DEPARTMENT OF SOCIAL DEVELOPMENT

MINOR DISSERTATION

Assessing the preparedness of the schooling system for The Fourth Industrial Revolution: The case study of two secondary schools in the Ekurhuleni South Education District

Submitted in partial fulfilment for the degree of Master in Social Science Specialising in Social Development

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ABSTRACT

Research indicates that South African teachers do not understand the use of technology for teaching and learning, the benefits associated with it, and classrooms are not designed to support technology-integrated teaching (Skhephe, Caga and Boadzo, 2020). Furthermore, access to technology for education seems to be limited and unequal across the nine provinces and different school quintiles (Meyer and Gent, 2016 in Kayembe and Nel, 2019). Despite this, the World Economic Forum predicts that approximately 65% of children presently starting school will have jobs in the future that do not exist yet (Soler & Dadlani, 2020). These jobs will require specific skills and knowledge that are consistent with the rapid advances in technology. However, it is unclear if, and how the current South African schooling system is equipping learners with the skills required for future jobs. The purpose of this qualitative study was to assess the preparedness of schools for the Fourth Industrial Revolution (4IR) in the Ekurhuleni South Education District, in Gauteng Province. The study had four main objectives: to investigate how the 4IR is understood by teachers, learners and the Institutional Development and Support Official (IDSO) in the Ekurhuleni South Education District; to determine what the perceptions and experiences of teachers and the IDSO are on the preparedness of secondary schools in the Ekurhuleni South Education District for teaching in the 4IR; to find out what learners' experiences are of schooling in the 4IR; and to ascertain how learners perceive their schooling experiences to help them after school.

This study employed a qualitative research approach to explore how the schools' preparedness for schooling in the 4IR is perceived and experienced by the participants. Twenty individual in-depth interviews were conducted with grade 12 learners. Additionally, seven key informant interviews were conducted with four secondary school teachers, two principals and one IDSO from the Ekurhuleni South Education District. Participants were selected through purposive and snowball sampling. Online interviews were conducted to adhere to COVID-19 health regulations. However, where learners did not have devices, in-person interviews were conducted.

The findings revealed that grade 12 learners were not aware of the 4IR as a concept but had some knowledge of 4IR-related technologies including automation and robotics. Learners described their schooling experiences during 4IR as consisting of various personal and structural challenges. They reported on mostly using smartboards in the classroom but described several challenges with using the technology, such as issues related to power outages and lack of internet connectivity. Teachers described the 4IR in terms of fast and easy access

to resources, people and information. They highlighted the advantage of using technology in terms of making lessons more interesting and interactive. Teachers also emphasised that the theft of devices and lack of training impacts on how effectively they use the technology. The principals reported that some teachers still showed resistance to using technology for teaching. They further reported that the schools did not offer any 4IR-related or basic information and communications technology (ICT) subjects and that current curricula was not aligned with the 4IR. The IDSO reported on the implementation of a twinning process of one of the schools, in an effort to facilitate the integration of ICT in the school. The IDSO also appraised the schools as not yet ready for teaching and learning of the 4IR. The lack of technology and other resources and infrastructure at the schools, lack of training and support for teachers, as well as the absence of 4IR subjects and curricula, reveal that the schools in this study are not prepared for schooling in the 4IR.

Recommendations are made to the Gauteng Department of Education to offer better technology training and support to teachers. The schools and district office are encouraged to put measures in place to better protect devices and infrastructure from damage and theft. Recommendations for further research are also offered.

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CHAPTER ONE:
INTRODUCTION

1.1. INTRODUCTION

This chapter begins with a presentation of the statement of the problem by providing the background to the phenomenon under study. It then outlines the significance of the study and how the findings might be useful. Next, the research questions and objectives are presented, followed by the clarification of terms pertaining to this study. The chapter ends with a presentation on the ethical principles adhered to in this study.

1.2. STATEMENT OF THE PROBLEM

During and indeed before apartheid, schooling in South Africa was racially segregated whereby white children were prioritised, and African children largely excluded. From 1950 onwards, White, Coloured, Indian, and African children had separate schooling systems with differential funding and curriculum design (Lam, Ardington and Leibbrandt, 2011). The main aim was to uphold white superiority and control of the economy and the state. The Promotion of Bantu Self-government Act of 1959 inaugurated the establishment of the six Bantustans where Africans were supposed to exercise their political rights (Chisholm, 2012). The 1960s saw the continuation of Bantustans which systematically removed Africans from urban areas. These Bantustans had their own education departments and were separately financed and staffed but were still regulated from the country's capital (Lissoni and Ally, 2018). The Bantustans also had teacher training colleges and universities to supply teachers and administrators to the system. During this time, education for Africans was vastly underfunded compared to education for other races. As a result there was a huge outcry and protest action against the apartheid regime, as seen in the case of the Sharpeville Massacre in 1960.

Between 1962 and 1971 political opposition was essentially restricted and as a result, the number of Africans enrolling in secondary school was also obstructed. However, from 1973 when South Africa was severely affected by nation-wide protests and the plunging oil price, secondary school admissions again began to rise (Chisholm, 2012). Secondary schools in urban areas were severely under-resourced. Accordingly, the 1976 Soweto uprising was not only against Afrikaans-medium instruction but also against inadequate resources and the rising numbers of learners demanding secondary school education. There was also pressure from industry on the South African government to meet its needs for skilled labour in urban areas (Chisholm, 2012).

Pressure to end apartheid intensified through the 1980s while schools continued to be poorly resourced. Township schools in particular, were extremely overcrowded (Chisholm, 2012). By the end of apartheid in 1994, huge inequalities in educational provision coupled with high levels of poverty, resulted in deeply entrenched differences between educational provision for black and white children in terms of infrastructure, school resourcing, teacher quality as well as post-school opportunities (Chisholm, 2012). Further confounding the issue, educational changes between 1994-2009 happened within financial constraints. This meant that infrastructure spending for schools was curbed to support social service spending. Significant progress was made in terms of South Africa's high unemployment rate up until 2008, however inequality has remained a key characteristic of society (Chisholm, 2012). Arguably, budget constraints, capacity challenges at a provincial level, corruption and unequal household income all contribute to reproducing inequality in the schooling system. Part of government's pro-poor policies was the institution of no-fee schools for low-income communities, with approximately 70% of public schools being no-fee schools (Sayed and Motala, 2012). Unfortunately, disparities persist in learning and teaching resources, infrastructure backlogs, and learning outcomes. Chisholm (2012) points out that many teachers trained during apartheid have struggled to adjust to the demands of new curriculum introduced after 1994. The poor performance of the schooling system has also been widely blamed for the deficit in high-level skills. According to the 2019 Trends in International Mathematics and Science Study (TIMSS) educators now largely have the necessary subject knowledge and experience to teach mathematics and science. However, the poor quality of learning outcomes for these subjects persist (Reddy et al, 2019),

The persistent legacy of extreme inequality in education during apartheid partly explains the poor performance of the South African schooling system today. While government spending was equalised across schools after apartheid, large disparities in learner progress through school and eventual educational achievement has remained (Lam, Ardington and Leibbrandt, 2011). Additionally, while there is more freedom to choose which schools to attend, most black children are still in schools with poor educational infrastructure (Ndimande, 2016). Furthermore, factors such as high teacher absenteeism, overcrowding and poor administration create disorderly school environments (Hoadley, 2007 in Lam, Ardington and Leibbrandt, 2011).

During the 1990s, approaches to technological change in schools were characterised by 1) Large investments of public budgets to ensure universal access to technology in schools; and 2) Extensive public research exercises that created prominent examples of the uses of technologies for advanced teaching practices (Halverson and Smith, 2009). In the US for example, approximately $8 billion was invested in educational technology between 1995 and 2000 by the federal government alone

(Halverson and Smith, 2009). Accordingly, large amounts were spent on computers, internet access and other digital technologies for public schools. There were also various projects aimed at developing innovative, technology-based curricular resources and opportunities for teachers' professional development (Halverson and Smith, 2009). However, Cuban (2001 in Halverson and Smith, 2009) argued that traditional teaching and learning practices persisted in spite of these investments. The advent of more advanced technologies of the Fourth Industrial Revolution has since changed this in many countries – particularly in advanced and emerging economies across the world.

Globally, the Fourth Industrial Revolution (hereafter 4IR) is characterised by rapid technological advancement in many sectors and areas of human endeavour. It is predicted to lead to widespread unemployment as many jobs become redundant due to automation, etc. (Bazić, 2017). This has led many countries to begin to prepare for such a period. These countries have chosen schooling as a tool for helping their citizens ready themselves for the 4IR (Uleanya and Ke, 2019). For example, schooling in advanced economies like the United States and the United Kingdom emphasize digitalization, cyberization and artificial intelligence. Similarly, Asian countries have introduced different subjects and initiatives at school level to help prepare learners for the 4IR. Some of these initiatives include Integrated Practical Activities in China, Life wide learning in Hong Kong and Integrative Activity in Taiwan (Voogt, Erstad, Dede and Mishra, 2013). However, in African countries the integration of technology in schooling is said to be lagging behind. For example, in Nigeria most teachers neither use technology for teaching, nor incorporate technology into the curriculum (Agbo, 2015). Similarly, in South Africa teachers are not trained in e-learning and the benefits associated with it, nor are classrooms designed to support e-learning (Skhephe, Caga and Boadzo, 2020). Access to technology appears to be limited and unequal across the nine provinces and different school quintiles (Meyer and Gent, 2016 in Kayembe and Nel, 2019). It is in this context that this research study takes place.

The World Economic Forum expects that about 65% of children starting primary school today will have jobs in the future that do not yet exist (Soler & Dadlani, 2020). These jobs will require specific skills that are aligned with the rapid advances in technology. However, it is unclear in what ways the current South African schooling system is equipping learners with the skills needed for the 4IR. Given this broad context of schooling in South Africa and the challenges that persist, this study aims to assess the ways in which secondary schools in the Ekurhuleni South Education District are prepared for teaching and learning in the 4IR.

1.3. RATIONALE AND SIGNIFICANCE OF THE STUDY

Data for the study was obtained from black and coloured[1] secondary school learners, teachers and an official from the Ekurhuleni South Education District Office, in order to ascertain how they understand the 4IR. The findings are useful for four reasons. First, gaps in the literature indicate that there is little known about the topic in the South African context, in particular with respect to township and rural communities. Therefore, the findings highlight what is known about the 4IR in these contexts and what the experiences of learners are who are undergoing secondary education during this period. Second, teaching practices, curriculum design, infrastructure and resource allocation may be strengthened based on these findings. This will facilitate the empowerment of learners for life and work in the 4IR upon completion of their schooling careers.

Third, the findings are useful for informing education policies, such as the White Paper on e-Education, 2004. The policy aims to integrate information and communications technologies (hereafter ICTs) into education in South Africa in order to capacitate youth with the necessary skills for work in the 21st Century, so that they can contribute to national social and economic development. The findings may be useful for informing policies like this on the current state of affairs of ICTs in marginalized schools, and how best these schools could be supported so that they are able to implement these policies. Finally, the findings are useful for informing civil society organisations and the social responsibility activities of businesses that work in marginalized communities. Organisations like Afrika Tikkun, Code for Change and the Siyakhula Computer School (none of which work in the community where this study was conducted, but in areas that are similar such as Diepsloot and Ivory Park) that work to end child poverty and youth unemployment, teach coding skills and digital entrepreneurship in secondary schools and aim to eliminate computer illiteracy, can all benefit from the findings of this study. Based on these findings, organisations like these may be able to direct their resources in order to better support technology infrastructure and skills development projects in communities similar to this study site.

