TAM, CA, and STS theories, and careful analysis of the literature available on youth and the role of tech hubs, the researcher found the STS theory to be the most suited for this research. This is because it considers all components of social, technology and the environment and the outcomes of technology use. The framework in figure 6 depicts the STS theory, which will guide the interview questions and presentation of research findings.

2.7 Summary of the Chapter

In this chapter, the four dimensions (social influences, institutional infrastructure, digital skills and policies) were explored before the conceptual framework was discussed. The tech hubs are a significant driver of digital transformation in resource-constrained environments, and their proliferation represents a rise in innovation and new digital markets. However, for societies to digitally transform they need to be skilled and equipped to use technologies while understanding inherent fears of technology that exist due to lack of education. In

addition, the implementation of ICT policies needs to be strengthened to ensure policy objectives are met, particularly on universal access and digital skills training. This helped in understanding how technologies are employed in poor environments, the digital skills required and the critical role of ICT policies in bridging the access gap. This chapter also provided a review of some theories that can be used as analytical lenses in exploring the perspectives of the youth on the role of tech hubs in resource-constrained environments. A conceptual framework was developed using the STS theory. The next chapter contains the research methodology.

CHAPTER 3: INTERPRETIVIST RESEARCH METHODOLOGY

3.0 Introduction

This chapter is on the research methodology of this study. It identifies and explains the research paradigm, the rationale for selecting that paradigm, and the approach used. The research design and strategy and the sampling techniques, data collection methods, and analysis are included in this chapter. A qualitative research methodology was used. The participants' context, attitudes, and behaviour were examined with a clear focus on investigating their influence on the use of digital technologies. The data collection technique was purposive sampling to allow in-depth interviews with the youth, where personal experiences, cultural meanings, and context were drawn. Interviews were also conducted with tech hub managers.

3.1 Research paradigm

A paradigm describes the philosophical orientation of the researcher and influences what should be researched, how it should be researched, and how to interpret the results of the research (Kivunja & Kuyini, 2017). Guba and Lincoln (1994) define a paradigm as a basic set of beliefs or worldviews guiding a research investigation. A paradigm comprises four elements: epistemology, ontology, methodology, and axiology (Lincoln & Guba, 1985). However, the three most commonly used paradigms in qualitative research are Interpretivism, positivism, and critical theory (Antwi & Hanza, 2015). This research is located in the qualitative interpretive paradigm.

Interpretivism is based on methods that accentuate the nature of people's characters and how they behave in their social and cultural contexts (Chowdhury, 2014). Interpretivists argue that reality and knowledge are social products that must be understood within the context of social actors (researchers) who construct and make meaning of that reality (Sekgwelelo et al., 2017). Furthermore, Chowdhury and Gopal (2014) affirm that new meanings are created through richer understandings and interpretations of the different social worlds and contexts. In the context of this study, the researcher's perceptions, values, and objectives play a significant part in influencing the social reality and bringing new knowledge on the perspectives of the youth on the role of tech hubs in poor environments.

3.1.1 Rationale for adopting Interpretivism paradigm

Interpretivism was adopted as it provides an opportunity for a researcher to make meaning of a constructed reality. The constructed reality needs to be guided by theory therefore; a

deductive approach within the interpretive paradigm was employed in this study. With deductive reasoning, the argument moves from general principles to particular instances. Guided by the STS theory, the study's objectives are to explore the sociotechnical factors influencing the use of tech hubs in resource-constrained environments.

3.2 Research Approach

This study used a qualitative research methodology situated in the Interpretivism paradigm. The researcher explored meanings and insights in qualitative research through engagement with identified subjects (Haradhan, 2018). The qualitative methodology enabled the author, through in-depth interviews, to capture a rich array of contextual data on technology use in impoverished environments. In addition, the use of multiple participants serves to deepen the understanding of the investigated experience (Polkinghorne, 2005). Accordingly, the researcher was able to construct reality through the interviewees' lived experiences and the meanings they make of those experiences.

3.3 Research Strategy

The research strategy enables a researcher to conduct research systematically by following a detailed plan of action that produces high-quality results (MacKenzie, 2014). The four main research strategies are case studies, qualitative interviews, quantitative surveys, and action-oriented research. The research strategy used in this research is a case study. A case study is, by its nature, exploratory and explanatory and is used to advance understanding of the subject matter in a real-life context while answering the how, why, and to a lesser extent, what research questions (Harrison, Birks, Franklin, et al., (2017). For this research, the case study was the best research strategy to explore the youth's perspectives on the role of technology hubs in poor environments. Without having deep conversations with the youth and the tech hub managers in their current context, it would have been impossible to get rich data and meanings.

3.4 Research Design

Research design in qualitative research seeks to find the answers to questions pertaining to the hows and whys of a phenomenon being studied. The following section details the unit of analysis, population, sample, demographics of participants and the sampling techniques.

3.4.1 Unit of Analysis

A unit of analysis is the critical object analysed in the study that the researcher wishes to say something about at the end of the study (DeCarlo, 2018). The research question determines

the unit of analysis. In this research, the unit of analysis was the youth and their usage of technology in resource-constrained environments.

3.4.2 Population

Population refers to all the individuals or groups in a particular space. As it is impossible to locate or access the whole population, the targeted population in this study were two distinct groups; the Diepsloot youth who visit the tech hub and the tech hub managers, who manage and coordinate the activities in the tech hub.

3.4.3 Sample

A sample is typically a representative subgroup of a population selected for investigative purposes. While the sample is a subgroup, it is representative of the population and appropriate for the research regarding costs, time, and convenience (Sharma, 2017). In this research, 18 youth from Diepsloot with an equal representation of male and female and three tech hub managers were interviewed. The number of people visiting the tech hubs during that period ranged between 20 and 30, daily. From a saturation perspective, Guest et al., (2006) state that a sample size reaches saturation when all key variations of a phenomenon are identified and there are no new themes to be gathered. Further, saturation is the gold standard to determine purposive sample sizes. Accordingly, the researcher reached saturation with the 18 youth and three tech hub managers.

3.4.4 Demographics of the Participants

The research design was based on a case study of 18 youths who are regular users of the tech hub. Two of them are studying, one at a tertiary institution and another at a college; 15 have completed Matric (a South African High School Qualification) or Cambridge O levels, while one did not complete Matric. Five youths are employed mostly as domestic workers and cleaners. One youth is an entrepreneur, running his radio station from the tech hub; he is also a past beneficiary of the tech hub. The demographic profile of the youth interviewed is shown in figure 6.

Figure 6: Demographics of participants



*O level, Ordinary level, is an internationally recognized subject-based qualification at the secondary school level, equivalent to 9th and 10th grade (Matriculation).

3.4.5 Sampling technique

Sampling is a technique used by a researcher to systematically select a representative smaller number of items or individuals from a population group to serve as data sources for investigation (Sharma, 2017). There are two broad categories of sampling techniques, namely probability, and non-probability. This study employed non-probability sampling based on the researcher's judgment. Purposive sampling was the most suitable method in this research, as selection was based on knowledge to fulfil the purpose of the study (Babbie, 2010). Respondents were selected in a systematic approach from the youth visiting the tech hubs so they can provide substantial contributions. Therefore, only the youth visiting the tech hubs were interviewed. The second group comprising tech hub community managers were

selected based on the length of service and their work. Groundskeepers, kitchen and office cleaners were not included in the sample.

3.4.6 Data Collection Method

The purpose of data gathering in qualitative research is to provide evidence in the form of accounts people have given of their experiences (Polkinghorne, 2005). Alshenqeeti (2014) adds that the interactive nature of interviews in research design allows for probing and clarity of responses. There are two types of interviews, structured and semi-structured interviews. For probing to get as much information as possible, a semi-structured approach was used. The in-depth interviews gathered data about the nature of the institutional, social and the technological environments, and the user community experiences concerning the tech hub in the context of Diepsloot. The benefits of this method include the ability for the researcher to capture the context through first-hand experience, which enriches the data. For ICT policy in South Africa, a policy document review was carried out to investigate the extent these policies promote social inclusion.

In addition to the interviews, a Likert scale was used to assess the level of competence of digital skills. According to Bertram (2007), a Likert scale is a psychometric response scale primarily used in questionnaires to obtain a participant's degree of agreement with a statement or set of statements on an ordinal scale. The Likert scale is easy to read and complete for participants and allows a reliable way to measure perceptions and behaviours on digital skills in ranking the levels of knowledge per topic/question (Bertram, 2007). For example, levels 1 and 2 represented "no knowledge," 3 indicated "some knowledge," 4 and 5 reflected "basic knowledge," 6 and 7 represented "intermediate knowledge," and 8, 9, and 10 reflected "advanced knowledge." The results were converted to percentage terms.

In terms of COVID-19, the researcher followed national regulations, guidelines, and protocols in collecting data in line with the HREC non-medical guidelines. To ensure the researcher's protection and that of the respondents from the risk of infection, the researcher ensured that all parties involve were wearing masks. In addition, the researcher ensured that all parties practiced social distancing of at least a metre apart during the interview process. All the precautionary measures outlined above were taken to ensure the researcher's safety and of the respondents.

3.4.7 Data analysis

Qualitative data primarily deals with meanings, mediated mainly through language and action (Dey, 2003). This constitutes looking for some form of explanation, seeking to understand and interpret meaning from the data collected. In this study, theoretical thematic analysis, based on a deductive reasoning approach, was used as a method of analysis. Theory shapes and guides the deductive approach (Braun & Clarke, 2006). Theoretic thematic analysis is a qualitative data analysis strategy based on theory and allows the researcher to identify, analyse, highlight and categorise data into themes (Braun & Clarke, 2006). This study relied on thematic analysis to guide and interpret the data. In figure 8 below, Braun and Clarke (2006) outline the analysis of data and the development and categorisation of themes. They also note that this is not a linear exercise but a more recursive process throughout the phases until the process is completed.

Figure 7: Phases of developing thematic analysis

Phase	Description of the process
1. Familiarizing yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Source: Braun & Clarke, 2006

Details of how the theoretical thematic analysis was undertaken according to the process above is presented below:

Familiarising with the data

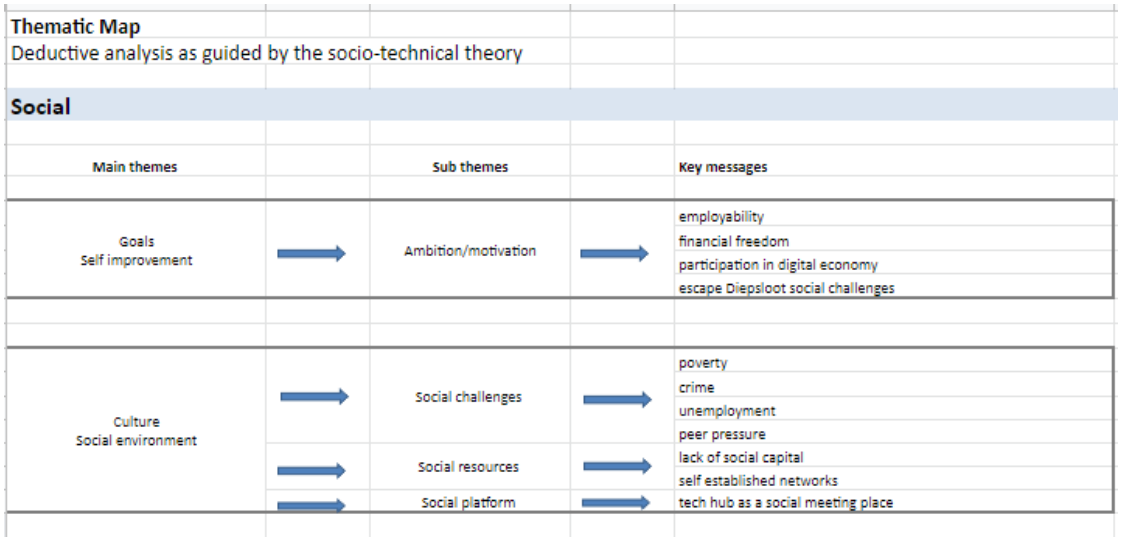
This first step of familiarisation focuses on data and transcription. During the course of this research, the researcher held semi structured interviews with the youth in the tech hub. The researcher transcribed the data verbatim and made additional notes on new ideas that were mentioned in the interview. Further, the researcher spent time reading the transcripts and in reflection to understand the meanings in the data.

Generating initial codes

This step involves taking interesting features of the data and categorising it in a systematic way. The researcher started to extract, explore, and systematically organise meaningful

pieces of data and assign relevant codes to them. An example of the coding process is provided below:

Figure 8: Generating initial codes



Thematic Map
Deductive analysis as guided by the socio-technical theory

Social

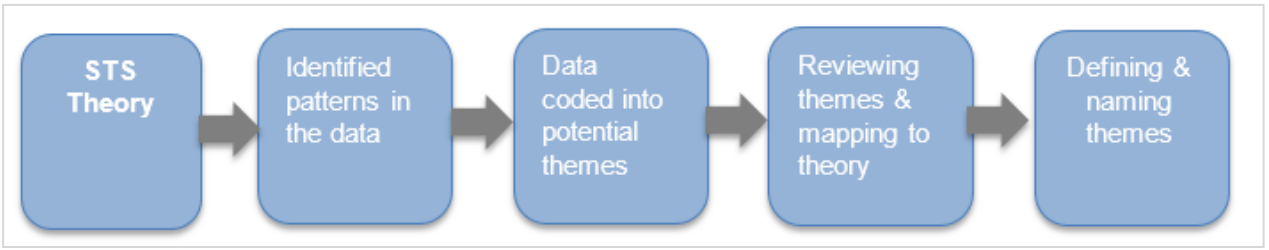
Main themes	Sub themes	Key messages
Goals Self improvement	Ambition/motivation	employability financial freedom participation in digital economy escape Diepsloot social challenges
Culture Social environment	Social challenges	poverty crime unemployment peer pressure
	Social resources	lack of social capital self established networks
	Social platform	tech hub as a social meeting place

Source: Matanda, 2023

Searching for themes

After assigning codes to meaningful pieces of data, the researcher grouped these codes into potential themes. Figure 10 shows the process used to search for themes in the data. Starting from the STS framework, the researcher identified patterns in the data and coded meaningful content before grouping it into potential themes. These potential themes were reviewed to ensure that they were aligned with the theory. Subsequently, an ongoing analysis of defining and naming the themes and sub-themes was undertaken to arrive at clear definitions for each theme. These themes were linked to each of the seven components of STS theory. In Braun and Clark (2006), the steps of reviewing, defining and naming themes overlap under searching for themes.

Figure 9: Searching, reviewing, defining and naming themes



Source: Matanda, 2023

Producing the report

The final step, according to Braun and Clark (2006), is to produce a final analysis with compelling extracts that relate to the research question and literature. In producing the report for this study, extracts of data considered most impactful were selected for Chapter 4, including aligning the analysis to the research questions.

3.4.8 Ethical considerations

Ethics are important because they uphold moral and social values essential to collaborative work, such as trust, mutual respect and fairness while promoting the expansion of knowledge and bringing confidence to research (Resnik, 2020). Accordingly, the researcher followed the ethics compliance procedure determined by the University of Witwatersrand. The researcher obtained ethical clearance (SLLM: M20-08) from the university in February 2021, which allowed them to conduct interviews with the youth and tech hub managers in Diepsloot. The researcher upheld the research ethics in line with the compliance procedure throughout the interview process.

3.5 Summary of the chapter

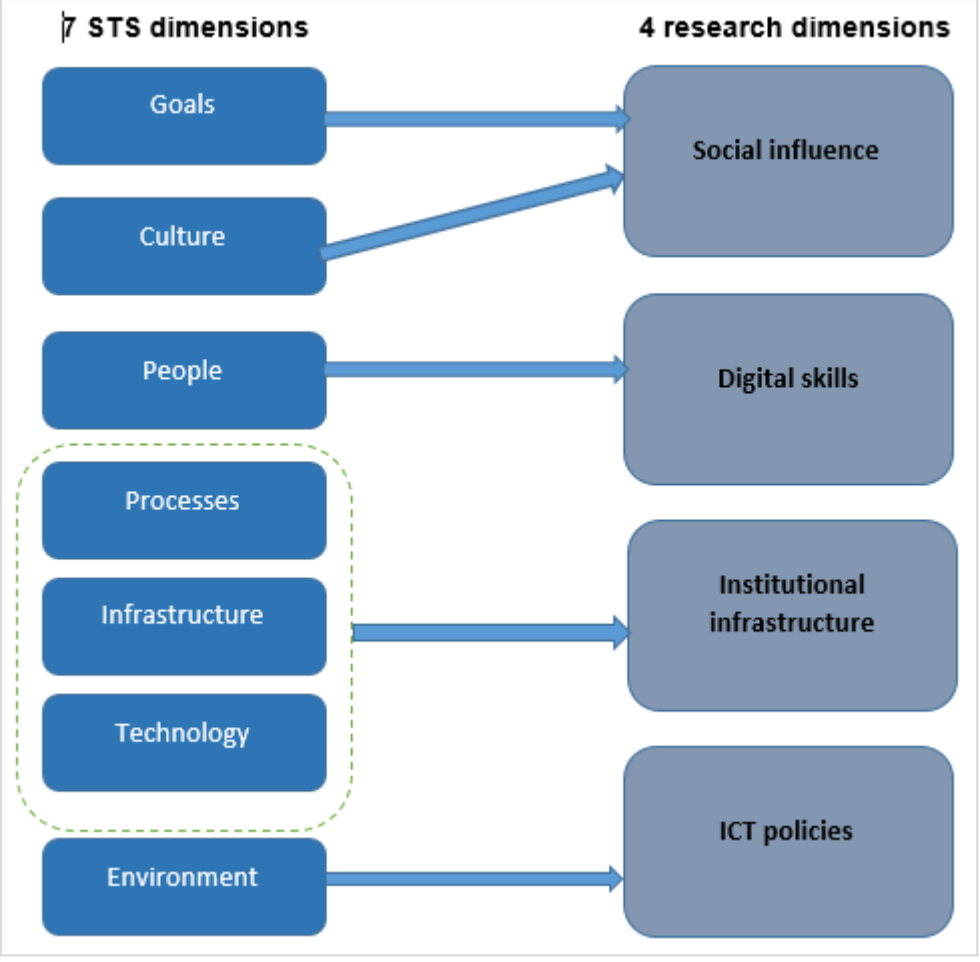
This chapter presented the research plan, including the approach, strategy, and methods of data collection and how the data will be analysed. As the research is exploratory in nature, seeking to investigate the sociotechnical factors influencing the usage of technology by young people, a qualitative approach was taken. The next chapter analyses the findings as guided by the research methodology.

CHAPTER 4: THE DIGITAL TRANSFORMATION JOURNEY OF DIEPSLOOT YOUTH

4.0 Introduction: Presentation of findings

This chapter presents the data collected from interviews with the Diepsloot youth and tech hub managers. The study's findings are categorised into themes using the sociotechnical systems (STS) theoretical framework. Each of the seven STS theoretical components (goals, culture, people, processes, infrastructure, technology and environment) was used as a lens to explore the social and technical factors that influence the perspectives of the youth on digital transformation. To address the objectives of the study, data on each of the four dimensions set out in the research sub-questions (social influence of digital adoption, institutional infrastructure for access, digital skills, and Information Communication Technologies (ICT) policies for digital enablement) is mapped against each of the seven STS dimensions:

Figure 10: Mapping of themes to research dimension



Source: Matanda, 2023

4.1 Goals: All about self-improvement in the long term

In STS theory, Davis et al. (2014) describe goals as the objectives or the desired outcomes produced from a system. Goals can be at an individual or organisation level. The existence of goals among the youth was investigated and self-improvement in the long term emerged as a theme. The youth have ambitions to improve their livelihoods, and according to them, becoming digitally skilled can open employment opportunities and lead them to financial freedom. Employability in a digital environment, broader participation in the digital economy and a sense of giving back to Diepsloot were sub themes that emerged under self-improvement.

4.1.1 Employability in the digital economy

The youth indicated that they want to hold better jobs and earn a decent living. In table 1, the youth are specific about the careers they want to pursue in the digital economy. These include careers in online entrepreneurship, graphic design, call centre, software engineering and running a tech hub.

Table 1: Career ambitions of the youth

Respondents	Responses
Interviewee 14	Software engineering is currently sought after - I want to have the skills of today, the digital skills so I can be competitive in the job market. I will work as a software engineer one day.
Interviewee 5	The hub motivates me to achieve my goals - my goal is to grow my business and the hub is giving me knowledge and information on sponsorships to take my business concept to the next level.
Interviewee 12	My goal is to enter into entrepreneurship. For me these activities take me closer to achieving my ambition, which is to be an entrepreneur who is running a business using technology.
Interviewee 3	My ambition is to work in the IT space as a graphic designer. I have a cousin who is in IT and he motivates me that future jobs are in IT so I must be prepared.

Interviewee 3 states that they get their motivation to work in IT from their cousin who is already in the field, implying a beneficial relationship. Interviewee 3 confirms the concept of social capital coined by Warschaeur (2003) which is a person's ability to benefit from social structures or memberships that they belong to. In the South African local language, this concept is referred to as "Ubuntu" translated as "I am because you are." Therefore, Interviewee 3's statement demonstrates how the spirit of Ubuntu plays a significant and beneficial role in influencing youth on their career paths.

4.1.2 Participation in the digital economy

In South Africa, DT is a buzzword mainly because the country is going through the 4IR. Emerging technologies such as IoT or AI are frequently mentioned on media platforms. The youth are hearing about the 4IR and desire to be part of it. The exposure to the tech hubs is influencing the youth's participation, which they believe will propel them towards their goals, as per table 2:

Table 2: Youth participation in the digital economy

Respondents	Responses
Interviewee 2	To keep up with what is happening around the world in the technology and creative spaces. So I can be involved in futuristic stuff, and find my space to create things that are aligned to where the world is going.
Interviewee 5	The 4IR – it is important to go with the times and technology is everywhere, it will be our lives and we depend on it all the time. Developing myself, always willing to learn to survive the technology era.
Interviewee 15	The world revolves around technology now and to be able to compete and find your space, you need to learn technology. I have ambitions to build my app, and I can't do that without constantly learning technology and its trends.

The tech hubs are giving the youth the opportunity and foundation to participate in the digital economy, where they can start seeing a future that they would not otherwise have imagined. A future where they have equal opportunity to compete and win in South Africa's digital economy, which according to Statista (2021) had revenues of USD 5,41 billion in 2020.

4.1.3 Giving back to Diepsloot through working as tech hub managers

The tech hub managers are young people in their late 20s, who have digital qualifications and are entrusted to run the various programs of the tech hubs. Two of the tech hub managers are from Diepsloot while the third is from Soweto, a township south of Gauteng province. The tech hub managers acknowledged that the community respected and recognised the work they are doing in teaching and supporting the youth to use technology. Because of their ability to manoeuvre with skill through the different technologies, the tech hub managers have become role models to the youth, who express their admiration for them in the following extracts:

Table 3: Working with purpose – aspirations to become tech hub managers

Respondents	Responses
Interview 2	As a way of giving back, I sometimes help in the tech hub, and by now, some of the guys know I am running my radio station, so they always want to know what they can do with this tech thing. I always advise them the first step is to spend more time in technology, spend time in the hub, volunteer, sharpen your skills and see which path opens for you, so for some motivated guys , they come and are now assistants here in the hub.
Interview 10	I would not mind being a tech hub manager, no day is the same; you are faced with different issues every day that you are constantly solving, while helping the community to be connected to technology.
Interview 7	So that one day I can be a knowledgeable person in technology. I would like to become a Tech hub manager and continue giving opportunities to the children of Diepsloot to be trained in technology.

The tech hubs are respected institutions in the townships because they are providing services to empower the youth in the community, instilling a greater sense of purpose among the tech hub managers. When the youth look at the tech hub managers, they feel inspired. The tech hub managers represent to the youth what they can become, which can open various opportunities and allow them to uplift their communities. From this perspective, the youth see themselves in the tech hub managers.

Figure 11: Tech hub managers lead a training session



Source: Wot If? Trust Facebook page

4.1.4 Reflections on the theme of self-improvement in the long term

As per research question 1, “how social influences affect the perspectives of the youth in adopting technology,” the data shows that personal goals are critical in adopting and using technology. The youth expressed a great desire to participate in the digital economy, explicitly mentioning the careers they want to pursue and being included in the 4IR. Maslow (1943) used the term “self-actualisation” to refer to the desire to become everything that one is capable of becoming. Although being digitally skilled is about self-actualisation, it is also about the status they want to achieve, a higher social standing in the community. They already see better versions of themselves in the future. An inherent desire to lift each other up, build careers in the digital economy and give back to Diepsloot are the goals of the Diepsloot youth that influence them to adopt the technology. This builds on what Kleine et al. (2014) found that basic ICT services are a game-changer in poor environments, creating life-changing experiences, helping marginalized youth fulfill their potential, and breaking the generational cycle of poverty.

4.2 Culture: Resilience in the face of a challenging context

According to Davis et al. (2014), culture refers to the prevailing mindsets and values shaped by the environment. Through the cultural lens, the researcher assessed how people live in Diepsloot concerning technology adoption. The key themes emerging from the data were resilience, peer pressure, and the perception of the tech hub as a place of hope.

4.2.1 Youth resilience in the face of socio-economic challenges

The youth are faced with numerous challenges, from unemployment, poverty, crime and a lack of service delivery in Diepsloot. Participants seemed to agree on how their lived experiences were tough due to poverty. However, they will do what it takes for them to survive each day, taking menial jobs and using their little resources to provide for themselves. Through these challenges, the youth visiting the tech hubs find strength among each other and have a desire to lift each other up in the spirit of “Ubuntu”. They have seen people come and go in pursuit of better living conditions and they believe their turn will come too. They are hopeful and determined to use technology to improve their circumstances.

Table 4: Socio-economic challenges faced by youth in Diepsloot

Respondents	**Responses**
Interview 3	Currently, my life is very difficult, as I do not have an income. I sometimes sell fruits and vegetables so I can have some money. I have

Respondents	Responses
	lived here since I was 16 and I have seen people come and go, to better places when they start working.
Interview 13	I didn't get a chance to finish my Matric because there was no money at home I started working as a domestic worker to provide for myself
Interview 17	I am a single mother who is currently doing piece jobs as a domestic worker.

The main challenges that confront the youth every day are poverty and unemployment. Interviewee 3 is unemployed while Interviewee 17 speaks about being a single mother doing menial jobs to support herself and her child. She will find time in her demanding schedule, between motherhood and domestic work and in a challenging environment, to get trained in digital skills. She also has to leave her child with someone at home while she is at the tech hub because, to her, it represents a significant stepping-stone in her life. Interviewee 13 did not get a chance to complete their high school education because of a lack of money. But now she is determined to get her Matric qualification and pursue a career in the digital economy.

The impact of Covid-19 on the participants was highlighted as exacerbating poverty. In table 5 below, Interviewee 15 lamented that the closure of schools during the lockdown resulted in an increase in drug abuse and teenage pregnancies, as teenagers tried to escape poverty at home. Interviewee 18 mentioned that they had lost their job due to the pandemic. Media headlines captured the impact of Covid-19 in Diepsloot with headlines such as "The poor, starving and forgotten people of Diepsloot: We are not going to survive this virus'. The media coverage of Covid-19 impact in Diepsloot is very similar to the sentiments expressed by the interviewees.

4.2.2 Peer pressure as a socio-economic challenge faced by Diepsloot youth

Peer pressure among the youth emerged as a key theme. The youth are at a stage in their lives where they can easily be swayed in the wrong direction, partly due to the difficult circumstances they live in:

Table 5: Peer Pressure as a socio-economic challenge faced by Diepsloot youth

Respondents	Responses
Interview 15	As currently with the lockdown due to Covid, and schools closed we are seeing increased use of drugs with teenage children and we also seeing an increased number of teenage pregnancies.

Respondents	Responses
Interview 1	Being a youth in Diepsloot is so challenging. You may be drawn to do bad things if you are not careful and get entangled in those things that you cannot easily release yourself from, the next thing, you find yourself in prison or you die poor.
Interview 2	On my radio station, people here in Diepsloot, particularly the youth, can participate which steers them from some of the challenges we face.
Interview 11	I take life skills courses to help me cope in my life because our situation in Diepsloot is not easy especially for the youth. The peer pressure is real.

The youth are at a critical age where peer pressure is a dominant force. Interviewee 1 described how one could be quickly drawn to do bad things, while Interviewee 15 lamented the peer pressure experienced by learners. However, a positive pressure is being exerted by the presence of the tech hub in Diepsloot as highlighted by Interviewees 2 and 11. These responses demonstrate the role the tech hub is playing in redirecting that negativity to positively influence the youth by giving them an opportunity to be trained in digital skills.