1.4. RESEARCH TOPIC

Assessing the preparedness of the schooling system for the Fourth Industrial Revolution: the case study of two secondary schools in the Ekurhuleni South Education District.

1.5. MAIN RESEARCH QUESTIONS

[1] The term coloured is used in this study not as an exclusionary characterization but as an official classification of a racial group in South Africa. It refers to a person of mixed racial heritage rather than one who is black (Adhikari, 2013).

How prepared are secondary schools in the Ekurhuleni South Education District for schooling in the 4IR? In particular:

1.5.1. How is the 4IR understood by teachers, learners and the Institutional Development and Support Official (IDSO) in the Ekurhuleni South Education District?

1.5.2. What are the perceptions and experiences of teachers and the IDSO on the preparedness of secondary schools in Ekurhuleni South Education District for teaching during the 4IR?

1.5.3. What are learners' experiences of schooling in the 4IR?

1.5.4. How do learners perceive their schooling experiences to help them after school?

1.6. RESEARCH OBJECTIVES

1.6.1. To investigate how the 4IR is understood by teachers, learners and the IDSO in the Ekurhuleni South Education District.

1.6.2. To determine what the perceptions and experiences of teachers and the IDSO are on the preparedness of secondary schools in Ekurhuleni South Education District for teaching in the 4IR.

1.6.3. To find out what learners' experiences are of schooling in the 4IR.

1.6.4. To ascertain how learners perceive their schooling experiences to help them after school.

1.7. MAIN ASSUMPTIONS

The main assumption of this study was that research participants would provide varying perspectives on the research topic that would ultimately answer the research questions.

1.8. CLARIFICATION OF TERMS

1.8.1. Youth

In South Africa, a person aged 14-35 years is a youth (National Youth Development Agency Act, 2008). However, in this study youth denotes to a person aged 17-18 years as the learners in this study are in their final year of secondary school.

1.8.2. Schooling

Schooling refers to a formal mode of educating children in pre-schools, primary and secondary schools which includes teachers instructing learners in an official curriculum comprised of distinct subjects (Gobby and Millei, 2017). In this study the focus is only on secondary schools.

1.8.3. Capabilities

Capabilities refer to what people are able to be and do (Nussbaum, 2003).

1.8.4. Social Exclusion

Social exclusion denotes a variety of social problems that are characteristic of individuals, families, groups and communities that experience various deprivations. It is the experience of being marginalized from the social, economic and moral mainstream (Macdonald, 2008).

1.8.5. Status Attainment

Status attainment is the processes by which the social status of origin later becomes the social status of an individual (Schoon, 2008 cited in Lui et al., 2014).

1.8.6. Fourth Industrial Revolution

The Fourth Industrial Revolution (4IR) denotes an era of rapid technological advancement that combines hardware, software, biology and advanced communication and connectivity (Schwab, 2016). It is marked by breakthroughs in, among others, robotics, artificial intelligence, nanotechnology, 3D printing, autonomous vehicles and 5G wireless connectivity (Schwab, 2016).

1.9. ETHICAL CONSIDERATIONS

Ethical standards in research are the rules for the most appropriate behaviour towards research participants, fellow researchers, sponsors and other stakeholders (De Vos et al., 2011). The following ethical principles were applicable to this study:

1.9.1. Avoidance of Harm

Avoidance of harm refers to the deterrence of any physical or emotional harm to research participants (Babbie and Mouton, 2001). In this study, physical harm did not arise. However, some questions may have caused emotional harm to participants, such as the sharing of sensitive details about their socio-economic information and past traumas. To limit potential emotional harm to participants, they were made aware of the possibility that some questions might cause emotional discomfort. Participants were reminded of their right to choose what information to share with the researcher, in that way they could abstain from answering questions that may have brought them discomfort. The researcher also debriefed participants immediately after the interview, so that they were able to work through any possible impact from the study.

1.9.2. Informed Consent

Besides obtaining permission from participants, it is also important for them to know what exactly they are agreeing to participate in so that they can make informed decisions (Neuman, 1994). The researcher verbally explained the study to participants. Each participant was required to sign a written assent form which explained the purpose and aims of the study, as well as the participant's right to withdraw from the research at any point. The researcher obtained permission from the schools to conduct research, as well as consent from the parents or caregivers of participants under 18 years.

1.9.3. Deception of Respondents

Deception of research participants refers to misleading participants or deliberately misrepresenting facts about the purpose of the study, the identity and affiliation of the researcher as well as concealment of information in order to secure participation (De Vos et al., 2011). In order to prevent deception of participants, the researcher used simple language that was clear and easily understood when explaining the purpose of the study, as well as throughout the study. Any unintentional deception was remedied during the debriefing of participant, which occurred immediately after the research interview.

1.9.4. Privacy

Privacy is defined as the right to choose not to share any information which is not intended for the knowledge of others (De Vos et al., 2011). To protect the privacy of participants in this study, the researcher explained at the outset that participants have the right to choose what information about themselves they wished to disclose. In the case of remote interviews, the researcher ensured that she was in a closed space and wearing headphones so that participants' responses were only audible to herself. Participants were also asked to ensure, as far as possible, that they were alone in the room for the duration of the interview. Face-to-face interviews were conducted in a closed room while observing covid-19 health and safety regulations. Only the researcher has access to audio files, field notes and transcriptions.

1.9.5. Anonymity

Anonymity in research denotes concealing participants' identities so that a given response cannot be linked to a specific participant (Babbie and Mouton, 2001). In this research participants' names were replaced with pseudonyms during the transcription process. Consent and assent forms were stored safely to protect the identity of participants. The names of the schools were also changed to School A and School B, respectively.

1.9.6. Confidentiality

Confidentiality is about the treatment of data in a confidential manner (De Vos et al., 2011). This means that the researcher does not share any of the participants' identifying details nor what they say in an interview with other people. For remote interviews, the researcher used her own personal devices for data collection. The devices are password protected and not used by anyone else. Face-to-face interviews were conducted in a closed room while observing covid-19 health and safety regulations. Where interruptions occurred, the conversation and recording were paused. Audio files, field notes and transcriptions were anonymized and stored on password protected devices only accessible to the researcher.

1.9.7. Voluntary Participation

In social research, participation should at all times be voluntary and participants should not be obligated to participate (De Vos et al., 2011). In this study, the researcher informed participants of their right to withdraw from the study at the outset of the research interview. They were also notified that no harm would come to them if they withdrew.

1.9.8. Debriefing Respondents

Debriefing is the process after the conclusion of a research project during which participants have the chance to process their experience of the research interview and the potential effects that the study may have had on them (De Vos et al., 2011). In this study, participants were debriefed by the researcher immediately after the research interview. Participants were also made aware of the community clinic for further assistance if required.

1.9.9. Publication of Findings

The publication of research findings relates to the correct reporting of all findings (De Vos et al., 2011). It also involves not falsifying research data (Babbie and Mouton, 2001). In this study a final report was written as a requirement for the fulfilment of the master's degree in social development. Participants were also informed of the academic requirement of this study.

1.9.10. Corporation with Contributors

The contributors in social research are usually the researcher's associates and students who contribute to the research process (De Vos et al., 2011). In this study, the contributors to the study were the research supervisor who was responsible for guiding and assessing the academic

component of the study, stakeholders in the education sector and the research participants themselves.

1.10. CONCLUSION

This chapter introduced the study by way of contextualizing the research topic. Key concepts and ethical principles relevant to this study were also clarified. The following chapter reviews the existing literature on the topic.

CHAPTER TWO:
LITERATURE REVIEW

2.1. INTRODUCTION

This chapter starts with a review of the literature on schooling in the context of the 4IR. A detailed review of earlier studies on schooling, 4IR and ICT integration in schooling is presented. A discussion of the theoretical frameworks that inform this study is presented next. Lastly, a discussion of the policies on schooling, the 4IR and ICT integration in schooling is offered.

2.2. REVIEW OF LITERATURE

2.2.1. Conceptualising the Fourth Industrial Revolution

The Fourth Industrial Revolution (4IR) is expected to drastically impact society in multiple ways. This industrial revolution is a continuation of the Third, the digital revolution, that has been taking place since the middle of the last century (Schwab, 2016). The 4IR is typified by a blending of technologies that are distorting the lines between the physical, digital, and biological spheres (Schwab, 2016). In other words, the 4IR brings with it various technologies which include automation, robotics, artificial intelligence (AI) and the internet of things (IoT) to be used in business, government, social institutions and every day life.

Various literature attempts to define what exactly the 4IR is and to explore its accompanying effects on society. For example, Roblek, Mesko and Krapez (2016) examined the known theory and practice of the 4IR and its resulting changes. They found that IoT technology aids the creation of completely new services, products, and business models that guarantee gains in virtually all industries. Similarly, in their analysis of how to respond to the 4IR, Lee et al (2018) define the 4IR in terms of the Second Information Technology Revolution which brings with it technological disruptions, the internet of things, super disruptive innovation and broad changes in industries and societies. Likewise, Kreuger (2018) defines the 4IR as a period of exponential change, with the rise of AI, robotics, 3D printing and digital computing. Morrar, Arman and Mousa (2017) describe the 4IR as being built on the previous technological transformations: steam power of the nineteenth century, electricity which transformed the twentieth century, and the era of computers which began in the 1970s. However, the authors state that the effects of 4IR will be more rapid, profound and irreversible than its preceding counterparts (Morrar, Arman and, 2017). These studies understand the 4IR as an era or context of building on the previous advances in technology, but also innovating completely new technologies that will be used to connect people to objects, objects to the internet,

and objects to one another. These innovations are expected to bring more efficiency to all industries, especially production and manufacturing.

The above-mentioned literature shows how the 4IR is understood, what it entails and the kinds of changes expected from the 4IR regarding business, in particular. However, the 4IR is also expected to impact other sectors of society such as education.

2.2.2. Opportunities and threats offered by the Fourth Industrial Revolution for education

Education is often thought of as the first step to any meaningful human action (Farooq et al., 2011). Access to education represents the chance to gain skills and knowledge that enables people to improve their quality of life. Education has become progressively important with the introduction of technology. Findings from several studies (Bazić, 2017; Krueger, 2018; Naude, 2017; Hirschi, 2017; Nordin and Norman, 2018) show both the kinds of opportunities and the threats offered to education by technological advances. For instance, Bazić (2017) aimed to identify and describe the basic factors of technological change in society and education. They found that innovations create the need for new professions that put pressure on educational systems but also inspire significant changes within the educational process. For example, the radical restructuring of the market due to 4IR may lead to redundancies of certain skills, jobs and professions. The schooling system, therefore, needs to equip young people with the appropriate skills and knowledge for life and work in the 4IR. Similarly, in addressing what the implications of this era are for the skills needed to succeed over the next two decades, Krueger (2018) asserts that a learning environment should enable learners to create their own personalized path, enabling creativity and collaboration, and allowing them to be critical thinkers. These are some of the critical skills needed during the 4IR (Naude, 2017; Hirschi, 2017; Nordin and Norman, 2018). Furthermore, in their comparative study to investigate the role of education in earning foreign income in the 4IR, Alam, Forhad and Ismail (2020) found that education strategically contributes to economic renewal of both developed and developing countries. These authors conclude that while technological advances and the changing nature of work put pressure on education systems, they also offer the opportunity for education systems and processes to change. These changes include the increased emphasis on the learning process and approaches to stimulate creative and critical thinking needed for new jobs in the 4IR.