4.2.3 Positive influence amidst socio-economic challenges

In a pandemic and a challenging social environment, the youth see the tech hub as a haven, where they not only momentarily escape from hardship, but they have an opportunity to create a digital future for themselves. Enabled by the tech hubs, the youth are building their social capital and leveraging the spirit of “Ubuntu” to stand together in resilience.

Table 6: Positive influence exerted by the tech hub

Respondents	Responses
Interview 12	It also keeps me away from the mischief in Diepsloot and the challenges we face at home. I can connect with other youth who want to improve themselves.
Interview 10	Coming to the tech hub gives me hope that I can be someone one day, because there are so many opportunities I am seeing through the Internet.
Interview 18	…at least the tech hub is there, I spend my time learning and doing something that will help me in the future. For sometime when I am here, I forget about my struggles and focus on learning the designs because that helps me to be better tomorrow.

The youth are spending time in the tech hubs, immersing themselves in online content they had never experienced. As a result, they can escape their reality into, according to them, a new world of endless possibility. Amid the challenging environment, the tech hub is exerting

positive pressure on the youth. The presence of the tech hub strengthens the resilience inherent in the youth who have managed to stand together and united in the hope of the benefits that technology will bring them.

4.2.4 Reflections on the impact of culture on youth adoption of technology

While their social environment is infested with social ills, the Diepsloot youth are determined to participate in the digital economy. Amidst the hardship, the tech hub is exerting a positive pressure to inspire and give youth hope. Their attitude towards the tech hub is that of a saviour who can free them from the chains of poverty. They are not taking this opportunity to learn digital skills for granted. This demonstrates why they perceive the tech hub as a haven and a stepping-stone to the future they desire. Through the STS culture component, question 1 of this study – "How social influences affect the perspectives of youth towards adopting technology?" was explored. The youth experience poverty, crime and negative peer pressure daily. However, everyday they choose to spend their time in the tech hub where they feel positively and gainfully influenced.

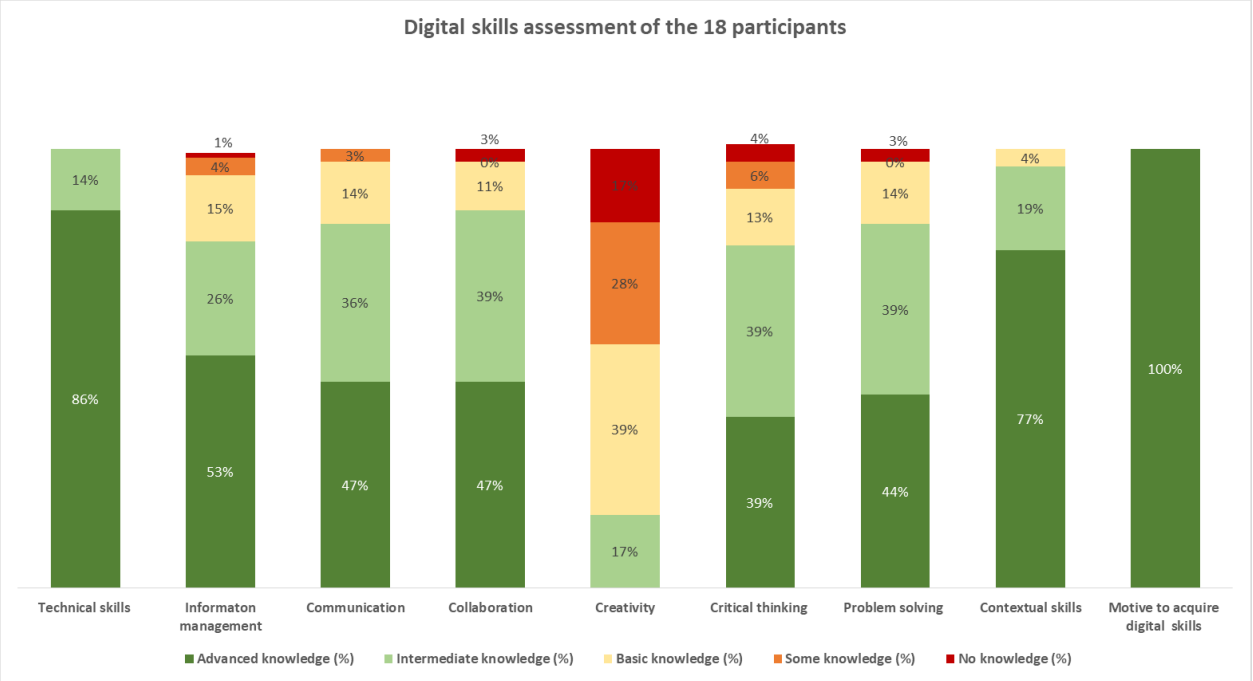
4.3 People: Digital skills to access economic opportunities

In Emery and Trist (1965)'s initial version of the STS, people are a significant social component that interrelate with all components within the system. For without people, the system cannot be used and without knowhow, people cannot operate systems. Therefore, the STS people lens was used to understand the digital skills the youth possess, including their motivation for learning. Digital empowerment emerged as the key theme under this section.

4.3.1 Assessment of technical digital skills among the Diepsloot youth

A framework by van Deursen, Helsper, Eynon, et al. (2017) was adopted to determine the youth's digital competencies, including the ability to effectively use the ICTs to get tangible outcomes. The competencies tested were technical skills, information management, communication, collaboration, creativity, critical thinking, problem solving, and digital contextual skills. Figure 12 shows the competencies of the Diepsloot youth and the results are discussed further below:

Figure 12: Digital competencies of the 18 participants



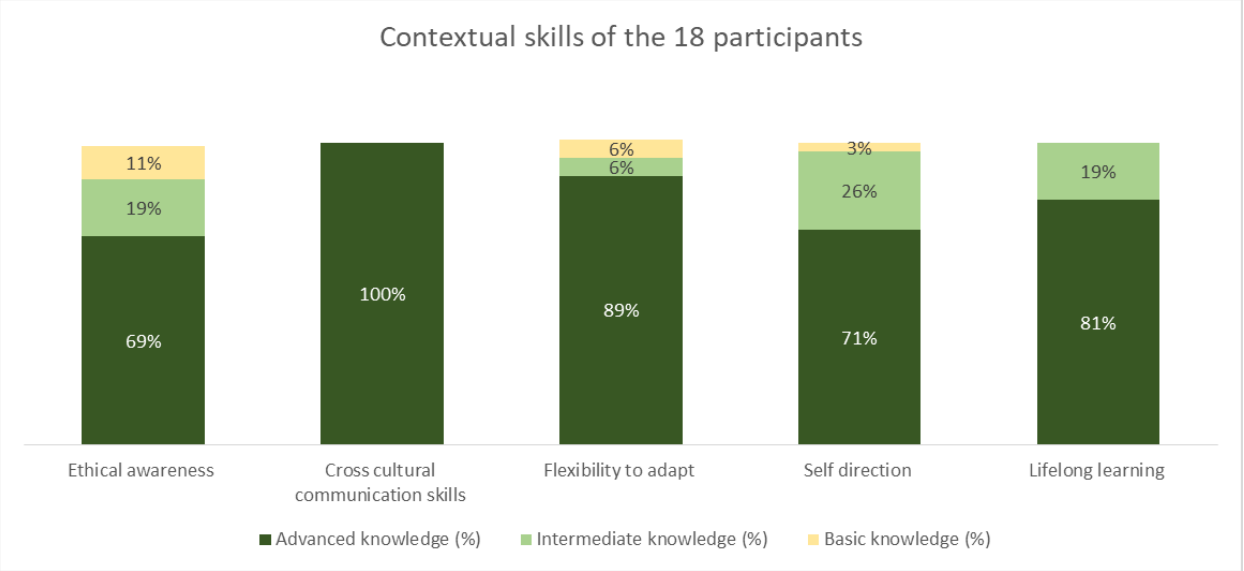
Technical skills were assessed to determine understanding of the characteristics of a device (computer, laptop, tablet) and the extent the youth can log into a device and access online content. 86% showed advanced knowledge in operating a device. Information management skills tested the ability to use ICT efficiently to search and organise information to make informed decisions, resulting in 53% of the youth indicating that this is a skill they have advanced knowledge. On communication and collaboration, the skills to use ICT to express information effectively and the skills to use the Internet to develop a social network to exchange information, 83% had intermediate to advanced knowledge on this topic. Critical thinking tested the skills to use ICT to make informed judgments and choices using reflective reasoning with 78% having basic to intermediate knowledge in this area. 84% had intermediate to advanced knowledge in problem solving which tested the use of ICT to process and understand a problem cognitively.

In terms of creativity, the skills to use ICT to generate new ideas or transform familiar ideas into a new product or service were not common among most youth, with 83% responding that they had an introductory to zero knowledge of this skill. The respondents are starting from a place where they need to be taught technology basics. Most of the youth are still in the initial phase of discovering the power of the Internet. They have not fully comprehended the power of technology to be able to start thinking innovatively to create new products or solve their problems. However, their learning journey has begun. Combining the strength of their ambitions and the immense power of the Internet, it is a matter of time before innovative services and products proliferate from Diepsloot.

4.3.2 Beyond technical skills: Contextual digital skills among Diepsloot youth

Contextual digital skills were defined as skills that are needed to take advantage of the core technical skills. These are ethical awareness, cross-cultural communication, flexibility, self-direction and lifelong learning. Overall, the youth showed that their knowledge of contextual skills was high with 96% indicating they had intermediate and advanced knowledge of contextual digital skills. A detailed breakdown of these skills as indicated by the youth is presented below in Figure 13:

Figure 13: Contextual digital skills of the youth



The youth of Diepsloot have demonstrated significant flexibility to adapt their thinking to changing ICT environments, with 89% indicating they had adapted their attitudes towards technology. On self-direction in terms of the skills to set goals and manage their own progression, 97% indicated that they had set goals for themselves on learning ICT and were taking control of their progress. The participants also had 81% advanced knowledge on monitoring their progress in learning to use ICT. All the youth are 100% committed and motivated to learn digital skills and carry a sense of pride and boast of the digital skills such as using Adobe Suite and JavaScript among others. Interviewee 14, mentioned that they are now designing posters for their church and the community. Interviewee 15, indicated that she is now skilled in Html and JavaScript and went to a series of interviews where they had to do practicals on coding. Though she did not get that particular job, the opportunity to participate in an interview for a Developer position is a proud moment. In both instances, the concept of self-actualising through the opportunities that have been made possible by the tech hub is reinforced.

The researcher also investigated the presence of social capital to determine if a sense of community and belonging among the youth had developed as part of contextual skills. According to Warschaeur (2003), social capital refers to an individual's capacity to derive benefits based on their personal and memberships in social networks or structures. In the context of this study, when the youth visit the tech hub, they join a community of like-minded and motivated individuals and become part of a knowledge network. It emerged that there is no formalised ecosystem around the tech hubs, however the youth have created their own informal community to support each other in the context of learning about technology:

Table 7: Social capital among Diepsloot youth

Respondents	Responses
Interview 14	I have made networks at the tech hub because I am always there. So I can ask within that network a few people who I think might know the answer
Interview 11	No, I have no one else to ask except when I am here and speak to others who know better and there is free Wi-Fi for them to show me
Interview 1	Yes, I have support from the animation school in Craighall, whom I connect with and also share ideas with. AT the tech hub, I normally assist others who have questions.

Diepsloot youth have established their own network of learning and sharing. Some have emerged as the experts and some as the students, but a learning journey is evident. This is a DT journey shaping youth perspectives on the immense power of technology, and more importantly building hope for a better future. The social capital built around tech hubs extends what Marcia and Garcia (2016) found about informal communities sharing knowledge in a participative way. The youth are lifting each other up and building digital skills targeted at specific career paths.

4.3.3 Profiles of youth who have been digitally empowered

In the context of the 4IR and DT, digital and contextual skills are imperative. This section highlights four youth profiles to demonstrate digital empowerment among Diepsloot youth as a result of the presence of the tech hub. The first profile is Interviewee 2, who is one of the first beneficiaries of the Wot If? Trust hub, now running his online radio station. He is based at the tech hub and benefits from the Internet provided by the hub, office space, support and software licensing. In giving back to the community, he is providing practical experiences and opportunities to the youth who are interested in digital content production. He hopes to

continue making an impact on the youth so they can pursue careers in technology. Interviewee 2 has ambitions of owning a media house and a clothing brand in the future.

The second profile is Interviewee 15 who was on the hub's 4IR learnership program. Among the skills she learnt were coding for the front end – Html, CSS and JavaScript and also learnt about robotics. She also had opportunities to attend interviews for a Developer position. She is passionate about empowering young children and is currently managing her Facebook page – Talk to Lesego. With funds available in the future, she hopes to build her own app aimed at teaching and empowering children in Diepsloot on making the right decisions in their lives.

The third profile is Interviewee 3, a Unisa undergraduate student studying towards a BA degree in Creative Arts. During the pandemic, he was able to continue with his degree program because of the free internet at the tech hub. As a full time student, the tech hub was able to assist him with securing a laptop. He commented on the benefit he gets from the tech hub that "the tech hub gives me a certain knowledge beyond what I learn at Unisa". He is interested in digital drawing and has ambitions of being an Art Director in a technology environment.

The fourth profile is Interviewee 7, a victim of teenage pregnancy who had to drop out of school to look after her baby. Now determined to get her formal Matric qualification, the tech hub is a big stepping-stone to get her qualification. She indicated she has been able to attend online classes and download study guides to continue her studies during the pandemic. She has aspirations of becoming a tech hub manager.

Table 8: Digital empowerment through four youth profiles

	Interviewee 2	**Interviewee 15**	**Interviewee 1**	**Interviewee 7**
Ambition	Own media house and clothing brand. Use radio station as a platform for youth to participate towards building Diepsloot positively	Build my own app to teach and empower kids in Diepsloot	Become an art director in a technology environment	Become a tech hub manager and teach technology to Diepsloot children

Across these four profiles, the ambitions of the youth are pointing to a general pattern towards entrepreneurship and giving back to Diepsloot. This presents an opportunity for tech hubs in poor environments to reposition themselves and create spaces for nurturing digital entrepreneurship, moving the society away from the "blue collar" mentality of training.

4.3.4 Reflections on digital empowerment of Diepsloot youth

The Diepsloot youth are at different levels in their digital and contextual skills journey, however, they are all committed to learning digital skills. The four profiles presented demonstrate the impact made by tech hubs in digitally upskilling the youth who can be described as digitally transformed. A digital transformation journey has started in Diepsloot through these young entrepreneurs. Friederici et al. (2020) described this transformation as creating an avenue for the continent to enter the global economy as more people become socially included. Tech hubs,as evidenced by this case study, are positioned to promote entrepreneurship and innovation, encouraging locals to establish their start-ups leading to employment creation and alleviating poverty.

Further, the digital empowerment of the youth is a manifestation of joint optimisation as expected from the STS theory. When the technology artefacts in the tech hub, the people, and all the environmental factors work together to produce digitally empowered youth with tangible outcomes, the STS is accomplished. Based on this insight, there is an opportunity to use tech hubs as competency centres for mass skilling towards adopting the 4IR technologies. This requires tech hubs to rethink their position with the support of the government, business, and academia to build solid ecosystems to scale their offerings and digitally upskill more people. Research question 3 asks, “What are the digital skills that the youth possess?” This was addressed through the demonstration of the digital and contextual skills that the youth possess. The selected profiles highlight a solid existence of digital skills and the pursuit of tangible outcomes among the Diepsloot youth.

4.4 Processes: Procedures to achieve set goals

In STS theory, Davis et al. (2014) define processes as the actions put in place and adhered to achieve the end goals of a system. In this study, processes refer to how the tech hub is set up as an organisation providing services to its patrons. In understanding the processes that define the tech hub, the following themes emerged - partnerships, learnerships and time-sharing.

4.4.1 Partnerships for outsourcing capacity

From a partnership perspective, Interviewee 2 mentioned that they are using the tech hub facilities to run their radio station and further train the youth on how to produce digital content. The relationship between the tech hub and Interviewee 2 can be described as a partnership.

Table 9: Tech hubs outsourcing capacity

Respondents	Responses
Interviewee 2	I am one of the first beneficiaries of Wot If? Trust. The tech hub supported me in establishing my radio station. I benefit from free internet to broadcast the radio station, I do not have to pay for a software licence and benefit from free space at the hub. On my radio station, people here in Diepsloot, particularly the youth, can participate which steers them from some of the challenges we face

As part of its processes, the tech hub is outsourcing capacity. In the digital economy, companies such as Uber and AirBnB business models are built on the premise of extra or spare capacity. For example, a person with spare rooms in their home can partner with AirBnB and offer their “extra space” at a cost. A person with extra capacity in their car can offer rides at a cost using Uber’s digital platform. Similarly, the tech hub is fully utilising its extra working spaces to provide tenancy for the youth through their partnership with Interviewee 2.

4.4.2 Learnerships to build digital skills

As part of their processes to bring value, tech hubs are also providing learnerships in various courses to upskill the youth. These learnerships are aimed at developing digital skills among the youth as a prerequisite for future employment in the digital economy. One such learnership is through the innovative Digital Lab Program sponsored by Ericsson, launched in 2020. The Digital Lab Program provides courses in basic programming, robotics and game development. To sustainably provide learning content, tech hubs have to source funding from the private sector. Corporate sponsors who were mentioned are Standard Bank who sponsored the course on Battling youth unemployment and MTN who sponsored a course on creative animation spaces.

Table 10: Digital skills programs for the youth

Respondents	Responses
Wot If? Trust tech hub manager	The tech hub runs a number of programs and workshops in partnership with the private sector. In 2020, we launched the Digital Lab program sponsored by Ericsson and focused on providing coding and robotics skills to the youth. We also run various workshops aimed at empowering the youth with digital skills.

Tech hubs have the opportunity of leveraging South Africa's Broad Based Black Economic Empowerment (BBBEE) legislation when they seek sponsorship from the private sector. The BBBEE Act provides benefits such as tax relief and access to government tenders for big corporates who demonstrate compliance with this legislation. Corporates regularly track their performance on BBBEE to ensure that they achieve a level that enables them to claim the tax relief or maintain their BBBEE level by working and supporting small medium enterprises.

4.4.3 Time-sharing in line with digital economy principles

Finally, tech hubs use the concept of time-sharing to ensure that everyone gets an equal opportunity to use the tech hub. During the Covid-19 pandemic when social distancing had to be strictly observed, tech hubs created an online place on Whatsapp where their patrons could book time to use the tech hub. Even after the Covid-19 peak, tech hubs still ensured that their patrons had equal access to the tech hub facilities through the concept of allocating a certain amount of time per person to use their facilities. Speaking on computer availability in the tech hub, 72% of youth indicated they have to wait their turn to use a computer. This waiting time can be at least one and half hours.

Time-sharing is an efficient process that ensures inclusivity in the access where resources are limited. The concept of time-sharing is also applicable in time-division multiplexing (TDM) in telecommunications. This demonstrates that the tech hub processes are aligned with principles of time-sharing within the digital economy.

4.4.4 Reflections on processes to achieve system goals

The key processes of partnerships, learnerships and time sharing established by the tech hub help in addressing question 2 of the research which explored institutional infrastructure established to support access and use of digital technologies. By setting up governance structures to outsource capacity through partnerships, similar to how Internet companies operate, tech hubs in poor environments can scale up to bring more value to their patrons. The tech hub can set up its processes to align itself with the needs of the youth in Diepsloot. Most of the youth's first encounter with the Internet was at the tech hub. Logically, their first step is to build the basic skills in technology. The tech hub has created a number of courses from basic to advanced, including learnerships to support the youth at various stages in their learning journey. The learnerships provide the youth better chances of competing in the digital economy. The concept of time-sharing is in line with the digital economy principles and the tech hub aims to achieve equal participation of their patrons, while the youth are happy to take turns, despite the long wait. To them it is better than not having the digital opportunity. They do not take the presence of the tech hubs for granted.

4.5 Infrastructure: Supporting access and use of digital technologies in Diepsloot

According to Davis et al. (2014), devices (laptops, computers, cell phones), supporting technical infrastructure (Wi-Fi), Internet, mobile network access, cloud hosting) and software (video conferencing, professional messaging services) among others, form part of the infrastructure component of the STS framework. Infrastructure was also viewed from a social inclusion perspective in line with Warschaeur (2003)'s framework, which advocates for access to ICT to look beyond the provision of devices (physical access) but instead to consider elements such as digital access, literacy and social capital which were discussed earlier. The central theme to emerge from the findings was access, supported by two subthemes: physical access and digital access. The existence of these elements leads to the effective use of ICT to promote social inclusion.

4.5.1 Physical access to devices, supporting infrastructure and software

In determining physical access to the infrastructure, computer and Internet availability, Internet speed, completion of tasks, and frequency of visit to the tech hub were investigated. As the youth in this study do not have computers or Internet access at home, they have to physically visit the tech hub to use the technologies and their experiences with physical access are detailed as follows:

Computer availability

72% of youth indicated that it is not easy to find a free computer at the tech hub - one has to either go early and be the first or wait their turn for at least one and half hours. The remaining 28% of the youth indicated that it was relatively easy to find a laptop, because they always went into the tech hub earlier. The computers are not enough for the number of youth coming into the tech hub. Waiting times of over one hour are telling of a computer deficit in the tech hubs.

Internet speed and availability

The internet speed in the tech hubs was reported as 10mbps and below. According to WebAfrica, an Internet Service Provider based in South Africa, an Internet speed of 10mbps is ideal for two to three devices, checking email, social media browsing, occasional media downloads, and streaming for one user at a time. A tech hub environment where multiple devices are connected needs an Internet speed of 50 – 100mbps to enable media-rich downloads, streaming, social media, email, VoIP calls, and video chats by several users at once with zero lag. This analysis confirms the finding by 61% of the youth, who described the Internet speed as slow and unstable. In terms of internet availability, 89% of youth indicated that the Internet was always available at the tech hubs, with some

highlighting intermittent power supply due to loadshedding. The youth in Diepsloot have access to the Internet through a basic download speed, and the Internet is always available.

Ability to complete tasks on the Internet

The youth indicated that they could complete their tasks, although the Internet was sometimes slow, or they had power cuts. They also indicated that they had received certificates for various courses in networking, graphic design and Microsoft office among others. Interviewee 14 indicated that they are designing posters for their church and community. The ability to complete these milestones tells of the tech hub fulfilling a need among the youth.

Frequency of visit and duration of stay in the tech hub

The youth have to walk relatively short distances to the tech hubs to access the Internet. 67% youth visit the tech hub almost daily and spend either half a day or a full day, including the waiting time for a computer. This speaks of their commitment to learn digital technologies and improve their livelihoods. On the other hand, it tells of their desperation and the limited resources that they have to be at the tech hub daily. From both perspectives, the youth want to be digitally empowered and socially included. The 33% who are employed as domestic workers and food parcel distributors only visit the hub during their off days, which demonstrates their commitment to participate in the digital economy.

Covid-19 impact on physical access

Due to the Covid-19 pandemic, South Africa declared a state of national disaster, which subsequently saw the country being placed on lockdown from March 2020 until April 2022. During this period, five lockdown levels were instituted in response to managing the pandemic. These lockdown levels affected access into the tech hubs. Tech hubs closed in lockdown level 1 and opened during level 2, albeit with shorter opening hours and fewer people were allowed to use the centres. However, in lockdown levels 3 and 4, when the interviews were conducted, the tech hubs were operational while strictly observing Covid-19 protocols.

Figure 14: Youth collaborate on digital platforms



Source: Wot If? Trust Facebook page

4.5.2 Digital access and digital content

On digital access, the researcher looked at digital content and how easily a user can understand the content and formats displayed on the sites they visit. From the data, there were no barriers to digital access, as all participants indicated that they understood the content on the websites they visited. Moreover, 94% of participants of this study have completed Matric. The four participants who indicated that they preferred the content to be in their home language were females who were not shy to express themselves and ask for digital content in their home language.

4.5.3 Reflections on the infrastructure to access technology in tech hubs

Research question 2 asked, “How does the available institutional infrastructure established to support access to digital technologies enable the Diepsloot youth to access the Internet and digital opportunities?” Access to ICT infrastructure is a significant element in social inclusion. Limited resources such as few computers, low internet speeds, erratic power supply, and Covid-19 restrictions, impact physical access. The youth have to take turns to access the tech hub. A blessing in disguise for the young people is that while queuing to use the computers, they have built their social capital to positively influence each other on digital topics. From a digital access perspective, most youths showed high access levels, driven mainly by their relatively high literacy levels. Digital literacy emanates from the ability to read, which is a fundamental element of successful participation and helps people make meaning from what they read and see online.

4.6 Technology: The key artefact in the tech hub

Davis et al. (2014) refer to the technology component of the STS as the equipment developed from the application of scientific knowledge. The Internet is the main artefact in the tech hub, supported by computers, software programs and the supporting infrastructure such as Wi-Fi. These supporting elements were discussed in detail under the infrastructure section.

4.6.1 The Internet: an escape and pathway to a new world

Through the youth's descriptions of their immersive experiences with the Internet, a new theme emerged – a new world through the lens of the Internet. Keeping in mind that the youth are from a resource-constrained environment, this new world is being experienced from an escape and novelty perspective.

Table 11: A new world through the lens of the tech hub

Reference	Responses
Interview 11	I have been able to remove myself from the peer pressure in Diepsloot. I spend most of my time at the tech hub where I am now exposed to Adobe and I work on designs and going to other sites for design inspiration makes me feel like I have become part of the global village while I am here in Diepsloot.
Interview 16	The tech hub also is a place where I spend most of my time, away from the youth who like to just walk up and down the streets. It gives me an opportunity to join groups on coding and networking and makes me feel like part of a group of clever IT coders. I would not have had this opportunity without the tech hub
Interview 14	Since I am unemployed I come here everyday, this is where I spend all my time, developing my skills and researching new ideas. It's almost like the world in your pocket with the Internet and can be exposed to whatever you want, there is no limit on data.

Through exposure to different technologies, the tech hub is providing a window into "a new world of endless opportunity" to the youth. It is critical to understand that this new world is being seen from an environment where this opportunity would never have been possible had it not been for the tech hub. It is revolutionary for the young people to be in places where they cannot physically travel.

4.6.2 A "new world" from a philosophical perspective

Post phenomenologist (Ihde, 1975) analyses the relations between human beings, technology, and the world. He investigates the role technology plays when humans interact with the world and states four kinds of human-technology relations: embodied, hermeneutic, alterity, and background. For this study, the researcher focused on embodied and hermeneutic interactions. In these two relations, technology is a mediator of how humans experience the world. Ihde (1975) provides an example of a person wearing glasses and how the glasses change their perception of the world. In the embodied relation, he states that a person perceives through technology, and in the hermeneutic, a person does what they do with the technology. This critical thinking in human technology interaction plays out among the Diepsloot youths about their human-computer relationship with the tech hub and how it shapes their perception of the world. The "new world" that the youth are experiencing is what Ihde described as the embodiment and hermeneutics of human technology interaction, with technology mediating and influencing, digitally transforming and shaping the youth's perceptions of the world. The youth reported feelings of the world in their pocket, of being part of clever coders and being part of a global village. The Internet has opened a window to "a new world" that the youth never imagined existed. The power of technology to influence and shift perspectives is evident in poor environments.

4.6.3 Characterisation of the uses of technology by Diepsloot youth

Technology use 101: The introduction

The use of technology by the youth was characterised in three broad ways. The first characterisation can be described as technology use 101, the introduction. Most of the youth's first encounter with computers and the Internet was at the tech hub. This informs why the starting point, when they start at the tech hubs, is learning how to use the computer and basic functions in Microsoft programs.

Table 12: Technology use 101, the introduction

Respondents	Responses
Interviewee 1	Tech hub is where I first learnt to use a computer.
Interviewee 7	I am starting to think of courses in IT that can interest me such as Networking and coding which I didn't know about before.
Interviewee 3	My thinking about technology has improved, I can see a better future for myself through the MS programs I am learning. I can now use a computer

Technology use 201: The reinforcement

The second characterisation is technology use 201, the reinforcement. The use of technology by the youth can be described in phases that build on each other. For example, the technology use 102 builds on the fundamental digital knowledge, where the youth use technology to develop further and refine their digital skills. Interview 14 indicated they are advancing their skills to a senior weight graphic designer, while Interviewee 12 has now started thinking of ideas for the digital business he wants to start. The influence of the vast possibilities presented by the Internet is shaping youth perspectives and guiding their thinking on what they can become in the digital economy.