However, when exploring the improvements in open and distance learning in developing nations, and the question of whether these advances are addressing the educational gaps, Gulati (2008) found

that a lack of resources and infrastructure, socio-economic and political conditions in developing countries contribute to educational gaps. In addition, Gulati (2008) found that the urban-rural divide in developing nations could contribute to increasing inequalities in education. Adeosun (2010) found similar results when examining Nigeria's policies and efforts for ICT in education. These findings indicate that primary school learners do not have adequate access to computers, with only 29.8 per cent of teachers actually teaching computer skills, and that the number of computers in schools vary. There is an opportunity here for increased training and support of teachers, in conjunction with improved resources and infrastructure at schools. Thus, governments need to play a bigger role in strengthening the capacities of teachers and learners.

The opportunities presented by the 4IR for education and schooling in particular, also relate to the advantages of using technologies for schooling. For example, Merchant (2012) presents a literature review on the use of mobile phones in the classrooms. The author argues that cell phones, like other technologies, can easily disturb the ecology of classroom life. According to Merchant, new digital practices can have a disrupting effect, in that they provide possibilities for different kinds of learning relationships, different kinds of interaction and different genres and communicative purposes. The author reports that schools such as Notre Dame High School in Sheffield, England, use cell phones in several ways such as making visual notes; searching for information; accessing material on the virtual learning environment (VLE); and for scheduling submission and exam dates. The author also asserts that mobiles may be used for educational purposes including photographing notes, video, voice, image responses to learning tasks, and organising learning.

Another study, conducted by Kaya and Balta (2016) examined the attitudes of 146 English language learners from a preparatory school in Turkey towards using Socrative – a smart response system that enables teachers to assess learners and provide feedback in real-time. The findings reveal that students agree or strongly agree that the response system improved their engagement, pointed out gaps in their knowledge, made lessons more interactive, helped teachers understand where learners had difficulty, helped their understanding of course material and was very easy to use. However, some of the disadvantages reported by learners included technical issues, such as memory capacity of smartphones, the distractions characteristic of smartphone use, and the fact that not everyone has a smartphone or other electronic device. Similarly, Wakil, Qaisar and Mohammed (2017) studied the role of technology in the classroom for learning. Their quantitative study of 32 primary school learners in Iraq found that learners in technology-enhanced classroom performed better than those

in traditional classrooms. Learners taught and tested in technology-enhanced classrooms achieved higher pass rates (87.5%) and grade point averages per student (83.3%). Also, most learners preferred a technology-enhanced classroom to a traditional classroom and reported learning better in the former.

Srivastava (2018) presents a conceptual discussion to define e-education or e-learning and to discuss some of its advantages and disadvantages. The author posits that e-learning is any learning that involves the internet/intranet; anything delivered, enabled, mediated by electronic technology for the purpose of learning. Some advantages of technology integration in schooling is convenience and flexibility in that content can be accessed at any time and does not require learners to be physically present. Learners are also able to access up-to-date teaching and learning materials as e-learning material can be updated more frequently than traditional print materials. Furthermore, in Shatri's (2020) quantitative study to investigate the impact of using information technology for teaching, they reported various advantages and disadvantages of using technology for learning. Over 80% of learners reported using the internet and benefitting from its many advantages, especially in acquiring new information and communicating with people, as well as being more efficient. However, other learners reported that information technology affects their concentration in class and consumes a significant amount of time.

These studies indicate some of the clear disadvantages to education presented by technological advances, which include the lack of infrastructure and human resources necessary to integrate these technologies in specifically, education and schooling. This poses a threat not only to educational outcomes of learners but also to increasing social inequalities in the long-term. The literature also presents the many advantages of integrating technology in schooling and highlights the ways in which these could and should be exploited in the schooling system in order to offer schooling for the 21st century.

There are additional aspects pertaining to schooling in the 4IR. These include teaching practices and approaches, as well as teachers' attitudes towards technology.

2.2.3. How teaching and learning need to adapt to the Fourth Industrial Revolution

Curriculum content and subjects

Teaching and learning in the 4IR is affected by the changes in technology in order to prepare youth to function in the 4IR. Sanders (2012) argues for integrated Science, Technology, Engineering and Mathematics (STEM) education, rather than S, T, E, M education. In other words, in order to be comprehensive, the science, technology, engineering and technology components should be combined and integrated into school curricula as opposed to fragmented. Several studies (Uleanya and Ke, 2019; Skhephe, Caga and Boadzo, 2020; Arek-Bawa and Reddy, 2020) cite the need for curriculum content and teaching practices to change. For example, Uleanya and Ke (2019) explored the readiness of African nations in relation to formal education in the 4IR. They indicate that the African continent is underdeveloped and unprepared for the 4IR and this is shown in curricula guiding education practiced in Africa. The authors assert that Africa is still grappling with the Third Industrial Revolution. That is, computer and communications technology development and practice has not yet been successfully achieved in many African countries. Moreover, African curricula are preoccupied with issues of decoloniality and decolonization[2].

A study carried out by Skhephe, Caga and Boadzo (2020) explored the readiness of accounting teachers to implement e-learning in their classrooms during the 4IR, in schools in the Eastern Cape province of South Africa. They found that teachers did not understand their roles and responsibilities in implementing e-learning. In addition, accounting teachers did not understand e-learning, or the benefits associated with an e-learning classroom. Over and above this, according to this study, accounting classrooms are not designed in a way that supports e-learning. Similarly, Arek-Bawa and Reddy (2020) conducted a qualitative study to determine the extent to which academics in Kwa-Zulu Natal have merged digital and technological skills with traditional commerce education knowledge. They found that teachers are expected to have technological and digital skills to be able to work in the 4IR classroom. However, there is no component of the module outcome targeting the development of technological and digital skills in students, stipulated in the module templates. The ramifications of this are evident in the realm of teaching and learning, which are expected to be conducted virtually in the era of the covid-19 pandemic. These studies show that both curriculum content, teaching practices and infrastructure are out of touch with the developments of the 4IR.

[2] For these authors, decoloniality refers to exposing colonial power structures masked as globalization, modernity and apartheid; while decolonization entails challenging colonial institutions, policies, beliefs and structures, etc. in order to safeguard the survival of indigenous communities, beliefs and cultures (Uleanya and Ke, 2019).

This will affect the preparedness of youth for work in the 4IR and by extension, the quality of life they are able to experience.

Teachers' attitudes towards technology

Another aspect of the preparedness of developing countries for schooling in the 4IR, is the attitude of teachers towards technology use in the classroom. An and Reigeluth (2012) explored K–12 teachers' perceptions, barriers, and support needs in the context of creating technology-enhanced, learner-centred classrooms in Texas and Kansas in the United States. They found that teachers believed that technology played an important role in teaching and learning, it helped students learn and enabled teachers to do tasks more effectively and efficiently. K-12 teachers in this study support the use of technology in class and are willing to take time to learn and use new technology. They also believed that incorporating technology in the classroom was part of their job. In contrast, O'Bannon and Thomas (2014) conducted a quantitative study of 1095 teachers in Kentucky and Tennessee in the United States to investigate the role that age played in the perceptions of teachers, regarding the use of mobile phones in the classroom. Their study revealed that teachers who were 50 years and older were significantly less supportive of using mobile phones in the classroom. Oke and Fernandes (2020) conducted a qualitative study with 23 stakeholders in the education sector to explore the readiness of the South African education sector for 4IR. They gathered information about their perceptions and attitudes toward technology, which may in turn, have lowered the motivation for the sector to adopt 4IR. In another similar study, Nkula and Krauss (2014) explored ICT integration in marginalized schools in the Eastern Cape, South Africa. They discovered that the decision to use and how to use technology in the classroom, depended on the teachers' beliefs about teaching and learning and the role of technology. In other words, teachers with learner-centred beliefs are linked with a high-level use of computers, whereas traditional teacher-centred beliefs and practices are linked with low computer use. Therefore, teachers' attitudes towards the usefulness of technology, and their beliefs about teaching and learning, impact their technological use or lack thereof, in the classroom.

How technology is used at schools

Connected to the importance of teachers' attitudes towards technology, is how technology is ultimately used at schools and in the classroom. In a mixed method study of 310 principals in a large metropolitan area in the southwest of the United States, Waxman, Boriack, Lee and MacNeil (2013) examined principals' perceptions of the importance of technology, and whether their perceptions differed by years of experience and by gender. About one-third (35%) of the principals indicated that technology was used as a primary communication tool. Over one-quarter (28%) of principals

indicated that technology was incorporated in teachers' classroom instruction. Fourteen percent indicated that technology was used for data sharing and management; and 15% reported that technology was a resource to find information. Technology was also used for administrative tasks, such as marking attendance (10%). Only 10% of principals indicated that technology was used for student learning (Waxman, Boriack, Lee and MacNeil, 2013).

In a similar study, Sikhakhane, Govender and Maphalala (2021) explored learners' perspectives on how their schools were preparing them to thrive in the 4IR era driven by AI. A qualitative study of 30 grade 10 and 11 learners in the KwaMashu and Mafukhuzela Gandhi clusters in Kwa-Zulu Natal, revealed that the frequency of computer use in the sampled schools was exclusively reliant on the availability of computers in the schools and municipal libraries, and/or the number of assignments given where learners perceived that computers could be useful in terms of making their research easier. The study also found that learners rarely accessed computers due to shortage of computer resources; a shortage worsened by the widespread theft causing havoc in the area of study (Sikhakhane, Govender and Maphalala, 2021).

Lim and colleagues (2013) studied the gap between technology trends and the use of technology in schools and explored the options for addressing the gap to transform the teaching and learning in schools. They revealed that while schools had been acquiring hi-tech equipment as a means of introducing the newest technologies in teaching and learning, the results were not clearly noticeable in terms of acceptance by the teachers or in students' learning outcomes. Similarly, Tondeur and colleagues (2008 cited in Lim et al., 2013) confirmed the importance of technology planning in schools. They found in their survey that ICT integration planned to include ICT support and ICT training had a noteworthy effect on classroom use of ICT. Correspondingly, several studies (Levin and Schrum, 2013; An and Reigeluth, 2012; Mathevula and Uwizeyimana, 2014; Derbel, 2017) showed that technology integration and use at schools was strongly linked with the training and professional development of teachers. Mathevula and Uwizeyimana (2014) for example, studied the availability and accessibility of ICT equipment, and the impact of training in ICT use, on the integration of ICT into curriculum-related activities by teachers in the Mopani Municipality in Limpopo. Their quantitative study of 146 secondary school teachers and principals revealed that 41% had a professional ICT qualification; most said trainings were too short and basic to make an impact on their ICT skills; 59% had received basic computer literacy training instead of learning how to use computers to prepare slides and use the internet to access curriculum content. Additionally, 7% of teachers and principals were trained on electronic communication devices and computer integrations; only 1% were trained in programs like Microsoft. Furthermore, 18% said

training benefitted them and their learners, while 82% found no link. Finally, 53% of teachers and principals reported no confidence in ICT implementation in classrooms, and 17% reported that training was paid for by the Department of Basic Education, donors or the school (Mathevula and Uwizeyimana, 2014).

A study by Derbel (2017) explored if, and how technology-trained teachers were making the transition into technology-challenged schools. The author employed a mixed-method approach to study five English language teachers in Tunisia who had received in-service technology skills training. The study revealed that teachers demonstrated great commitment toward applying the ideas and/or skills received in the training and that they attempted, as technology-capable teachers, to incorporate technology in their day-to-day practice despite the limitations they faced in the schools. Additionally, their success in integrating technology remained restricted by problems of infrastructure, limited access to a technology space, and learners' "playful" attitudes (Derbel, 2017).

Impact of the coronavirus pandemic

The adoption and use of technology for teaching and learning has been influenced by the current coronavirus pandemic. Mhlanga and Moloi (2020) investigated the influence of covid-19 in accelerating the use of the 4IR tools, as a platform for providing learning. Their literature review of approximately 33 journal articles, 23 reports and 29 news articles, revealed that the Department of Basic Education used radio and television to offer virtual lessons to pupils during the lockdown, on SABC television and radio, E.tv stations and DSTV. Additionally, the South African government partnered with private network providers to offer zero-rated applications and educational websites. The literature review also indicated that mobile networks dropped data costs. However, due to poverty, which limits access, some learners were still unable to access virtual lessons. The authors found that the Department of Basic Education had also published study material including textbooks, worksheets, and study guides on their website. In October 2019, the Gauteng Department of Education officially launched its digital content and online assessment platform. The platform aims to expand access to digital content and to enhance opportunities for continuous assessment activities to support curriculum delivery in ICT-enabled schools.

Furthermore, Pokhrel and Chhetri (2021) performed a literature review to provide an extensive account on the impact of the covid-19 pandemic on online teaching and learning. They indicate that 98.6% of learners globally have been affected by the pandemic, representing 1.725 billion children and youth, from pre-primary to higher education, in 200 countries. They also report that virtual classroom platforms like videoconferencing and customizable cloud-based learning management

platforms such as Moodle, BigBlueButton and Skype are progressively being used. However, many countries have significant challenges with a reliable internet connection and access to digital devices. There are also practical issues regarding physical workspaces favourable to different ways of learning (Pokhrel and Chhetri, 2021). The authors report that the majority of students and learners do not have access to smartphones or TV at home, and/or have a poor internet connection. Tarkar (2020) also explored the effects of lockdown on schools, universities, teachers and parents in India. The review of existing literature reveals that online teaching methods are implemented by a few private schools. However, low-income private and government schools experienced complete closure and did not have access to e-learning solutions.

Twinning of schools

Another approach to integrating technology in schooling has involved the pairing of schools. Berliner (1990 cited in Makgakga, 2016), defines school twinning as the shared commitment of two schools to share resources and expertise for their mutual benefit, and in particular, to encourage improved school results. Lock (2011:5 cited in Makgakga, 2016) concurs that school twinning is the coming together of two schools to improve both schools. Chertok, Mittelberg, Laron and Koren (2013) investigated the challenges of twinning American and Israeli schools. They employed a multi-method qualitative design to study a three-year twinning process between two pairs of high schools in Israel and America. They found that educator teams did not have timelines for working together. The teams also lacked tools and online resources for sharing work in progress. Furthermore, each of the cross-national educator teams experienced significant organisational irregularities in the structure, size demographics, and staffing of their respective schools.

A study by Gallwey and Wilgus (2014) aimed to assess an Ireland–South Africa twinning programme, specifically focusing on the programme's potential to either support sustainable, equitable partnerships or promote power imbalances. They employed semi-structured interviews, observations and document analysis to study the link between four pairs of primary schools in Ireland and the Western Cape, South Africa. The study revealed that the Irish schools approached their participation in the twinning with clear, precise (though erroneous) assumptions about the South African schools' motivations for participating in the twinning, which they believed to mainly be about getting access to material goods. On the other hand, South African school staff reported they did not know what the Irish schools' motivations were for participating in the twinning entail.

Papadakis (2016) conducted a ten-year review of e-twinning in Europe in order to inform the educational community about the process and the benefits of using e-twinning in schools. The author found that e-twinning initially aimed to twin schools in Europe for joint projects through the wide use of ICT, by providing the necessary infrastructure. In the first six years of e-twinning (2005–2010), at least 750,000 learners in 33 European countries participated. However, many schools faced implementation problems including unfavourable school settings characterised by deficits in ICT infrastructure, support to teachers and a narrow and inflexible curriculum. Moreover, the lack of digital skills of many teachers across Europe continued to be an impediment to the participation of the majority of teachers in e-twinning. Nevertheless, some of the long-term benefits of twinning included contributions towards teachers and learners improving their ICT literacy and training, developing communication skills in English and other foreign languages, as well as encouraging learning about democratic citizenship, human rights, and promoting intercultural conversation (Papadakis, 2016).

Although twinning appears to have originated in Europe, the process has been implemented in South Africa, at a local district level. For example, Makgakga (2016) aimed to explore the usefulness of twinning two Grade 11 mathematics teachers in the Polokwane District of Limpopo Province. The study employed a mixed-method, pre-test-intervention-post-test design and included two grade 11 mathematics teachers, and 84 grade 11 learners. The results revealed that the teacher from the control group brought worksheets, handouts and DVDs, to share with the teacher and his learners in the experimental group. Post-intervention, the teacher continued to use those DVDs in order to strengthen mathematical knowledge. Furthermore, the teacher's efficacy in the experimental group seemed to have improved during the twinning process, as the teacher confirmed the skills and knowledge gained during the intervention developed his/her confidence in teaching topics such as functions and number patterns after the intervention. The motivation of the learners was also improved by the teacher's change in teaching practices. Finally, it seemed that twinning the two Grade 11 teachers, had a positive impact on the learners' ability in solving algebra problems in the experimental group. Learners in the experimental group showed improved performances in solving quadratic equations and interpreting the hyperbolic and exponential graphs (Makgakga, 2016).

Some potential barriers to twinning were also revealed in the study by Makgakga (2016). The findings suggest that school twinning leads to added responsibilities and work-related stress for teachers. Twinning was also shown to take up a lot of time for the two mathematics teachers under study. Financial and other resources were also problematic for the two schools involved.

Nevertheless, the overall benefits of twinning include better learner performance, improved teaching practices, and the opportunity to develop successful twinning models (Makgakga, 2016). This clarifies the purpose of school twinning in being to improve learning outcomes, by improving teaching practices and sharing resources and expertise between the twinned schools. Although the challenges to a successful twinning process can be significant especially in developing contexts such as South Africa, the literature suggests that the process can be beneficial to learners, teachers and schools as a whole.

The studies discussed in this section highlight the need for curriculum content, educational infrastructure and resources, as well as human resources, to be revised and improved in order to prepare, especially, African and South African contexts for teaching and learning in the 4IR. A key component of successful technology integration in schools is a change in the attitudes and perceptions of teachers towards technology. The research suggests that this might also be linked to the effectiveness of the technology training that teachers receive. The impact of the covid-19 pandemic has also led to accelerated adoption and use of technologies for teaching and learning. However, many schools and learners have experienced difficulties due to affordability and accessibility of devices and internet connectivity. These changes are instrumental for the preparation of youth to work and live in the 4IR, as the nature of work continues to change along with technological advancements.

2.2.4. The changing nature of work

It is widely accepted that the 4IR will change the way we work. Bazić (2017) emphasizes that the radical rearrangement of the economy, as a result of technological advances, is accompanied by redundancies of some jobs and the exploitation of cheap labour. This, in turn, may lead to increases in poverty, social stratification and crisis if everyone is not included and prepared accordingly. Several studies (Hirschi, 2017; Butler-Adam, 2018; Setyaningsih, 2019; Kayembe and Nel, 2019) highlight the changes in the nature of work and which kinds of jobs will be most affected in the 4IR. For example, Hirschi (2017) examined the then existing literature of the major trends for career researchers and practitioners to be aware of. The author found that job polarity would continue where semi-skilled jobs such as sales assistants and administration clerks were removed, while lower skilled and higher skilled jobs increased disproportionately. In another study, Butler-Adam (2018), in unpacking the existing literature on the implications of the 4IR on education in South Africa, found that optimistic predictions of the implications of the 4IR indicated that competition would grow for workers who had scarce skills required to implement, manage and work alongside the new technology. For Butler-Adam (2018), these skills included problem solving, adaptability

and written and verbal communication skills. Setyaningsih (2019) agreed that learners needed to be trained in a range of skills, not only in technical competencies but also in creativity and innovative problem-solving; flexibility and adaptability, critical thinking, communication and collaboration, information literacy, media literacy, and ICT literacy.

Kayembe and Nel (2019) aimed to determine the challenges and opportunities for education in the 4IR context, with a focus on the South African education sector. Their desktop study of the existing literature revealed that digital literacy was a basic requirement for students to develop adaptive capabilities in order to share in the global digital society, to benefit from the digital economy, and to generate new opportunities for employment, innovation, creative expression, and social inclusion. The authors further argued that changes could adversely affect the quality of the graduates if students were not well prepared and there was inadequate investment in resources.