Table 13: Technology use 201, the reinforcement

Respondents	Responses
Interview 14	Now I am able to design posters using Adobe. Last year I didn't know how to do this. I am advancing to a Senior weight Graphic designer.
Interview 12	The tech hub has been a place where I learnt about entrepreneurship. I am working on ideas on what to buy and sell online.
Interview 5	Now I know about how to generate ideas and develop them. I can also connect on social media with my friends and follow celebrities who I want to copy ideas from.

Technology use 301: The mastering

The third characterisation is technology use 301, the mastering. At this point, the use of technology focuses on digital skills application to produce tangible outcomes. For example, Interviewee 3 is designing posters for their church, Interviewee 15 is thinking of building an app and Interviewee 2 is running an online radio station. In addition, the youth indicated that they are using social media for news, entertainment, and inspiration, among other things. Social media has become integrated into the lives of the youth. Not only is it serving an entertainment and inspirational purpose, but it is keeping the youth informed and updated about what is happening in the world. As the adage goes, information is power; informed people make a better society and nation.

Table 14: Technology use 301: The mastering

Respondents	Responses
Interview 3	Through self-coaching and determination, I have advanced my skills. I have done all the courses at the hub and now I do graphic design for posters at my church and the community.

Respondents	Responses
Interview 15	Through the learnership program provided by the tech hub, now I can code for the front end i.e. Html, CSS and Java Script. I want to use these skills to build my own app
Interview 2	I am producing content, doing AV development, recording podcasts, video production and interviews. I am getting my sustenance from doing this things at the tech hub

4.6.4 Reflections on technology and Internet as key artefacts in the tech hub

Technology is digitally transforming the youth, exposing them through the Internet, to new worlds they did not know existed. The human-computer interaction plays a crucial role in shaping the perspectives of the youth who are on a journey to digitally transform. Some are starting the journey; some are progressing, while some have mastered and are applying their digital skills to produce tangible outcomes.

Research question 2 asked, “How does the available institutional infrastructure established to support access to digital technologies enable the Diepsloot youth to access the Internet and digital opportunities?” This section highlighted the transformative power of technology through the Internet to transpose youth into “new worlds” and shape their perspectives on DT and what they want to pursue as careers. By characterising the uses of technology, this section also demonstrated the use of technology by the youth who are at different stages of their digital transformation journey.

4.7 Environment: ICT policies' effectiveness in supporting social inclusion

In the initial version of the STS, Emery and Trist (1965) state that the environment is an open ecosystem that constantly evolves, influencing the system's performance. ICT policies significantly influence the environment, as their implementation impacts the connectivity of the poor. Therefore, ICT policies are reviewed through the lens of the environmental component of the STS theory.

4.7.1 Universal access policy key to achieving social inclusion

The youth of Diepsloot lamented the lack of individual access to the Internet. This indicates that the Universal Service and Access Fund (USAF), which provides ICT services for people in underserved areas, has failed to produce tangible outcomes. Gillwald et al. (2017) found that the USAF funds, earmarked to provide universal access and service to all, did not reach the needy. Universal access policies and programs typically focus on ensuring that the cost of access to communication technologies is affordable to all, particularly in low-income

groups. Therefore, the rollout of tech hubs in impoverished areas demonstrates the policy being implemented to address the gap in access. In Diepsloot, the Southern Africa Youth Project and the Wot? If Trust tech hubs were planted in the community. Both tech hubs have contributed immensely to driving social inclusion as they serve as proof points of the implementation of universal access in marginalised areas.

4.7.2 Digital skills roadmap that leaves no one behind

Digital skills are central to DT and a crucial topic within the ICT policy framework. The National Integrated ICT Policy White Paper (2016) clarifies that digital access without literacy will not address the digital divide. The National Skills and Future Skills Strategy (2017) specifies implementing the skills roadmap, with the first of the eight strategic pillars focused on foundation learning through the tech hubs.

From the findings of this research, tech hubs in poor areas are providing the foundational digital skills. The participants reported that prior to visiting the tech hubs; they did not have knowledge of the Internet or how to use a computer. The digital skills the youth possess in graphic design, digital content development, and coding, among others were attained through the tech hubs. This confirms that tech hubs are well placed as places of developing foundational digital skills. However, the policy neglects to mention the importance of scaling up these tech hubs with the right infrastructure to accommodate more people. Interviewees indicated that the waiting time to use computers ranges from one hour to two hours a day. Though they socialise while they wait, this is time lost that they could be building or refining their digital competencies. This slow progress means that the youth stay in the phase of basic digital skills for longer than necessary. If there is adequate infrastructure, the youth can progress their digital competencies quicker, thereby catapulting them to a new level of thinking on digital possibilities, ushering in innovation earlier. Digital upskilling of the youth in marginalised environments is key to digital transformation and an important policy initiative that government and private companies must prioritise.

4.7.3 ICT policy impact on the Internet as a human right

The African Declaration has merely advised but not mandated governments to categorise the Internet as a human right. The National Integrated ICT Policy White Paper (2016) has its roots in the South Africa Constitution and highlights the importance of human rights in the provision of ICT. However, the actions on the ground tell a different story. The Internet seems a long way from being freely accessible to everyone in South Africa. The marginalised youth do not enjoy this human right. Poor people cannot receive information, access news, or

share ideas online because they are socially excluded. A few pertinent questions arise about how the government perceives poor people and their role in the digital economy. If human rights are used to guide policy, and the government is as committed to enacting these policies as drafting the documents, why are these rights not extended to poor people? Why are poor people still excluded from enjoying the freedom of online information? In the case of Diepsloot youth who have to walk to the tech hub to access the Internet, why have they been robbed of this human right? As put by Anand (2022), the lived realities of people, such as education, economic development, and social environment, among others, are affected by their access to the Internet. With 50% of South Africans still offline, the right to access the Internet and by extension, information is not passed to the poor. Perhaps their rights do not matter. The rights of poor people do not matter in South Africa.

4.7.4 Impact of 4IR recommendations on digital technology use

The first recommendation from the Presidential Commission on the 4IR presented in January 2020 was human capacity development (Department of Communication & Digital Technologies, 2020). This recommendation considers building capacity in education, competencies, and strategic projects in mass skills development in selected 4IR areas. Tech hubs can play a key role in the implementation of this recommendation. Wot If? Trust tech hub is already providing learnerships in 4IR programs in partnership with the private sector, albeit at a small scale. However, it remains to be seen if tech hubs can have a voice as part of a formalised ecosystem to build capacity in 4IR.

4.7.5 Reflections on the ICT policies' effectiveness in supporting social inclusion

ICT policies whose grounding is in the South African Constitution show a willingness by the government to provide universal access to all its citizens. However, due to reasons ranging from a lack of leadership in government to the mismanagement of funds targeted towards provision of access to the poor people, half the population is not connected. There is a lack of policy implementation and monitoring. There are some efforts from the government to address the challenge of universal access funds and the digital divide. The National Skills Strategy (2017) is a step in the right direction focusing on tech hubs as foundational centres for building digital skills. However, it doesn’t address how tech hubs in resource poor environments can scale up to reach more people to digitally empower, bearing in mind that these tech hubs have very limited resources and yet have to cater for high numbers of people. This is another example of well meaning policy that falls short on implementation due to reasons already experienced with prior policy implementations. It shows a leadership culture devoid of learning from past mistakes and an utter lack of concern for poor people.

Research question 4, “To what extent do current ICT policies embed the promotion of digital technologies in support of social inclusion?” has been addressed in this section. ICT policies have only existed on paper in government offices. The lack of policy implementation and monitoring has resulted in the poor being excluded. And the youth of Diepsloot are a case in point.

4.8 Synthesis of findings and objectives

The theoretical thematic analysis and the four dimensions of the study were mapped back to the research objectives to highlight the findings. The first research objective was to explore the social influences on the adoption and use of technology. The main themes that emerged under the first objective were self-improvement in the long term and youth resilience in a challenging environment. The findings show that the youth have clear ambitions to build specific careers in the digital economy. Ultimately, they want to improve their standard of living. At the same, the youth are aware of the challenges that confront them every day, which include poverty, unemployment, crime, and peer pressure. Despite this, they demonstrate resilience. They have formed their social capital, learning and inspiring each other on their digital learning journey. Young people are not deterred by lack as they embrace technology to choose their careers. A common goal unifies people and propels them to stand together, learn from and inspire each other while preserving their dignity.

The second objective was to assess the available institutional infrastructure to support access to digital technologies. The themes that emerged were access and use of digital technologies, and technology as a key artifact in the tech hub. Tech hubs are using digital economy time-sharing concepts to provide access to more people, as resources are limited. Through characterising the usage of digital technologies, the data revealed that the youth are at different stages of their digital transformation journey. Technology has the power to transpose people into new worlds and influence the course they take in their lives and careers.

The third objective assessed the digital skills of the youth and digital empowerment emerged as the key theme. Four youth profiles were selected to showcase digital empowerment. These profiles highlight a solid existence of digital skills and the pursuit of tangible outcomes among the Diepsloot youth. In addition, these youth want to pursue digital entrepreneurship, meaning that tech hubs can significantly contribute to the small and medium enterprise sector by becoming mass training centres that equip young people with digital entrepreneurship skills. It is time policy makers, government and business gave attention to tech hubs and capacitated them to produce more digital entrepreneurs.

The fourth objective explored the extent current ICT policies embed the promotion of digital technologies in support of social inclusion. There is a chasm between the ICT policy objectives and activities on the ground, pointing to a lack of implementation and monitoring of ICT policies.

4.9 Summary of chapter

The chapter presented the research findings through the lens of the STS framework. The findings were categorised into themes in line with the theoretical thematic analysis. Then the data was interpreted according to the research questions.

CHAPTER 5: DEVELOPING A SOCIALLY INCLUSIVE STS FRAMEWORK FOR TECH HUBS IN RESOURCE-CONSTRAINED ENVIRONMENTS

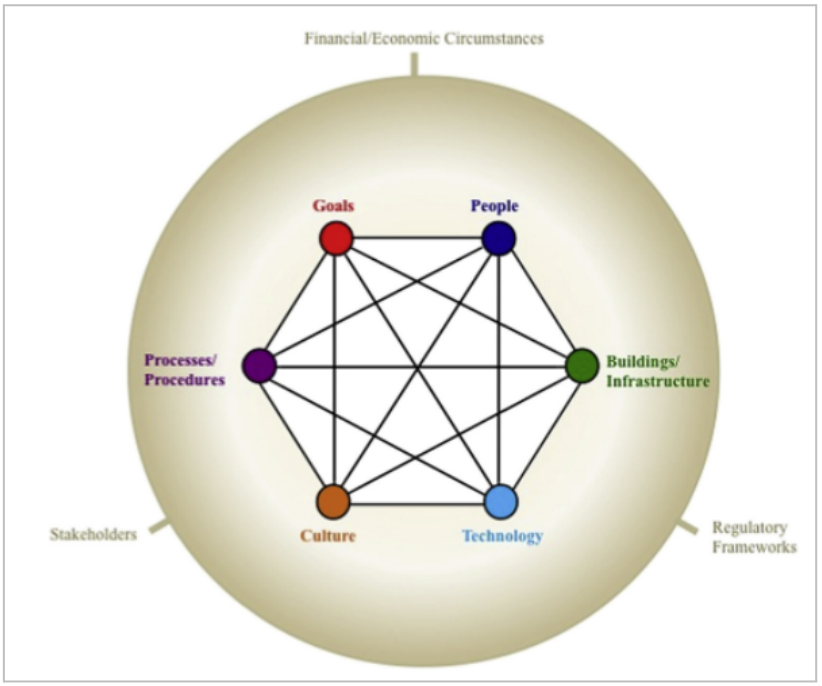
5.0 Introduction

This section presents a socially inclusive sociotechnical systems (STS) framework for tech hubs in resource-constrained environments. This is done by revisiting the conceptual framework, reflecting on the framework's elements and considering the themes which emerged from the data to develop an adapted framework.

5.1 Conceptual framework revisit

The conceptual framework initially presented in chapter 2 was used as a lens to explore the social and technological aspects influencing the youth in Diepsloot to adopt and use technology in gainful ways. The STS framework is shown below:

Figure 15: Conceptual research framework



Source: Davis, 2014

5.2 A socially inclusive tech hub framework for resource-constrained environments

Based on the data and analysis, the current STS framework needs to be adapted to make it suitable for the design of socially inclusive tech hubs in impoverished environments. The table below shows the translation of the seven STS dimensions into an adapted framework

with the research themes and related factors to be considered when redesigning tech hubs in resource-poor environments.

Table 15: Socially inclusive STS

	Applied STS dimension	**Findings/themes**	**Redesign factors**
1	Goal alignment between tech hub and patrons	Self improvement in the long term	Structured feedback mechanisms to understand youth ambitions
2	Nurture a digital and innovative culture	Resilience Peer pressure Tech hub influence	Strengthen tech hub influence to promote digital practices Embed innovation a new way of thinking
3	People centred digital Transformation	Youth digital Empowerment	Build capacity - scale up tech hubs as places of learning Strengthen social capital among youth
4	Tech hub governance Processes	Tech hub process	Establish governance processes Reposition the tech hub
5	Bricolage the infrastructure in the tech hub	Physical access Digital access	Use bricolage i.e. leverage smartphone ownership and find alternative power supply and fibre
6	Reinforce the transformative power of technology	Uses and benefits of Technology	Provide the right technologies Customisation of training based on learning phase
7	Policy and regulatory environment	Lack of policy implementation and monitoring	Engage and lobby policymakers to have a voice on policy and implementation thereof

5.2.1 Goals alignment critical in design of tech hub

As per the synthesis in Table 15 above, a redesign of the tech hub that considers alignment of mutual goals between tech hubs and patrons is crucial in the optimal design of a socially inclusive tech hub. Although the youth showed resilience, ultimately, they want to improve themselves by taking up careers in the digital economy and the tech hub aims to digitally empower the youth and lead them to various opportunities. However, tech hubs in resource-constrained environments are not designed for this joint optimisation. The researcher calls for a revisit of the initial design of the tech hubs in resource-constrained environments. There is room to build strong networks with businesses and government to not only digitally empower more youth, but guide them in their ambitions to start up businesses. If tech hubs fail to support the youth, ideas are likely to die prematurely. The continuous engagement with youth allows collaborative decision-making, particularly when the goals of the youth and the tech hubs are aligned to achieve joint optmisation. Further, in

these impoverished environments, Kumar e and Gowda (2020) emphasise that the optimal design of systems involves adjusting the design variables to get the most benefit using minimum resources. Therefore, a redesign of the tech hubs to ensure mutual goal alignment using minimum resources is possible in these environments.

5.2.2 Build an innovative and digital culture

The tech hub is exerting positive pressure and influencing the youth to be digitally savvy, potentially ushering in a new culture that embraces technology and shapes perspectives. The findings show that the youth are embracing the technology and supporting each other in their digital transformation journey. However, tech hubs need to be more deliberate in how they can influence and reinforce an inclusive innovative culture of learning and collaboration where everyone can participate. The researcher calls for what Rowles and Brown (2017) advocate that organisations looking to build or strengthen a digital culture must start with an audit to determine key areas of focus on their digital transformation. These areas include environment, technology, skills and talent, communication, process and governance, structure, and leadership among others. The audit to determine where a tech hub stands cannot be a one-size-fits-all, it is unique to each context and must be treated as such to assess the strengths to amplify and areas of weakness to improve in fostering a digital culture in resource-constrained tech hubs. Key ingredients of a digital culture as described by The World Economic Forum (2021) include collaboration, innovation, data and customer centricity. Tech hubs can therefore consider these elements as part of their deliberate effort in nurturing a digital culture, which brings significant benefits to all involved.

5.2.3 People-centred digital transformation

As per the synthesis in table 15, people-centered digital transformation based on the theme of youth digital empowerment requires tech hubs to build their capacity to meet the demand for skills development. The four highlighted youth profiles pursuing entrepreneurship point to an urgent need to reposition tech hubs as massive skills development centres that foster innovation and entrepreneurship. Tech hubs have the potential to nurture digital entrepreneurship and move society away from the "blue-collar" mentality of training. The opportunity to focus on building human capacity by scaling tech hubs is ripe in resource-constrained environments. Building capacities in human resources, education and integration becomes as fundamental as the technology to drive digital transformation (Celaschi, 2017). It is about focusing on potential young entrepreneurs and taking them under the wings of the tech hubs to nurture and give life to their ideas.

5.2.4 Governance processes in local tech hubs

As indicated in table 15, tech hub governance processes are essential in achieving its financial and social objectives. However, tech hubs are lacking in establishing governance processes that can drive revenue from their innovation or build ecosystems. It is paramount to establish a governance structure that defines the purpose of the tech hub and overlooks all activities to ensure inclusive wins for tech hubs and communities. Kelly and Firestone (2016) highlight that an appropriate governance structure is one of the essential non-automatable factors in running an inclusive and efficient tech hub. To build on this thinking, there are prerequisites of good governance that tech hubs should consider before developing the governance structure and processes. Whitt (2017) describes these as transparency and accountability. However, one must consider governance structures and processes as taking a holistic view of the social and technical aspects impacting the tech hub and developing a comprehensive structure and process that considers all these factors. Through this approach, tech hubs can apply the established governance processes to guide inclusive digital innovation and support the achievement of tangible outcomes by its patrons.

5.2.5 Bricolage infrastructure in local tech hubs

The findings show that physical access to the tech hubs is constrained by a lack of resources and constrained spaces. Tech hubs can leverage smartphone ownership for patrons to participate in online activities without necessarily waiting for a computer to become available. The power constraints in South Africa are long-term, therefore alternative power sources such as inverters, solar, and generators are available on the market. To provide faster connectivity, tech hubs can use fibre rather than modems. Tech hubs need to reach out to hub capacity-building initiatives such as The Launch League in South Africa, which assist tech hubs in positioning themselves to serve entrepreneurs through programs such as training, open license program tools, and network opportunities for peer learning and collaboration. These kinds of adaptations are what Ciborra (2000) describes as bricolage, a way of working with information technology characterized by improvisation, experimentation, and flexibility. It is relevant in situations where the technology or the problem is not well understood, and where standard approaches or solutions are not available.

5.2.6 The transforming power of technology

The right technologies and training are prerequisites for people to experience the transformative power of technology. The tech hubs can strategically use their technology as a transformation platform to integrate more people into a connected society. The findings revealed that the Internet is the core artefact in the tech hub, and through exposure to it, the

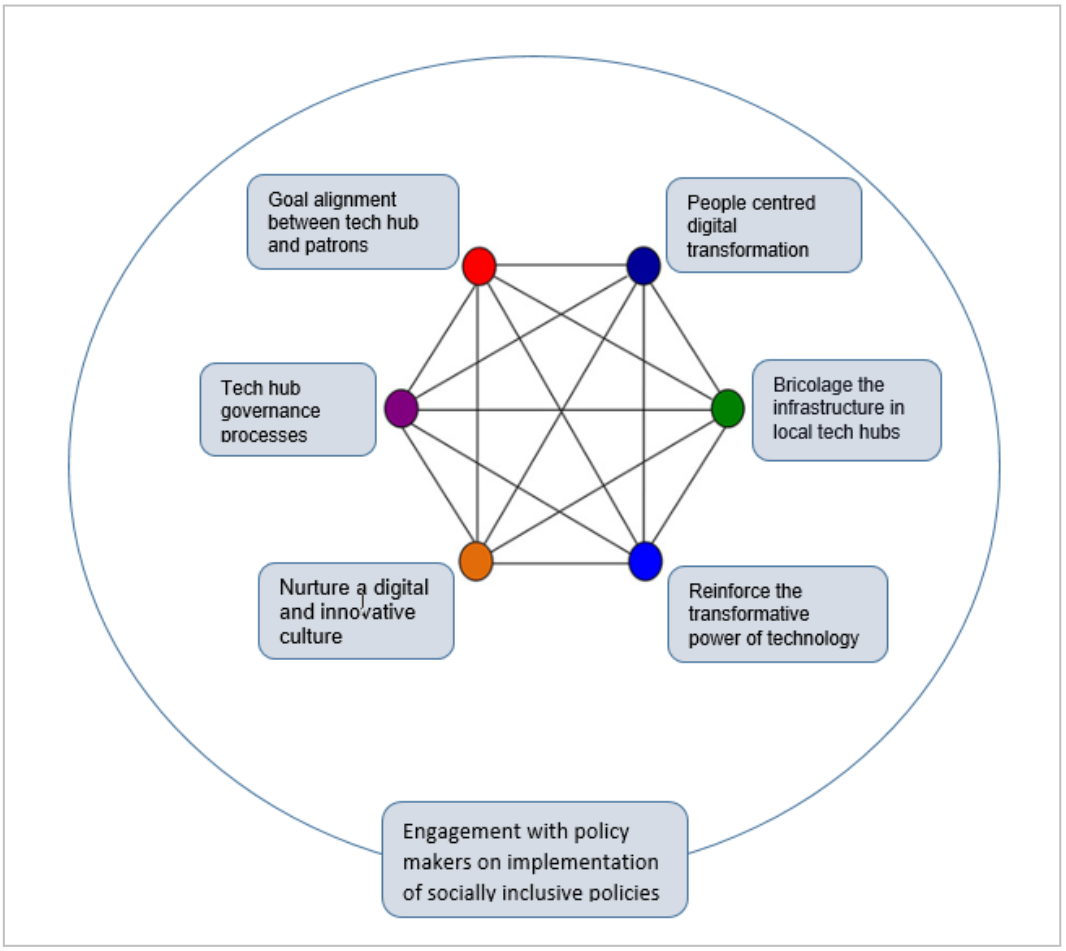
youth feel transposed to new places. As a result, the youth want to pursue careers in software development and digital entrepreneurship, among others because they have been exposed to the immense power of technology that can potentially change their lives. Until people see the transformation of a place or of a people driven by technology, they will not know what tech can do. It is therefore important in resource-constrained environments for people to see and experience technology. The highlighted four youth profiles now want to pursue digital entrepreneurship, something that they would not have done had they not been exposed to the tech hub. These experiences are what Majumder and Tripathi (2021) describe as a magnification of human experiences due to the power of technology, fundamentally changing how people live and communicate.

5.2.7 Robust engagement with policymakers

As shown in table 15, based on the lack of ICT policy implementation and monitoring to ensure that people in resource-constrained environments are socially included. This study has revealed that there is no interaction between tech hubs and policy makers, consequently tech hubs are not positioned to fully benefit from government resources. Although the United Nations Department of Economic and Social Affairs (2021) states that governments are mandated to lead transparent public debates on digital topics in the development of ICT policies and regulatory frameworks that uphold social inclusion. Tech hubs must therefore call for immediate action from the government to prioritise funding in line with the National Skills Strategy (2017) which already acknowledges the role that tech hubs can play in building digital skills, mostly among the marginalised. In addition, tech hubs can take a more proactive stance and host events where they invite thought leaders and government representatives who can act as their conduits and links to government resources and knowledge. An example of such initiative is the “Wireless Wednesdays” events in Kenya held from 2012 to 2014, and attracted industry and government representatives and established a robust ecosystem for the tech hubs.

Accordingly, a socially inclusive STS framework is as follows:

Figure 16: STS framework for tech hubs in resource-constrained environments



Source: Matanda, 2023

The table above presents the seven dimensions of a socially inclusive STS framework for tech hubs operating in resource-poor environments. The tech hubs operate within an external environment shaped by government policy. Therefore, it is in the best interest of the tech hub to engage and lobby policymakers to influence policy decisions impacting tech hubs, particularly those in marginalised areas. Inside the tech hub, the framework comprises six social and technical elements that systematically work together to produce mutual wins for the tech hub and its patrons. Starting with the social elements, for the system to work, the goals of the tech hub need to be aligned with the goals of its patrons while building an innovative culture focused on people-centred digital transformation. These three social elements of goals, culture and people are enabled by the technical elements, namely infrastructure, processes, and technology. Through the bricolage of their infrastructure to cater to more, tech hub processes must support and empower patrons to achieve their goals while reinforcing the transformative power of digital technologies. These social and technical

elements, including the policy context, are interrelated and form a socially inclusive STS framework that tech hubs in resource-poor environments can adopt.

5.3 Summary of chapter

The conceptual framework was revisited and augmented taking into account important factors that are unique to tech hubs operating in poor environments. Each dimension of the theory was reviewed in the context of the four dimensions of the study (social influences, infrastructure, digital skills and policies) and the objectives of the study. The suggested redesign factors were informed by the data collected and related examples in literature to make solid recommendations. Therefore, the adapted framework is a rich framework that considers both social and technical aspects of operating tech hubs in resource-constrained environments. Subsequently, a socially inclusive new design of tech hubs in resource-constrained environments was provided.

CHAPTER 6: CONCLUSION: HOW THE SOCIALLY-INCLUSIVE STS FRAMEWORK FOR TECH HUBS INFORMS RECOMMENDATIONS

6.0 Introduction

This chapter is a culmination of this research, assessing what was achieved against the research objectives. It also includes the evaluation of the methods and approach used. This chapter also presents the study's limitations, key contributions, and suggestions for future research.

The matrix shows the four dimensions of the study namely social influences on digital adoption, digital skills, institutional infrastructure and ICT policies for digital enablement and the seven elements of the socially inclusive STS framework. The intersection points highlight opportunities to further develop the STS framework in line with the research dimensions. It is from this matrix that recommendations discussed below are developed.

Table 16: Matrix of the socially inclusive STS and the research dimensions

	Social influences	**Institutional infrastructure for access**	**Digital Skills**	**ICT Policies**
Goal alignment between tech hub and patrons	Tech hub and youth goals alignment		Digital empowerment intrinsically linked to goals	
Fostering a digital culture	Extend the tech hub's positive influence to build a digital culture		Leverage digital skills to develop innovative solutions	
People centred digital Transformation	Strengthen social capital	Reposition tech hubs as massive skills development centres that foster innovation and entrepreneurship.	Meet people where they at in their DT journey	People first in policy development
Tech hubs governance processes	Establish mutual wins with communities	Build revenue generating streams Build ecosystems with academia, business	Outsource capacity to accommodate more	Engage policymakers on policy affecting tech hubs
Bricolage infrastructure in local tech hubs		Bricolage- make more out of less	Potential use of cell phones as a	

	Social influences	Institutional infrastructure for access	Digital Skills	ICT Policies
			device to learn digital skills	
Transforming power of Technology	Highlight transformative power of technology	Right mix of technologies	Customisation of training Drive innovative thinking	Inclusivity – technology must reach everyone
Socially-inclusive ICT policies	Universal access coverage in resource poor environments	Support for tech hubs to scale as mass training centres		Practical approach to addressing policy implementation gaps – start with quick wins Strict monitoring of policy implementation Continuous engagement with policymakers

Source: Matanda, 2023

6.1 Summary of Findings

This section summarises findings while reflecting on the goals, objectives, and research methodology. The aim of this study is to explore and understand the sociotechnical factors influencing access and use of digital technologies by youth in Diepsloot to promote social inclusion. The research objectives and how they were addressed are as follows:

- ✔ **To determine the impact of social influences shaping the perspectives of youth towards adapting to technology**

This objective sought to understand the social influences affecting the adoption and use of technology among the youth in Diepsloot. Social factors such as culture, goals, poverty, peer pressure, social capital and Covid-19 impact have a significant impact on how young people perceive and use technology. The tech hub is exerting a positive pressure on the youth and starting a new digital culture in Diepsloot. While social factors influence the young people's perspectives, inherently, they are resilient and driven by ambition to achieve their goals and improve themselves to participate in the digital economy.

- ✔ **To evaluate the available institutional infrastructure established to support access to digital technologies and how it enables the Diepsloot youth to access the Internet and digital opportunities**.

Two tech hubs in Diepsloot were included in this study. The tech hubs' resources are limited; they operate in quite small spaces and have limited devices relative to the population they are serving. Technology use by the youth can be characterised at different levels from basic to advanced. The Internet is the main artefact that opens a window of opportunity into the digital world. From a process perspective, the tech hub is effectively using the concept of time-sharing to provide both physical and digital access in the tech hub.

- ✔ **What digital skills do the Diepsloot youth possess to use digital technologies**

The digital skills of the youth were assessed to determine their technical and contextual digital skills. The youth are at various stages of learning digital skills, some have advanced and are helping those who are starting on their journey. The youth are optimising their social capital as they go through their digital transformation journey. Their possession of digital skills is putting the youth in good stead for specific careers in the digital world. There is an opportunity to reposition tech hubs as competency centres for mass skilling towards adopting the 4IR technologies.