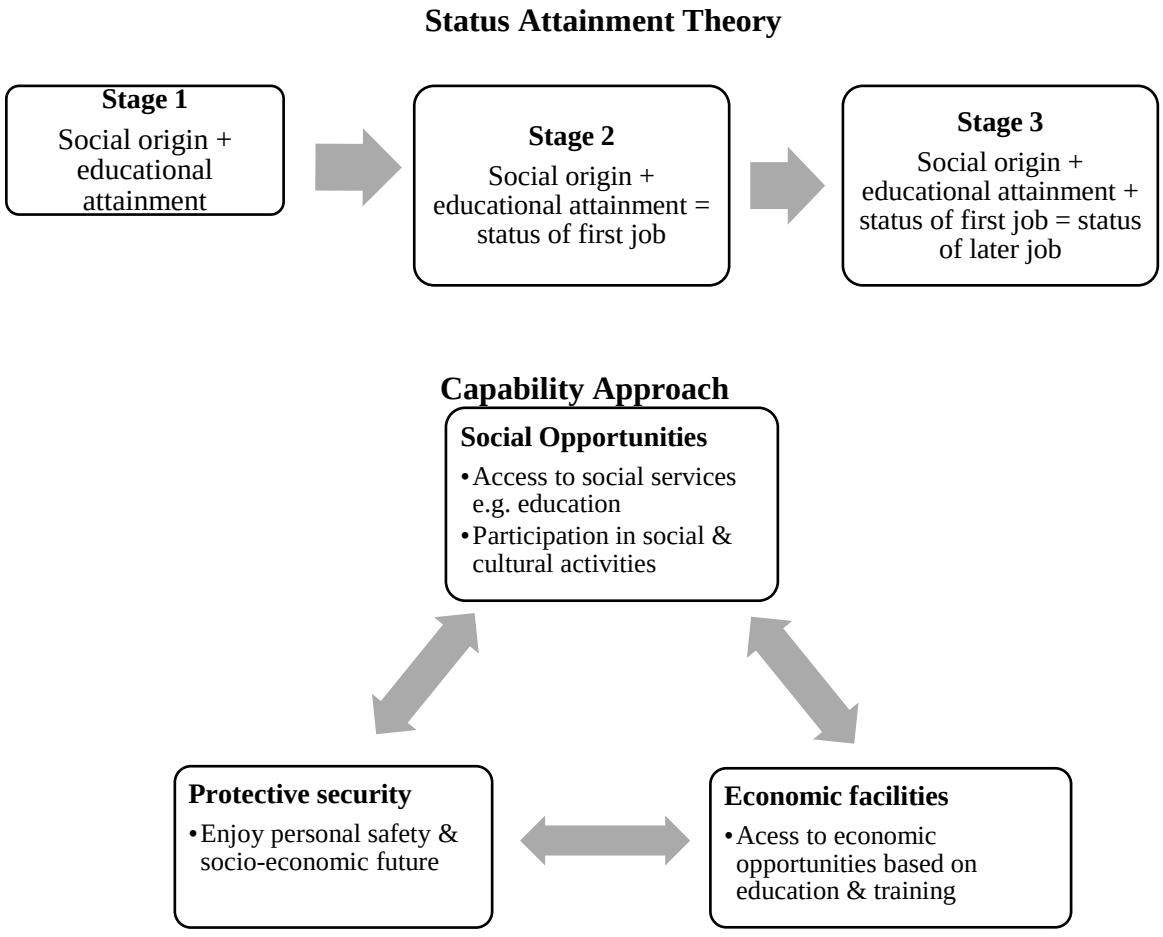
Furthermore, Bonilla-Molina (2020) examined what he termed the global pedagogical blackout in relation to the 4IR and the covid-19 pandemic and its lockdown regulations. The pedagogical blackout refers to the transitional stage between the Third and Fourth Industrial Revolutions during which education was characterised by, amongst other things, educational disinvestment, particularly in terms of technological updating which, he argued was turning public schools and universities into museums (Bonilla-Molina, 2020). He indicated that in the context of social distancing and lockdown restrictions, the home had become the centre of schooling and consumption. In other words, in the covid-19 and social distancing contexts, people have had an increasing responsibility of teaching and working from home. It can be speculated that this also has implications for the type of instruction young people undergo in preparation for life and work in the 4IR. Marwala (2020) argues that the preceding three industrial revolutions provided many high paying industrial jobs. Conversely, the 4IR is leading to mass unemployment and a mass of unemployable people. Marwala (2020) quotes a 2018 Accenture study which revealed that roughly six million jobs in South Africa could be at risk of being lost to automation by 2025. These include blue and white-collar jobs, that is, jobs from the manufacturing to the financial services sectors (Marwala, 2020). From these studies we can see how developing the skills required in the 4IR is crucial for youth wishing to remain relevant in an increasingly automated workplace.

The studies presented in this section suggest that improved infrastructure, teaching practices and teachers' attitudes are critical, in order to facilitate the inclusion of youth in the 4IR through schooling. While the technologies associated with the 4IR are seemingly more sophisticated, the

argument presented here is that schooling should at least start with the integration of basic technologies. The hope is that exposure to these basic technologies such as computers, will lay the foundation for skills such as computer literacy which young people can build upon post-secondary education.. The preparedness of the South African schooling system may significantly affect young people's capabilities that will enable them to excel and enjoy a good quality of life. The following section discusses the theoretical frameworks relevant in this study.

2.3. THEORETICAL FRAMEWORK

This section presents three theories which will be used in this study as a framework of analysis: the Status Attainment Theory according to Kerckhoff (1995), Sen's (1999) Capability Approach and Bhalla and Lapeyre's (1997) operational definition of Social Exclusion. A theoretical framework diagram (Figure 2.1) is used to illustrate the main components of each theory, after which each theory will be discussed. A discussion of the interplay between the three theories follows thereafter.



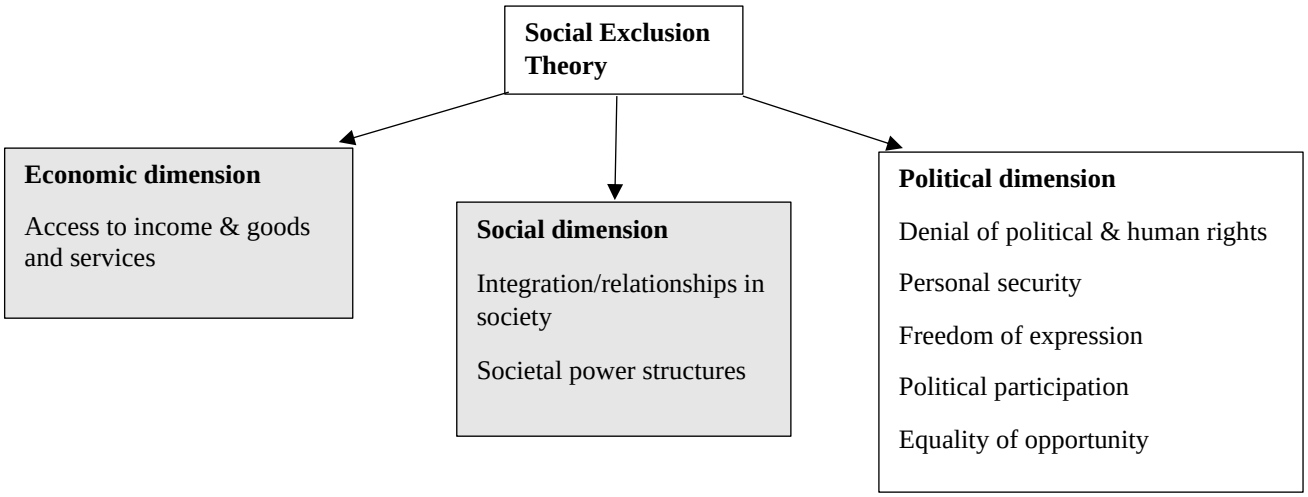


Figure 2.1: Theoretical Frameworks

2.3.1. Status Attainment Theory

Status attainment refers to the processes by which initial social status becomes social status over time (Schoon, 2008 cited in Lui et al., 2014). Status Attainment Theory, adapted from the Blau-Duncan (1967) basic model of status attainment, looks at processes of social stratification and the role of social institutions in shaping these processes (Kerckhoff, 1995). In the Blau-Duncan model, the stratification process consists of three stages. The first stage links social origin with educational attainment. The second stage links educational attainment and social origin with the status of the first job. The third stage links the status of the first job, educational attainment, and social origin with the status of a later job (Kerckhoff, 1995). In other words, an individual's initial social status affects their educational outcomes which in turn affects the status of their first and later jobs.

This theory is relevant to this study in so far as the social origins of learners from a low-income community and their educational attainment and employability in the 4IR are concerned. The theory helps one understand how learners' experiences of schooling in the era of the 4IR impact upon their employability and their consequent status in society. This, in turn, helps one comprehend how social stratification may be perpetuated by institutional arrangements, in this case the school, and how this might manifest in the socio-economic outcomes of learners.

2.3.2. Capability Approach

The Capability Approach was first introduced by Amartya Sen as a basis for evaluating individual well-being, policy designs and general social change (Robeyns, 2005). The approach helps to

understand issues of deprivation such as poverty and inequality. At its basic level, the Capability Approach is about the doings and beings valued by people - what they are able to do and how they are able to be (Sen, 1999). The approach involves components which Sen calls the bundle of freedoms. They refer to social opportunities; economic facilities; political freedoms; transparency guarantees and protective security (Sen, 1999). Social opportunities refer to access to basic social services including the ability to participate in social and cultural activities. Economic facilities refer to the ability to access economic opportunities as a result of adequate education and training. Political freedoms refer to the ability to exercise one's political rights such as the right to vote. Transparency guarantees are about the guarantees by those with political power to be people of integrity and sound moral values. Protective security is about the ability to enjoy a sense of personal safety as well as security in one's socio-economic future. In this study of learners from a low-income community, social opportunities, economic facilities and protective security are the most relevant components.

The Capability Approach helps to understand how access to new technologies, resources and skills impacts upon the kind of skills learners will acquire for life and work in the 4IR. The implication is that their capabilities in terms of social opportunities, economic facilities, and protective security are not optimally enjoyed. The approach helps to understand what the implications are of limiting certain freedoms, and the ability of learners to function as responsible, contributing adults in an ever-changing society.

2.3.3. Social Exclusion Theory

Bhalla and Lapeyre (1997) offer an operational definition of social exclusion in which they suggest that social exclusion presents in dynamic ways - in social, economic and political ways. According to Bhalla and Lapeyre (1997), the sociological, political and economic aspects of exclusion are equally important. Specifically, the ways in which society is organised, together with the existing societal power structures, should be given the same priority as the financial aspects of exclusion. According to Bhalla and Lapeyre's (1997) definition of the multi-dimensional nature of social exclusion, there are three dimensions, namely the social, economic, and political dimensions. The economic dimension is concerned with income and one's access to material goods and services from which some individuals and communities are excluded, others not. The social dimension relates to the integration of individuals in society. For example, unemployment not only implies a lack of income but also an inability to contribute to society. In other words, along with access to income, employment offers social legitimacy and social status. The authors assert that employment entitles

individuals to awards and rights which are necessary for full citizenship. The political dimension involves the denial of political and human rights of certain segments of the population. This includes such rights as personal security, political participation, equality of opportunity and freedom of expression.

The multi-dimensional nature of Social Exclusion Theory captures the diverse ways which learners in this study might experience social exclusion when accessing 4IR technologies and their position in society in relation to existing power structures. The multidimensional nature of social exclusion recognises that exclusion is about more than the inaccessibility of economic resources. On the contrary, social exclusion is experienced in the social and political arenas as well. In the context of this study, Social Exclusion Theory helps one understand this relationship between the different dimensions. The theory helps one comprehend how limited or strained access to technological advances, during schooling, due to limited or lack of access to economic resources, might influence learners' ability to participate economically and socially in society. Social exclusion, as conceptualized by Bhalla and Lapeyre (1997), therefore helps one understand how learners' capabilities might be affected over the long-term. The multidimensionality of the Social Exclusion Theory illustrates the impact of intergenerational reproduction of inequity and persistent coloniality. In this study, the social and economic dimensions were most pertinent.

2.3.4. Interplay between the theories

Figure 1 above shows how one's social origin might affect one's experiences of schooling, capabilities and eventual status in society. In this study, black and coloured learners are classified as socially excluded due to their being part of historically disadvantaged population groups, their geographical positioning on the outskirts of the main city, and their origins being from low-income communities. Based on these characteristics, learners in this study receive a different quality or standard of schooling due to a limited, or lack of access to technologies, in other words, technological advances of the 4IR. This standard of schooling combined with the initial social status of these learners, may mean that certain skills and aspirations are cultivated, which in turn, could influence their socio-economic prospects. In other words, learners' capabilities, what they are able to do and become in future, and by extension the quality of life they will be able to enjoy, are all affected by their social status of origin and educational outcomes.