- ✔ **To evaluate the current ICT policies embedding the promotion of digital technologies in support of social inclusion**

The fourth dimension was to investigate how ICT policies are implemented to promote the objectives of universal access, digital upskilling, and the socioeconomic rights to the Internet. It became evident that policy objectives are not implemented for various reasons, much to the detriment of poor people. The poor remain offline with no access to the Internet. Digital upskilling is happening at a languid pace. There is still more to be done to achieve policy objectives which meet the needs of the people.

6.2 Conclusion

Diepsloot is a resource-constrained environment. Being a young adult is not easy in that environment. The social and economic challenges in Diepsloot are burdensome for the youth, and they yearn for a better future through participation in the digital economy. In poor environments, tech hubs have proved to be solid stepping-stones for ambitious young people. Tech hub managers need to take up their position of influence to intentionally lead the creation of a digital and innovative culture and develop these ambitions. They need to rethink the design of the tech hub as more robust value creators to meet the growing potential of the youth.

In resource-constrained environments, the most popular use of technology by youth is for skills development. This presents an opportunity for tech hub managers to scale up tech hubs as competency centres for mass skilling, particularly towards adopting the 4IR technologies. The first recommendation from the PC4IR was to build capacity/human skills in the 4IR realm of technologies. Tech hubs can contribute to implementing this initiative, establish the correct networks and ecosystems and possibly get funding for contributing to the 4IR skills pipeline.

From a resource perspective, tech hubs in resource-poor environments have limited resources, ranging from physical space to software services. The spaces are quite small, the youth have to take turns to access the tech hub and the Internet speed was described mostly as slow. The devices relative to the number of employees are too few, which has made the tech hubs to innovatively introduce timesharing to give everyone a chance to use the computers.

This study revealed a lack of Internet access in marginalised communities despite the constitutional right of all citizens to have access to the Internet. Policymakers must firstly ensure inclusivity in policies, particularly in poor environments where access to technology is a challenge. The challenges, which vary from illiteracy, lack of resources and capacity and disabilities among others need to be incorporated in policy drafting with possible solutions on how to address these in a socially inclusive way. In addition, policies must be implemented according to the policy objectives and the Constitution. Taking learnings from the gross mismanagement of the USAF, the newly established DDF Fund must be accounted for and measured against its targets of not only providing infrastructure, but also digitally upskilling citizens to ensure social inclusion. Cohesion in the different departments and government ministries will expedite the decision-making process to allow quicker implementation and turnaround time.

The journey to digital transformation has indeed begun in Diepsloot. Social influences have a significant part to play in shaping the perspectives of the youth on technology use. The tech hubs are playing an instrumental role to build a digital culture and as a platform for digital skills. The youth are building digital competencies and 21st century skills from the beginner phase to the expert phase. The duty to arrive at universal access and service remains with policymakers, who are required to monitor implementations to ensure policy objectives are implemented and that the poor are not left behind.

6.3 Recommendations for practice in tech hubs

6.3.1 Leverage tech hub positive influence to drive social change

From its establishment in 1995, Diepsloot was considered a temporary shelter for people evicted from their homes in other informal settlements. The concept of Diepsloot being a transitory place still exists today, affirmed by ambitious people who arrive looking for economic opportunities and pack up when their financial standing improves. Consequently, there is a lack of concern for improving the lives of people or the service delivery in the township. However, by leveraging technology, Diepsloot can become an attractive place and a digital training ground for youth while remaining a transit township. Tech hubs have the potential to drive social change by using their positive influence to cultivate a digital and innovative culture where youth look to technology to solve problems. An example is leading the motivated and ambitious Diepsloot youth towards social entrepreneurship to solve pressing social issues through technology is one way that tech hubs can create more value for communities and support the ambitions of young people to participate in the digital economy. The transformation of New York City in the United States Of America (USA) provides perspective on how a deliberate multi-pronged approach to building a technology ecosystem in consultation with people can have far-reaching benefits for communities.

6.3.2 Bricolage and develop revenue streams to operate sustainably

The tech hubs' spaces and resources are limited in the area. For example, Wot-If? Trust uses a shipping container, while the South African Youth Project uses the front yard of a residential property. These tech hubs are not-for-profit but rely on private companies, NGOs, and government funding. They cannot quickly expand their physical space overnight, as they are focused on the services they provide to the community. This implies that the youth and the tech hubs have to manage the available resources and find innovative ways of increasing their outreach. Tech hubs must consider the bricolage concept while unconventionally using available resources. For example, they can create online chat rooms on specific topics, so while the youth wait their turn to use a computer, they can already be engaged online. In this way, the tech hub leverages the youth's smartphones and creates room for more.

Tech hubs must belong to ecosystems to benefit from knowledge sharing and capacity building leading to self-sufficiency. This approach would enable the tech hub to create bridges enriching the participants' experience while building expertise so that they can generate revenue. The tech hub should start forming alliances and networks with academia and business associations in the area, such as the Diepsloot Small, Medium & Micro Enterprises Forum (DSMMESF) to name a few. Networks with businesses will steer the tech hub towards self-sufficiency. Therefore, tech hubs must develop revenue-generating

streams, offering their services at a fee and targeting businesses in the area or even the government. This can be made more accessible when tech hubs belong to an ecosystem that helps them to develop their expertise through knowledge sharing. The transformation of New York City provides perspective on how a deliberate multi-pronged approach to building a technology ecosystem in consultation with people can have far-reaching benefits for communities.

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6.3.3 Digitally empowered youth must produce tangible outcomes

Tech hubs are designed to be playing grounds for innovation and creativity, which birth entrepreneurs and create employment, ultimately improving the living standards of a community. In resource-constrained environments, tech hubs mostly play the fundamental role of providing foundational training to their patrons encountering technology for the first time. The tech hubs need to be repositioned and scaled as mass training centres complementing the conventional institutions of higher learning. This would enable the tech hubs to increase their reach in the digital training and empowerment of youth.

This study has tangibly demonstrated the results of digital empowerment through the highlighted four youth profiles. The youth are leaning more towards digital entrepreneurship and have presented solid ideas about what they want to do. These ideas must not die prematurely because of a lack of resources. Tech hubs need to take advantage of their networks for expert support in the development, conceptualisation, testing and launch of these ideas.

6.3.4 Policy implementation and monitoring key to social inclusion

The ICT policy objectives are well-meaning but need more implementation and monitoring. Tech hubs need to engage policymakers and ensure they have a say in policy matters that affect them. In addition, they need to make policymakers aware of their role in the digital empowerment of the youth in marginalised areas. This will create an environment where the needs of the tech hubs are considered in policy development. In addition, tech hubs must be in tune with current ICT policies. For example, they need to pay special attention to the implementation of The National Skills and Future Skills Strategy (2017), particularly on strategic element 1, where tech hubs must act as a platform for digital foundations. They need resources to deliver on this mandate, which requires alignment between the government and the tech hubs.

6.4 Evaluation of the study

The main aim of this study was to explore and understand the sociotechnical factors influencing youth access and use of digital technologies in Diepsloot to promote social inclusion. Through the thematic theoretical analysis, based on the deductive approach, the researcher discussed the social and technical factors that influence digital transformation among the Diepsloot youth. The researcher found that more than the STS framework in its current format was needed to help tech hubs achieve social inclusion in Diepsloot. This led to the researcher developing an adapted socially inclusive STS framework for tech hubs in resource-poor environments.

A socially inclusive STS framework will ensure that no one is left behind in the tech hubs. The framework will ensure that tech hubs are aligned with the people's ambitions and achieve joint optimisation by producing digitally empowered youth who can pursue entrepreneurship or other digital careers. The socially inclusive STS also guides how tech hub processes must be governed. In addition elements like culture and the environment play a crucial role in shaping perspectives in poor environments and are considered in the proposed framework. Finally, under an inclusive STS framework, tech hubs can use bricolage to reach more people and be in a good position to demonstrate the transformative power of technology through digitally empowered youth.

6.5 Contributions of the study

This section presents the contributions to the body of knowledge the study on access and use of tech hubs in resource-constrained environments. The contributions made by this research are practical and contextual.

6.5.1 Practical contributions

The main research question was “What are the sociotechnical factors influencing access and use of digital technologies by youth in Diepsloot to enable social inclusion?” To address this question, this study employed the STS theory as conceptualised by Emery and Trist (1965) and the adapted version by Davis (2014). The STS theory was the analytical lens through which to understand the interconnectedness of the social and technological aspects in the adoption of technology in Diepsloot. As shown in the data, the combination of these aspects working symbiotically in poor environments produces digital empowerment, fulfilling the concept of joint optimisation.

6.5.2 Contextual contributions

This study contributes to the body of knowledge on the use of tech hubs in poor environments. Poor communities present a different dynamic when it comes to tech hubs.

Tech hubs are places of skills development before they are innovative and creative spaces for entrepreneurs. Secondly, tech hubs are escape places that open up new worlds for the underprivileged. Therefore understanding that in poor environments, the most dominant use of technology is skills development and that the revolutionary nature of the Internet is opening a passage into new worlds of possibilities for the youth is significantly beneficial to the body of knowledge.

6.5.3 Theoretical contributions

This study showed that the STS needs to be adapted when applied in the context of tech hubs operating in resource-constrained environments. The researcher presented an adapted socially inclusive STS framework that tech hubs can use as a blueprint.

6.6 Limitations of the study

Qualitative research is regarded as limited due to sometimes sample sizes being small, rendering the sample to not being fully representative of the larger population (Naidoo, 2015). The noteworthy limitation was that the researcher conducted interviews during Covid-19 pandemic and there were restrictions on the number of people allowed in the tech hubs at a given time. Online interviews were not possible as tech hubs could not anticipate in advance who would be coming into the hub or what time they came. Consequently, the researcher only interviewed face to face a sample of 18 people, evenly distributed between males and females. However, from these interviews the researcher was able to gather sufficient information on how the youth use technology in Diepsloot. The second limitation is that the researcher only did interviews at two tech hubs in Diepsloot. Other tech hubs in the area include SafeHub, which was closed due to the pandemic and school holidays and Riversands, which is not easily accessible to the residents of Diepsloot, as one requires traveling by car or taxi to get to. To overcome this limitation, the researcher made a point to use tech hubs that were open and easily within reach of the Diepsloot community.

6.7 Suggestions for Future Research

The important role played by the tech hubs in providing Internet access and digital skills training to the youth in Diepsloot cannot be underestimated. Suggestions for future research is a research that is conducted during the normal period post Covid-19 that considers the whole community, from learners in primary and high schools to pensioners to get a more comprehensive understanding of how everyone in Diepsloot benefits from the tech hub. Secondly, future research could delve deep into tech hub programs and ecosystems to ensure that digital skills training is comprehensively delivered at the foundational stage, so

that no one is left behind, and aligned to the 4IR realm of technologies to feed the country's digital skills pipeline.

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Annexure A – Ethical Clearance Certificate

SCHOOL OF Literature, Language and Media RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: SLLM-M20-08**
PROJECT TITLE	**Youth and tech hub perspectives on digital transformation in environments of poverty and unemployment: A study of Diepsloot youth**
INVESTIGATOR	Lorraine Matanda
SCHOOL/DEPARTMENT	SLLM/ICT Policy and Regulation
DATE CONSIDERED	Nov 2020
DECISION OF THE COMMITTEE	Approved

This ethical clearance is valid for 2 years and may be renewed upon application.

EXPIRY DATE	Date of submission of the project report

ISSUE DATE OF CERTIFICATE Feb 2021 **CHAIRPERSON**

Colleen Dawson

cc: Supervisor : Luci Abrahams

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethics committee.

I fully understand the conditions under which I am are authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

L Matanda
Signature

Date 9, 3, 2021

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Scanned with CamScanner

Annexure B – Request for permission to conduct research (two letters)

University of the Witwatersrand,
School of Humanities
Learning Information Networking Knowledge (LINK) Centre |
Tel: 011 717 1000

The Manager
Wot-if Trust
7184 Peach Road
Diepsloot
Johannesburg, 2189

4 September 2020

Dear Sir/Madam,

Re: Permission to conduct research at Wot-if Trust Diepsloot

My name is Lorraine Matanda. I am studying for a Master of Arts in the field of ICT Policy and Regulation in the School of Humanities at the University of the Witwatersrand. The title of my study is: Youth and tech hub perspectives on digital transformation in environments of poverty and unemployment: A study of Diepsloot youth.

I am seeking permission to do research at Wot-if Trust Diepsloot.

I am conducting research to find out how digital technologies are used in environments of poverty and unemployment. Despite government's efforts to develop and transform the lives of citizens, approximately half of South Africans remain poor and are offline with no access to the Internet. The gap in knowledge is that we do not know enough about how digital technologies are used in environments of poverty and unemployment, neither do we know the digital skills applied, nor the value and benefit users get from using digital technologies.

The aim of this research project is to find out how digital technologies are used in environments of poverty and unemployment using the case study of Diepsloot. This study seeks to investigate the digital transformation required to address poverty and unemployment by exploring available institutional infrastructure necessary to access the Internet. The study also seeks to gain insight into digital skills and the motivation to acquire digital competencies among the youth. Lastly, it seeks to investigate to what extent social policies promote the use of digital technologies to enable economic participation among the poor.

Wot-if Trust Diepsloot provides a physical and safe space where the youth can access the Internet, training and life-skills workshops. The research will entail collecting data from patrons of the tech hub to investigate how they use technology and how they find it beneficial to their

lives. In addition, I would also like to invite individuals from your organisation to participate in this study. These individuals are your employees who interact with the residents of Diepsloot when they come into the tech hub. This will help get their perspective on the use of digital technologies in environments of poverty and unemployment. If they agree, they will be interviewed for about 20 minutes during the day at the tech hub. The interviews will be recorded on audio.

Participants will be asked to give their written consent before the research begins. Their responses will be treated confidentially, and identities (their names and the name of the organisation) will be anonymous unless otherwise expressly indicated. Individual privacy will be maintained in all published and written data resulting from the study. The results will be communicated in the dissertation

The research participants will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study. All research data will be preserved anonymously for reuse by other researchers.

With respect to COVID-19, the researcher will follow national regulations, guidelines and protocols in the collection of data in line with the HREC non-medical guidelines. To ensure the protection of the researcher and that of the respondents from the risk of infection, the researcher will ensure that all parties involved wear masks. In addition, the researcher will ensure that all parties practice social distancing of at least a metre apart during the interview process. Lastly, the researcher will also request for the facility to provide sanitizers upon entry into the premise. If there are no sanitizers, the researcher will provide her own sanitizers. All the precautionary measures outlined above will be taken to ensure the safety of the researcher and of the respondents.

I therefore request permission in writing to conduct my research at your organisation. The permission letter should be on your organisation's headed paper, signed and dated, and specifically referring to myself by name and the title of my study.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

Lorraine Matanda
083 728 1195
1813095@students.wits.ac.za

Supervisor's details
Dr Lucienne Abrahams
082 569 7675
Luciennesa@gmail.com

University of the Witwatersrand,
School of Humanities
Learning Information Networking Knowledge (LINK) Centre
Tel: 011 717 1000

The Manager
Southern Africa Youth Project
6863 Peach Road
Diepsloot Ext 10
Diepsloot, 2189

25 August 2020

Dear Sir/Madam,

Re: Permission to conduct research at Southern Africa Youth Project

My name is Lorraine Matanda. I am studying for a Master of Arts in the field of ICT Policy and Regulation in the School of Humanities at the University of the Witwatersrand. I am seeking permission to do research at Southern Africa Youth Project
.

I am conducting research to find out how digital technologies are used in environments of poverty and unemployment. Despite government's efforts to develop and transform the lives of citizens, approximately half of South Africans remain poor and are offline with no access to the Internet. The gap in knowledge is that we do not know enough about how digital technologies are used in environments of poverty and unemployment, neither do we know the digital skills applied, nor the value and benefit users get from using digital technologies.

The aim of this research project is to find out how digital technologies are used in environments of poverty and unemployment using the case study of Diepsloot. This study seeks to investigate the digital transformation required to address poverty and unemployment by exploring available institutional infrastructure necessary to access the Internet. The study also seeks to gain insight into digital skills and the motivation to acquire digital competencies among the youth. Lastly, it seeks to investigate to what extent social policies promote the use of digital technologies to enable economic participation among the poor.

Riversands incubation Hub provides a physical and safe space where the youth can access the Internet, training and life-skills workshops. The research will entail collecting data from patrons of the tech hub to investigate how they use technology and how they find it beneficial

to their lives. In addition, I would also like to invite individuals from your organisation to participate in this study. These individuals are your employees who interact with the residents of Diepsloot when they come into the tech hub. This will help get their perspective on the use of digital technologies in environments of poverty and unemployment. If they agree, they will be interviewed for about 20 minutes during the day at the tech hub. The interviews will be recorded on audio.

Participants will be asked to give their written consent before the research begins. Their responses will be treated confidentially, and identities (their names and the name of the organisation) will be anonymous unless otherwise expressly indicated. Individual privacy will be maintained in all published and written data resulting from the study. The results will be communicated in the dissertation

The research participants will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study. All research data will be preserved anonymously for reuse by other researchers.

With respect to COVID-19, I will follow guidelines and protocols in the collection of data in line with the national regulations. To safeguard against the risk infection for myself and the respondents, I will ensure that all parties involved wear masks. In addition, I will ensure that all parties practice social distancing of at least a metre apart during the interview process. Lastly, I will ensure that I sanitize my hands upon entry into your premise. All the precautionary measures outlined above will be taken to ensure the safety of all parties involved in the research.

I therefore request permission in writing to conduct my research at your organisation. The permission letter should be on your organisation's headed paper, signed and dated, and specifically referring to myself by name and the title of my study.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

Lorraine Matanda
083 728 1195
1813095@students.wits.ac.za

Supervisor's details
Dr Lucienne Abrahams
082 569 7675
Luciennesa@gmail.com

Annexure C – Permission letters

Tel: + 27 (0) 11 071 1903
Email: info@southernafricayouth.org
www.southernafricayouth.org

Southern Africa Youth Project

Head Office: 6863 Peach Road,
Diepsloot Ext 10, Diepsloot, 2189

Non-Profit Organisation	Non-Profit Company	Section 18A Tax Exempt	SARS Income Tax	Central Supplier Database
193-165	2015/111519/08	930049785	9896925154	MAAA0005717

We implement community development projects all over South Africa and cross boarders
05 June

Confirmation to conduct research

Southern Africa Youth Project is a Youth development institution that strives to empower communities through up-skilling them to recognize and utilize the opportunities that are around them. Southern Africa Youth Project does this through Capacity Building to Unemployed Youth, Educational Support, Addressing issues of Gender Based Violence and Job placement.

I Clifford Legodi herewith give permission to Lorraine Matanda a student in studying masters at the University of Witwatersrand to conduct research at Southern Africa Youth Project.

I trust that the above is in order; should you require further information kindly contact us on the details provided.

Kind regards
Clifford Legodi
Southern Africa Youth Project
General Manager
011 071 1903/ 072 653 9834

Re: Research at Wot-If External Inbox ×

Palesa Wot-if? <palesa@wot-if.co.za> Fri, Jul 9, 2021, 1:03 PM

to me, Hellen

Hi Lorraine

Thank you for the draft.
I am confirming that you can come to conduct your interviews at the centre on Tuesday, 13 July 2021. You are welcome to come and work from the centre from 10h00 - 15h00. I will email you the confirmed time slots for the interviewees on Monday.

Kind Regards

wot-if? trust

THE INDEPENDENT CODE

Palesa Moreku

Programmes
The Wot-If? Trust
m: +27761920614
w: wot-if.co.za e: palesa@wot-if.co.za

On Thu, Jul 8, 2021 at 4:00 PM MATANDA, Lorraine <lorraine.matanda@airliquide.com> wrote:

> Hi Palesa
>
> Thanks for making the time to see me earlier today.
> As discussed here is a draft for the permission letter, you can edit as you see fit.
> Once you are happy with it you can copy it onto your letterhead and sign it so that I can proceed with the research.
>
> I look forward to our next interaction (on Tuesday:)

Annexure D – Consent to participate

Informed Consent Form
Diepsloot youth

Youth and tech hub perspective on digital transformation in environments of poverty and unemployment: A study of Diepsloot youth

This research seeks to understand how digital technologies are used by the youth in Diepsloot.

Name of researcher: Lorraine Matanda

I....., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous	YES	NO
I agree that the researcher may use anonymous quotes in her research report	YES	NO
I agree that the interview may be audio recorded	YES	NO
I agree that the information I provide may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	YES	NO

..... (signature)
..... (name of participant)
..... (date)

..... (signature)
..... (name of person seeking consent)
..... (date)

Annexure E – Participant information



Good day

My name is Lorraine Matanda and I am studying for a Master of Arts in the field of ICT Policy and Regulation in the School of Humanities at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating **Youth and tech hub perspectives on digital transformation in environments of poverty and unemployment: A study of Diepsloot youth**, under the supervision of Dr Lucienne Abrahams. The aim of this research project is to find out how digital technologies are used in environments of poverty and unemployment.

As part of this project, I would like to invite you to take part in an interview. This activity will involve one interview and will take around sixty minutes. With your permission, I would also like to record the interview using a digital device.

There will be no personal costs to you if you participate in this project, You will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. Any confidential information will not be disclosed to anyone else. The interview will be anonymous as I will not be asking for your name or any identifying information. I will be using a pseudonym (false name) to represent your participation in my final research report. If you experience any distress or discomfort at any point in this process, we will stop the interview or resume another time.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. With your permission the data collected from this research project may be used by other researchers. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely,
Lorraine Matanda

Researcher:
Lorraine Matanda,
1813095@students.wits.ac.za 083 728 1195

Supervisor:
Dr Lucienne Abrahams
luciennesa@gmail.com 082 569 7675

Annexure F – Interview questions

SEMI-STRUCTURED INTERVIEW GUIDE

Youth and tech hub perspectives on digital transformation in resource-constrained environments and unemployment: A study of Diepsloot youth

Group 1: Diepsloot youth

General social questions

- Why do you visit the tech hub?
- What kind of activities do you mostly engage in when you visit the tech hub?
- Why do you mostly engage in the activities you just mentioned above?
- How often do you come to the tech hub?
- How long do you stay in the tech hub at a time?

Institutional infrastructure

- Why is accessing the Internet at the tech hub important to you?
- In what ways do you benefit from using the Internet at the tech hub?
- How has the tech hub supported you in learning to use the Internet?
- What are the online opportunities that you have been exposed to?

Elements for addressing social inclusion
Physical Accass- computers and connectivity

- How easy is it to find a free computer to use at the tech hub?
- Is the internet always available?
- What about the speed of the Internet, does it enable you to do what you want to do?

Digital Access

- To what extent do you think that the free Internet access enables you to do what you want to do at the tech hub?
- To what extent do you understand the content displayed on the websites you visit?
- Do you think it would be easier to understand if the content was in another language, like your home language?

Social Resources

- When you need help with using the nternet or accesing digital technologies, who do you call on to assist you?
- Are there groups of people with whom you can connect and ask questions related to digital technologies?

Human resources

- What is your level of education?
- How would you describe you reading, writing, thinking skills when using the Internet?

- To what extent do you think by using the Internet at the tech hub, you are able to apply your skills and achieve your goals?

21st century digital skills (core skills and contextual skills)
What are your core digital skills? C*ore skills are fundamental for performing tasks that are necessary in a broad range of occupations. These skills are technical, information management, communication, collaboration, creativity, critical thinking and problem solving.*

Scale of 1-10 (with 1 being the lowest and 10 the highest)

Technical - The skills to use devices and apps to accomplish practical tasks.

a. To what extent do you understand the characteristics of a device (computer/laptop/tablet)?

1	2	3	4	5	6	7	8	9	10

b. To what extent can you log into a device and access online content?

1	2	3	4	5	6	7	8	9	10

c. To what extent do you lose orientation when navigating online?

1	2	3	4	5	6	7	8	9	10

Information management - The skills to use ICT to efficiently search, select, organize information to make informed decisions about the most suitable sources of information for a given task.

a. To what extent can you formulate a statement for the search of information online?

1	2	3	4	5	6	7	8	9	10

b. To what extent do you use the Internet to find and retrieve information from a variety of online sources?

1	2	3	4	5	6	7	8	9	10

c. To what extent do you use the Internet to judge the usefulness and sufficiency of information for a specific purpose?

1	2	3	4	5	6	7	8	9	10

d. To what extent do you use the Internet to organize information so you can find it later.

1	2	3	4	5	6	7	8	9	10

Communication - The skills to use ICT to transmit information to others, ensuring that the meaning is expressed effectively.

a. To what extent do you have the skills to use the Internet to send information to others?

1	2	3	4	5	6	7	8	9	10

b. To what extent do you use the Internet to communicate information and ideas effectively to multiple audiences?

1	2	3	4	5	6	7	8	9	10

Collaboration - The skills to use the Internet to develop a social network and work in a team to exchange information, negotiate agreements, and make decisions towards achieving a common goal.

a. To what extent do you use the Internet to develop a social network and exchange information, negotiate agreements, and make decisions as a team towards achieving a common goal?

1	2	3	4	5	6	7	8	9	10

b. To what extent do you use the Internet to gather and share ideas (e.g. on online platforms)?

1	2	3	4	5	6	7	8	9	10

Creativity: The skills to use ICT to generate new or treat familiar ideas in a new way and transform such ideas into a product, service or process that is recognized as novel within a particular domain.

a. To what extent do you use the Internet and the tech hub to generate ideas and develop new ways of doing things?

1	2	3	4	5	6	7	8	9	10

Critical thinking: The skills to use ICT to make informed judgements and choices about obtained information and communication using reflective reasoning and sufficient evidence to support the claims.

a. To what extent do you use the Internet to ask and answer questions related to a particular problem?

1	2	3	4	5	6	7	8	9	10

b. To what extent do you use the Internet to judge the suitability of a source for a particular problem?

1	2	3	4	5	6	7	8	9	10

c. To what extent do you use the Internet to link facts, ideas and notions?

1	2	3	4	5	6	7	8	9	10

Problem solving - The skills to use ICT to cognitively process and understand a problem situation?

a. To what extent do you use the Internet to acquire knowledge about a specific problem?

1	2	3	4	5	6	7	8	9	10

b. To what extent do you use the Internet to apply knowledge about the problem to find a solution?

1	2	3	4	5	6	7	8	9	10

What are your contextual digital skills? *Contextual skills are those skills that are required to take advantage of the core skills and, therefore, must be connected to such core skills.*

Ethical awareness - The skills to behave in a socially responsible way, demonstrating awareness and knowledge of legal and ethical aspects when using ICT.

a. To what extent do you understand the potential risks that exist on the Internet e.g. identity theft?

1	2	3	4	5	6	7	8	9	10

b. To what extent do you understand the impact of the Internet on the way people live?

1	2	3	4	5	6	7	8	9	10

Cross-cultural communication: attitudes towards online communication and collaboration experiences with people from different cultures when using ICT.

a. To what extent do you understand other people and respect their cultures when using the Internet?

1	2	3	4	5	6	7	8	9	10

Flexibility: The skills to adapt one's thinking, attitude or behaviour to changing ICT environments.

a. To what extent have you adjusted your attitude to the new tech hub environment?

1	2	3	4	5	6	7	8	9	10

Self-direction: The skills to set goals for yourself and manage progression toward reaching those goals in order to assess your own progress when using ICT.

a. To what extent have you set goals for yourself on learning new technologies?

1	2	3	4	5	6	7	8	9	10

b. To what extent have you taken control of your own learning the Internet?

1	2	3	4	5	6	7	8	9	10

c. To what extent have you proactively taken steps to make decisions when using the Internet?

1	2	3	4	5	6	7	8	9	10

d. To what extent have you monitored your progress to determine whether previously-set goals have been met when using the Internet ?

1	2	3	4	5	6	7	8	9	10

Lifelong learning: The skills to constantly explore new opportunities when using ICT that can be integrated into an environment to continually improve one's capabilities.

a. To what extent have you learnt new skills to constantly explore new ICT opportunities that can be integrated to continually improve your livelihood?

1	2	3	4	5	6	7	8	9	10

b. To what extent do you use the Internet to create useful knowledge for yourself?

1	2	3	4	5	6	7	8	9	10

Motivation to acquire digital skills

To what extent do you see yourself learning new skills to use the Internet more optimally?

1	2	3	4	5	6	7	8	9	10

Why would you learn new digital skills/Why would you not learn new digital skills?

Demographic questions

- What is your gender? M /F
- What is your age?
- What is your education level?
- What is your income level?