The next section covers policies and legislation on the 4IR and ICT integration in schooling.

2.4. POLICY AND LEGISLATION

2.4.1. White Paper on e-Education

The White Paper 7 on e-Education 2004 aims to make use of the opportunity presented by the real-world benefits of information and communication technologies (ICTs) to support teaching and learning in the 21st Century (Department of Education [DoE], 2004). This policy aims to integrate ICTs into education in South Africa in order to capacitate youth with the necessary skills for work in the 21st Century, thereby enabling them to contribute to national social and economic development (DoE, 2004). As a means to bridge the digital divide, government through this policy identified three areas for developing ICTs: education, health and small to medium and micro-enterprises. The policy makes provision for the ICT training of teachers, access to electronic content resources, and infrastructure and connectivity (DoE, 2004). The overall goal of the white paper was for every South African learner to be ICT capable by 2013, specifically for learners to confidently and creatively use ICTs to help them develop the skills and knowledge to achieve personal goals, and to fully participate in the global community (DoE, 2004). As such, it is the intent of the white paper that every teacher and learner have access to ICT infrastructure in order to manage administrative functions; access electronic learning materials; connect to information sources outside of the classroom; collaborate with others in, and outside the school environments; and add to the knowledge base (DoE, 2004). As the findings of this study will show, this policy has not been fully implemented at the schools and, therefore, its goals have not fully materialised.

2.4.2. White Paper on Science, Technology and Innovation 2019

The White Paper on Science, Technology and Innovation 2019, sets the long-term policy track for the South African government to guarantee the growing role of science, technology and innovation (STI) in a more successful and inclusive society (Department of Science and Technology [DST], 2019). It emphasises using STI to fast-track inclusive economic growth, make the economy more competitive and enhance people's daily lives. The policy intends to help South Africa profit from global changes such as the rapid technological developments and geopolitical and demographic changes, as well as respond to the pressures connected with some of these global trends. In order to harness the potential of 4IR, the policy recognises that present and future workers will have to obtain special skills or education as digitisation is anticipated to change the work environment in innovative ways (DST, 2019). The policy argues that reskilling and educating current workers will be critical to prevent skills gaps, mass unemployment and rising inequality. Therefore, greater investment will be essential to steer STI in response to these changes. In order to support new sources of growth, the policy intends to create a high-level national co-operative platform to position South Africa to

respond to the opportunities and risks arising from the 4IR. The aim of the platform is to help identify and support important STI programmes linked to the 4IR. The platform also offers a way to contribute to the development of a South Africa strategy on artificial intelligence (AI). In order to develop the human resources of the country, the government through this policy aims to create specific interventions to empower all children to become digitally literate, by, for example, making better use of mobile- phone technology in schools (DST, 2019).

2.4.3. National Youth Policy 2020-2030

The South African National Youth Policy (NYP) 2020-2030 intends to integrate youth development into government policies, programmes and the national budget (Department of Women, Youth and Persons with Disabilities [DWYPD], 2020). The policy makes a commitment to the educational outcomes of disadvantaged and marginalized youth. This includes the inclusion of holistic youth development in the school environment and curricula, and support and guidance to youth to enable them to make informed decisions about their education and careers (DWYPD, 2020). The policy also takes in to account the advances in technology in the 4IR, and that it should be incorporated into the education of youth. The policy acknowledges the challenges that youth experience in accessing quality education and sets out the measures that will be taken to overcome these challenges.

However, the policy seems to be out of touch with the realities at some South African schools. For instance, the policy fails to take into account the condition of infrastructure at some schools, such as the lack of decent ablution facilities, and the challenge some learners have in reaching schools in the first place due to distance, having to cross rivers, and transport costs. While the literature shows that poor resources and infrastructure are among the main hindrances to inclusion in education (Eleweke & Rodda, 2002 cited in Polat, 2011), these are not addressed in this policy. Additionally, although the policy mentions the incorporation of 4IR into education, it does not say how this will be done. In fact, the findings of this study will show the lack of 4IR education at the two schools. In fact, curriculum content and subject offerings at these schools do not cover 4IR and its related concepts.

2.5. CONCLUSION

This literature review has highlighted some of the opportunities and threats to education as a result of the 4IR. The literature suggests that there are several changes to teaching and learning that need to occur in order for youth to be prepared to fully participate in the 4IR. The theoretical frameworks chosen for this study help one to understand how the capabilities of some groups of youth may be affected, and how they may experience social exclusion if they are not adequately prepared for the 4IR by schooling. The policies discussed in this section indicate the steps government aims to take to address education in the 21st Century so as to enable youth to participate in the social and economic development of the country.

CHAPTER THREE:
METHODOLOGY

3.1. INTRODUCTION

This chapter outlines the research methodology that was used in this study. The chapter describes the chosen research design applicable to this study, the population and sampling, the data- collection method and instruments, as well as data recording. Also included are descriptions of the data analysis and verification processes.

3.2. RESEARCH DESIGN

The exploratory nature of the research topic required a qualitative research approach. Qualitative research intends to describe rather than explain and predict phenomena (Babbie and Mouton, 2001). It seeks to retrieve the subjective meanings attributed to the lived experiences of those being researched. In other words, qualitative research is designed in a way that employs specific techniques and procedures to reveal how people perceive and experience their daily lives in relation to a specific topic.

The chosen research approach was appropriate for this study as it allowed for dynamic interactions between the researcher and participants, who were considered most suitable for gaining information on the research topic. The researcher heard of the lived experiences directly from participants which permitted the collection of rich data. The flexible nature of qualitative research assisted the researcher in creating a relaxed atmosphere which, in turn, allowed for rich quality data to be collected.

3.3. POPULATION AND SAMPLING

3.3.1. Study Population

A study population refers to the group of people about whom the researcher wants to make conclusions (Babbie and Mouton, 2001). It is the broader group of people from which the study sample is selected. In this case, the study population refers to the secondary schools in the Ekurhuleni Metropolitan Municipality in the Gauteng Province. More specifically, the study population consists of two secondary schools in the Ekurhuleni South Education District.

The Ekurhuleni Municipality is the second smallest of its kind in the Gauteng Province. According to the latest available statistics, Ekurhuleni has a population of over 3.7 million people, of whom approximately 1.9 million are male and 1.8 million are female (City of Ekurhuleni, 2020). There are over one million housing structures in the municipality, with the majority being formal housing

structures found in townships, informal settlements and peri-urban areas. Seventy-two percent of households have access to piped water and approximately 425 000 households are supplied with electricity by the municipality. The unemployment rate in the municipality is recorded at 33.8%, making it among the highest in the province (City of Ekurhuleni, 2020). Most people in the municipality are said to work in the financial services and property sectors. The second largest sector of economic activity is the wholesale and retail sector. Public transport is found to be relatively expensive and inefficient for the poor due to the fragmented location and far-flung places of work. 65% of the residents are previously disadvantaged people living primarily in the peripheral areas of the city. The majority of residents use private vehicles (32%), public taxis (21%), or walk (32%) (City of Ekurhuleni, 2020). The municipality also has an illiteracy rate of 8.2% for persons 15 years and older. As of 2014, 14.6% of people 20 years and older attained some form of higher education qualification, while 35.5% completed grade 12 (Statistics South Africa [StatsSA], 2014).

The Ekurhuleni South Education District consists of different types of schools, namely public and independent schools. There are 214 ordinary (that is, not special needs) schools in this education district, 174 are public and 39 are independent schools (SNAP Survey 2013 cited in Department of Basic Education [DBE], 2018). Public schools are further classified in terms of quintiles from one to five, indicating the level of financial support received from the Provincial Department of Education. The two secondary schools selected for this study are quintile 4 schools, making both of them no fee-paying schools.

3.2.2. Sample Characteristics

The sample for this study consisted of three groups: twenty grade 12 learners from a community in the Ekurhuleni Municipality; four secondary school teachers and two school principals; and one Institutional Development and Support Official (IDSO) from the Ekurhuleni South Education District. The sample of learners consisted of both males and females who identified as black or coloured.

The research site is a township on the East Rand of Gauteng, in the Ekurhuleni Municipality. It was first established at the end of World War II and massive migration and an influx of people from rural areas seeking employment on the gold mines of Johannesburg, occurred thereafter. With the dawn of apartheid and its accompanying separate development policies, black and Indian people were removed to different areas. Coloured people remained in the area and the community has remained a predominantly coloured community to-date (SABC News, 2016). The research site often

makes news headlines for various reasons including protest action, crime incidents, substance abuse and widespread poverty.

The research site has six schools in total: four primary schools and two high schools. Most of the schools are quintile four schools, making them no fee-paying schools (Gauteng Department of Education, [GDE] 2019). There is also a skills training centre in the community where many residents have enrolled to complete their secondary schooling after dropping out, or to learn a trade. The community has a public clinic, library and access to public transport. The library is frequently closed following several incidents of burglary and theft of equipment. There have also been a number of community development projects which aimed at alleviating the high unemployment problem in the area. However, residents say that nothing has changed for them (SABC News, 2016).

3.2.3. Sampling Technique and Procedure

The study used non-probability sampling techniques, specifically purposive and snowballing. Non-probability sampling relates to the selection of research participants in such a way that not everyone in a population has an equal chance of being selected (De Vos et al., 2011). The researcher selects specific individuals, groups or settings where the problem under study is most likely to occur. Purposive sampling, in particular, denotes a research sample being selected based on specific attributes that best serve the purpose of the study (De Vos et al., 2011). Snowball sampling denotes locating a single individual that meets the criteria of the study, who then points the researcher to other individuals who meet the study criteria (De Vos et al, 2011).

The study site was deliberately selected because of its status as a historically disadvantaged community. The aim was to assess the experiences of schooling in the 4IR in such a community, and to see if and how it is being included in the 4IR, or whether it is being further marginalised. The two secondary schools selected were the only two in the community hence both were selected. Grade 12 learners were purposively selected because they had nearly completed their schooling careers and were preparing to enter the workforce or tertiary education. This grade 12 cohort was also the first to complete their schooling since the 4IR was first introduced five years ago. The researcher started by contacting the schools to explain the purpose of the study and to gain access. The deputy principal at School A identified learners and teachers whom she thought were suitable candidates based on the purpose of the study. The researcher then met with the learners to explain the purpose of the study. Learners who volunteered to participate received parental consent forms for their parents/guardians to complete, as well as assent forms. Learners who returned their signed consent forms were contacted telephonically or via WhatsApp to set up appointments for the research

interviews. Teachers were selected through snowballing whereby the deputy principals were asked to refer the researcher to teachers likely to be willing to participate in this study. The purpose of the study was explained to these selected teachers accordingly, and they received an informed consent form to complete and sign. The IDSO responsible for the two secondary schools was also purposively selected given they served as the liaison between the schools and the provincial Department of Basic Education. The IDSO was the preferred contact person as they had direct knowledge of the schools and what is expected by the Department of Basic Education. The IDSO was selected by obtaining the contact details from School A and making direct contact. The researcher explained the purpose of the study and asked for their participation. The IDSO also received an informed consent form detailing the nature and procedure of the study. After three attempts, an in-person interview was finally conducted with the IDSO at School A.

At School B the researcher first met with the principal to explain the purpose of the study and to inform him of what was needed from the school. The principal referred the researcher to the teacher responsible for ICT support at the school. She became the first informant at the school and referred the researcher to the second teacher who participated in the study. The first informant also identified the grade 12 learners whom she knew and thought would be best suited to participate in the study. Parental consent and assent forms were distributed to the learners and their contact details recorded. Learners who returned signed consent forms were contacted by the researcher to set up appointments for the research interviews.

3.4. DATA COLLECTION METHOD, INSTRUMENT AND RECORDING

The method of data collection employed in this study was semi-structured, one-on-one interviews. During the semi-structured interview, the researcher has a general plan of questioning rather than detailed questions that are asked in a particular order (Babbie and Mouton, 2001). The researcher guides the general direction of the discussion but follows up on issues raised by the participant (ibid).

This method of data collection allowed the researcher to access the particular perceptions and experiences of research participants on the topic under study. The semi-structured interview provided flexibility in that the researcher was able to probe responses as well as follow-up on issues raised by participants, which were not previously thought of. In order to execute this approach, a semi-structured interview schedule was used. The semi-structured interview schedule is a questionnaire designed to guide research interviews (De Vos et al., 2011). The interview schedule includes all the information to be addressed during the interview in order to answer the main research questions.

The researcher conducted both face-to-face and online interviews. Given that the study took place in a low-income community, where not all participants had access to technology, face-to-face interviews were necessary. Due to covid-19 social distancing regulations, all parties wore face masks throughout the interviews and a physical distance of 1.5 meters was maintained between participants and the researcher. However, for participants who did have access to a mobile device, interviews were conducted remotely using WhatsApp voice or video-calling. Mobile data bundles were supplied by the researcher to learners for the purpose of the interviews. Research sample sets were interviewed based on availability and not in any particular order.

Since this was a qualitative study, the research interviews were recorded. Audio recordings allowed the researcher to concentrate on how the interview was progressing and enabled more complete records than handwritten notes (De Vos et al., 2011). A cellular phone was used to record one-on-one interviews in this study. This device was most accessible to the researcher and allowed her to focus on the verbal and non-verbal responses of the participants rather than having to manually record the conversations. Recording the interviews also made transcription and analysis easier.

3.5. DATA ANALYSIS

Data analysis is the process of bringing structure and meaning to the data after is has been collected (De Vos et al., 2011). It involves finding patterns and themes from the raw data and generating a structure for communicating the core of what the study reveals. There are several ways of completing qualitative data analysis but the researcher used Tesch's (1990) strategy for thematic data analysis for this study. Tesch (1990 in de Vos et al., 2011) describes 8 steps in the data analysis process undertaken after all research interviews have been transcribed. The steps are illustrated in the diagram:

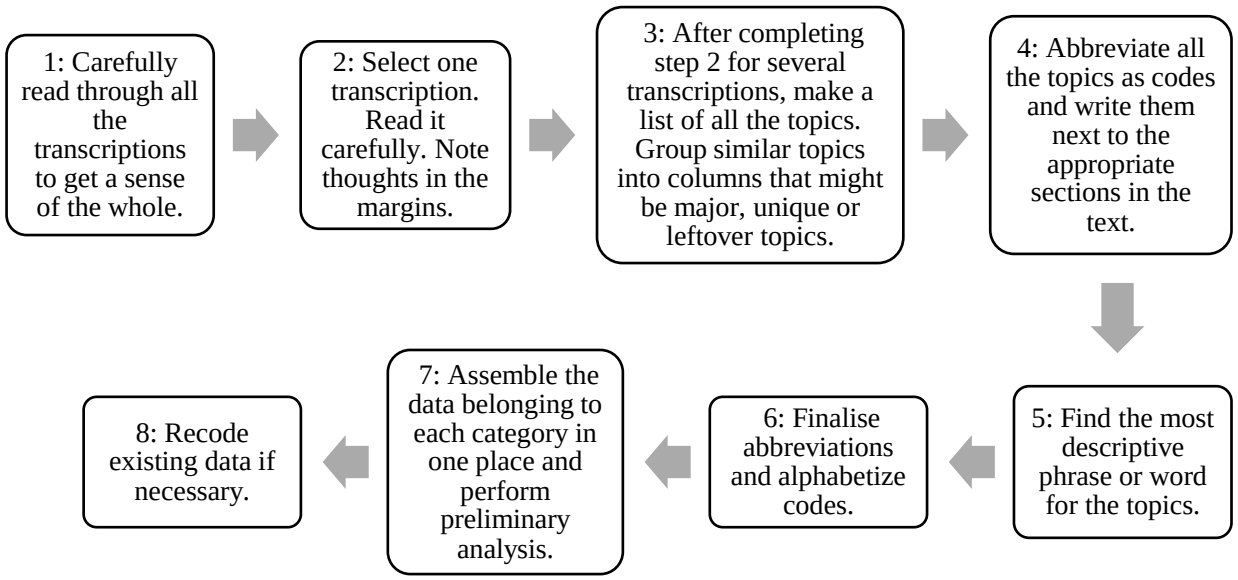


Figure 3.1: Data analysis

Figure 3.1 above describes the steps followed by the researcher in analysing the data. The researcher started by analysing data collected from the grade 12 learners. First the researcher read through all 20 transcriptions to get a sense of all the data. Then she took six transcriptions and read through each of them carefully, making notes regarding the sub-text of what participants were saying. Next, the researcher made a list of all the topics she had noted on the six transcriptions. She then grouped together similar topics and gave each 'group' of topics a name and a code. She then took the list of topics and wrote them next to the appropriate sections of the 20 transcriptions. Thereafter, the researcher alphabetised the codes and assembled all the data belonging to each topic, under the appropriate topic name and code, by electronically cutting and pasting the text in one file. The topics that related to one another were then turned into categories. Some of the data overlapped and were added to more than one category. Other segments of text were eliminated altogether as they formed part of the 'leftover' topics. A framework of analysis was compiled and is presented in *Table 4.2* on page 40. The researcher then followed the same process for the seven key informant interviews. Different topics emerged from these interviews and data belonging to each topic was assembled in a separate electronic file. A framework of analysis was also compiled and presented in *Table 4.4* on page 53.

3.6. DATA VERIFICATION

Data verification refers to the methods used during the research process to ensure the thoroughness of a study (Morse et al., 2002). In qualitative research trustworthiness is the means through which reliability, credibility, conformity and transferability are established (Guba and Lincoln, 1981 in Morse, 2002). To attain trustworthiness in this study, the researcher recruited an appropriate sample

comprising participants who best represented or had knowledge of the research topic. In other words, the learners answered questions one, three and four which pertained to their experiences and perceptions, while key informants answered questions one and two for the same reason. Trustworthiness was also attained through transcription of the research interviews and keeping record of every step in the analysis process. Finally, trustworthiness was also attained through regular meetings with the research supervisor to discuss the data and the appropriate analytical approach.

3.7. LIMITATIONS OF THE STUDY

This study had three potential limitations relating to data collection. Firstly, the potential obtrusiveness of the audio recording device. The device might have produced feelings of uneasiness for participants, which could have made them reluctant or selective in the information they chose to share. This in turn could have impacted on the richness of the data that was collected. Secondly, interviews were mostly conducted in English. The researcher recognised that English was not most people's first language. As such, some questions or terms could have been misunderstood by participants, especially the grade 12 learners. This could have also impacted on the kind of data that was collected. However, the researcher tried as far as possible to use simple language, free of jargon and to clarify when participants did not understand. Additionally, some interviews were conducted in Afrikaans for Afrikaans-speaking learners as this is also the researcher's first language. The researcher could have invited an interpreter for learners whose first language was any of the other official South African language. Finally, this study was only carried out in one education district in the Gauteng Province. While the findings cannot be generalised, insights can be drawn and used to inform policy, practice and further research.

3.8. REFLEXIVITY

Mason (1996 in Guillemin and Gillam, 2004) defines reflexivity as being all about researchers continually reflecting upon their actions and role in the research process, in the same critical way in which they subject their data. This includes researchers reflecting on their own social and political positions and how these might affect the research process (Harding, 1986, 1987, 1991 in Guillemin and Gillam, 2004).

This study was conducted in a low-income, previously disadvantaged community. This is the same community in which the researcher grew up and still lives. The researcher attended secondary school at a former Model C school in the nearby town, and during her time at the participating schools she

was very aware of the stark differences between these schools and her own. At various times during the interview process, she felt sympathetic to the participants, especially when they shared about their experiences of schooling in relation to the challenges with resources and absenteeism among teachers. These are challenges she did not experience as a learner. Conducting this research has made the researcher aware that she was privileged in comparison, and often took her experiences for granted. She also had some preconceived ideas of the schools, particularly School B, which has often been in the news for scandals that have occurred there. During her data collection at School B, the researcher realised that the school had experienced significant setbacks that affected the management, discipline and morale among the learners and teachers. She often found herself wondering how people she knew had managed to matriculate from there. Some of the participants expressed that the school had not always been the way it was now; that much had changed.

The researcher also had some anxiety relating to uncertainties created by the covid-19 pandemic and lockdown regulations. This was mostly related to the possibility of early school closures, which she feared would delay her data collection. Schools did, in fact, end up closing early for the midyear holidays, but she had managed to complete my data collection in time. This was a huge relief. There was also some anxiety about possibly contracting the virus during her time at the schools. This was worsened when several positive cases were reported at School B during her data collection time there. Towards the end of her research time at School B, the grade 12 learners organised a demonstration regarding their unhappiness over the school's management of the positive covid-19 cases. School classes were dismissed earlier that day and the researcher was not informed of this by any of the staff members. It was quite disappointing as she only found out upon arrival at the school for her appointment with a participant. As a result, the appointment was missed and she struggled to reach the participant because he did not have a cell phone. The researcher later learned that he had fallen ill with the virus, and she subsequently had to recruit another participant.

3.9. CONCLUSION

This chapter has presented an outline of the research methodology used in this study. The chapter has accounted for the research design, research population and sample, sampling techniques and data collection. The chapter has also described the data analysis technique used, how data was verified to ensure validity and reliability, and the limitations of this study in relation to data collection. The chapter ends with a note on reflexivity. The next chapter presents the findings of this study.

CHAPTER FOUR:
FINDINGS

4.1. INTRODUCTION

This chapter is divided in to two parts. The first part presents findings from 20 in-depth individual interviews conducted with grade 12 learners in the Ekurhuleni South Education District in Gauteng Province. Grade 12 learners answered research questions one, three and four. The latter part of the chapter presents findings from seven individual key informant interviews conducted with four teachers, two principals and one IDSO in the same district. Key informants answered research questions one and two. The chapter begins with a presentation of the demographic profile of the learners, followed by an in-depth analysis of the major findings of the study.

PART ONE: GRADE 12 LEARNERS

4.2. DEMOGRAPHIC PROFILE OF GRADE 12 LEARNERS

Table 4.1 Demographic characteristics of learners

VARIABLE		NUMBER	PERCENTAGE (%)
Gender	Males	8	40
	Female	12	60
Race	Black	11	55
	Coloured	9	45
Grade	12	20	100
Age	<18 years	12	60
	18 years	3	15
	>18 years	5	25
	Average age	17.8	
Parents' highest level of education	<Grade 12	13	65
	Grade 12	9	45
	>Grade 12	8	40
Parents' occupation type	Unemployed	8	20
	Low-skilled	8	20
	Medium-skilled	7	17.5
	High-skilled	5	12.5
	Unknown/Deceased	12	30
Housing type	Formal brick structure	17	85
	Informal structure	3	15
Household amenities	Running water inside	18	90
	Electricity	20	100
Technological devices	Smart phone	16	80
	Desktop computer	2	10
	Laptop computer	5	25
Internet access	Mobile data	14	70
	Wi-Fi	6	30

Community type	Suburban	12	60
	Informal settlement	8	40
Community amenities	Schools	17	85
	Public clinic	17	85
	Public library	10	50
	Public transport	20	100
Community social problems	Substance abuse	16	80
	Unemployment	15	75
	Crime	18	90
	Poor municipal services	16	80
SAMPLE SIZE = 20			

Table 1 presents the demographic characteristics of the grade 12 learners who participated in this study. Twelve of the participants were under 18 years old at the time of the study, while five were older than 18. Sixty percent of participants identified as female and 40% as male. More than half of participants identified as Black (55%) while 45% described themselves as Coloured. Sixty-five percent of participants' parents had not attained a grade 12 certificate. Forty-five percent of parents had reached grade 12, while only 40% held tertiary qualifications. Accordingly, eight parents (20%) were unemployed at the time of this study, while only five held highly skilled jobs such as teaching and managerial jobs. Seven parents (17.5%) worked medium-skilled jobs such as healthcare administration, while eight parents (20%) had low-skilled jobs such as domestic work and being supermarket cashiers. The vast majority (30%) of parents' jobs were unknown to participants or parents were deceased.

4.3. HOUSEHOLD CHARACTERISTICS

Seventeen participants reported living in formal brick housing, including those residents in the surrounding informal settlements. All participants reported having electricity in their homes, although many complained about experiencing issues related to load shedding or extended power outages. Ninety percent of participants reported having running water inside the home, only two residing in an informal settlement reported using a communal tap outside the home. Sixteen participants had smart phones, although some complained about them not working properly or being broken at the time of the study. Some had more than one device such as a smart phone, laptop and computer, or all three. Fourteen participants made use of mobile data to access the internet, though they complained about the unaffordability of data. Six participants reported having home Wi-Fi connectivity.

4.4. COMMUNITY BACKGROUND INFORMATION

Twelve participants were residents in a suburban community, while eight resided in different informal settlements. Most participants lived in areas where there were schools (85%), a public clinic (85%) and public library (50%). All participants reported having access to public transport such as taxis. In places where there were no clinics or libraries, participants reported having to travel or walk short distances to access these facilities in the nearest community. Participants reported the existence of various social problems in their communities. Chief among these were substance abuse (80%), high unemployment (75%) and crime rates (90%). Participants also cited service delivery issues such as extended power cuts and poor municipal services (80%).

4.5. DISCUSSION OF FINDINGS

Table 4.2 Framework of analysis

THEMES	CATEGORIES	SUB-CATEGORIES
Understanding 4IR and technology use for schooling	What do they know?	"I've never heard of it"
		Better ways of doing things
		5G, artificial intelligence, robotics
	Advantages and disadvantages	"Makes things easier"
		Used for unrelated things
Technologies at school	Devices used for schooling	Smart phones
		Smartboards
		Laptops and tablets
	Challenges with devices	Technical difficulties
		Issues with own devices
Quality of education in the context of 4IR	Discipline	No discipline among learners
		Disciplinary actions
	Teachers	Good teachers
		Absenteeism
		Teaching methods and styles
	Resources and infrastructure	Textbooks
		Paper
		Devices
	Subject choices	What they chose
		What they wanted
	Overall perception of quality	Poor
		Good
		Room for improvement
Challenges of schooling in the context of 4IR	Personal challenges	Death of a relative
		Family circumstances
		Bullying
	Structural challenges	Covid-19 pandemic
		School infrastructure & resources
		Electricity
	Coping strategies	Taking initiative and personal responsibility
		Sharing resources
Life goals and the 4IR	Studying	Various qualifications
		Motivations
	Other goals	Desire for independence
		Desire to support family
Skills and knowledge for life after school	Innate skills	Hardworking
		Good communicator
		Perseverance
	Knowledge of chosen career path	Unsure/still doing research
		There is a market for chosen profession
Exposure to helpful opportunities	Relatives and neighbours	

	Church and community organisations
	No opportunities

Table 2 above presents the major findings in the form of seven themes, categories and subcategories guiding the analysis, namely: Understanding the 4IR and technology use for schooling; technologies at school; quality of education in 4IR; challenges of schooling in 4IR; life goals; skills and knowledge for life after school; and exposure to helpful opportunities. These themes emanated from three of the four research questions posed to the learners, namely: how is the Fourth Industrial Revolution understood by learners in the Ekurhuleni South Education District; what are learners' experiences of schooling in the Fourth Industrial Revolution; and how do learners perceive their schooling experiences to help them after school?

4.5.1. Understanding 4IR and technology use for schooling

When asked about their understanding or awareness of the 4IR, most participants reported that they had never heard of it before. However, many of them had some awareness or knowledge of 4IR-related technologies.

> *I just know about the 5G networks, not much about robotics but they mentioned something about the new robotics something that they want to do in South Africa or something. I know nothing at all about 3D printing. I've never been in a discussion about that.* (P4, Female, 17)

> *Maybe I have [heard about it] but I didn't pay attention to it. I think it's robotic technology. [I've heard] that it does everything for you and you don't have to put in much effort anymore. You just input what you want or what you want to do and then everything comes up* (P6, Female, 17)

> *From games like FIFA and so forth that's as far as the AI I know because the AI is like when you're playing against the computer and things like that. And I've seen on the news before they show these robots that clean or these ATM machines, I believe that it's an AI system also.* (P9, Male, 16)

Participants expressed their perceptions about the advantages and disadvantages of technology use for schooling. Most of them reported that technology makes schooling easier for them, but it might also be a source of distraction for some.

> *It would be nice to have those things in the classroom. It would make our backpacks much lighter. If a teacher is absent, maybe a video can be shown on the board or on laptops that we can all watch and still continue with our work. But the disadvantage of*

that is that people will steal it. Then it will be used for something else instead of the actual purpose. (P5, Female, 18)

I can't remember when it was but there was a year when we had these tablets and stuff, laptops and tablets. So, that made it much easier for us. When everyone has a tablet, you get the work, you have the apps and everything. However, the problem is…the reason why they took it away from us is because some children would use the device given to them for purposes like…other purposes like downloading disturbing things. (P12, Female, 17)

While grade 12 learners in this study are not familiar with the 4IR, they do appear to have some knowledge of its related concepts. These include 5G technology, automation, robotics and artificial intelligence. However, that knowledge is limited. The learners in this study had strong perceptions about the advantages and disadvantages of technology use for schooling. Most of them reported that using devices such as smartboards in the classroom makes learning more interesting because different types of media can be incorporated into the lessons. Using smartboards in the classroom also means that learners can stay up to date with the syllabus even when teachers are absent, since the smartboards are loaded with their textbooks and activities. Most learners reported that having devices such as laptops or tablets also make their book bags lighter since they do not have to carry around many textbooks. However, the disadvantage for most of the learners in this study was that devices are often stolen or used for activities unrelated to schooling. While these learners had previously used laptops and tablet computers for schooling, they had not received these devices at the time of this study. Although participants did not report any advantages related to improving their educational outcomes as found by Kaya and Balta (2016), their experiences of using technology for schooling are that their book bags are lighter, lessons are more interesting and interactive and they are able to stay up to date with the syllabus; similar to the research findings of Srivastava (2020).

The grade 12 learners in this study have had limited exposure to technologies associated with the 4IR. By extension, their knowledge and skills required for the 4IR remain underdeveloped. This has implications insofar as impairing the further education and training opportunities that they will be able to access, as well as their access to economic opportunities based on their education and training upon completing grade 12 (Sen, 1999).This is likely to mean that this group of learners will experience some level of social exclusion in terms of access to income and goods and services, as well as their position in societal power structures based on the kind of work opportunities that they will be able to take up (Bhalla and Lapeyre, 1997).

4.5.2. Technology at school

Participants in this study reported having used some technological devices for schooling. However, most of them experienced various challenges with those devices.

> *There's no such things here at school, there's only a smartboard. But we don't even use it a lot. What we use a lot is this, what's this? The whiteboard, yes. They just use it (the smartboard) to show us if they maybe have a question that's not in the textbook. There's no internet connection. They don't allow us, actually phones are not allowed at school, but they do allow them now because it's covid times. So, we take pictures with our phones.* (P17, Male, 20)

> *It [the smartboard] works but sometimes it doesn't work properly. Sometimes it freezes, sometimes there's a pop-up that says there's a virus. We reboot it but sometimes that doesn't work, so then the teacher will write on the white board. Eskom is also a problem. Sometimes when the electricity is off in [the area] then it's also off here at school.* (P11, Female, 19)

> *Okay, we have the smartboard from which you can load the information onto your flash drive but when you don't have a laptop at home, how are you going to work? It's going to be useless. So, they think us having laptops makes it easy. It makes it easy when we're at school but not when we get home.* (P19, Male, 18)

The narratives above indicate that the schools have limited information and communications technologies (ICT) to enhance teaching and learning. It appears that the smartboard is the main ICT used in the classroom and it is mostly used for displaying electronic textbooks, exam questions and activities. In addition, given that the two schools in the study do not have internet connectivity, the smartboards are not used effectively. A further challenge related to the use of the smartboards is that they "freeze" or do not load the information properly. A major challenge with using technology for schooling is also related to issues with the poor quality of electricity supply resulting from load shedding or power cuts caused by cable theft in the area. Other technology used for schooling is learners' smart phones. However, smart phones are only used for taking pictures of the work from smartboards or textbooks, and for receiving activities from the teacher via WhatsApp Messenger. Therefore, the inadequate availability of technological resources coupled with other infrastructure challenges, inform the ineffective use of these technologies. These findings are similar to those of Sikhakhane, Govender and Maphalala (2021), in terms of learners in their study and the present one not reporting the use of a variety of other technologies for teaching and learning, such as computers. These findings also resemble those of Waxman, Boriack, Lee and MacNeil (2013) whereby technology used for learning remains limited due to inadequate availability, in the case of the schools in this study. Therefore, the inadequate availability of technologies for teaching and

learning, plus the infrastructure challenges which lead to the ineffective use of technology renders the schools in this study unprepared for teaching and learning in the 4IR. The implication of this for this group of learners is that they might be excluded from the further education and training and work opportunities presented by the 4IR, given their lack of exposure to 4IR technologies, knowledge and skills at school level. As a result, the respective social status of learners will also be affected based on the status of the jobs they will be able to access, given the quality of their educational attainments (Kerckhoff, 1995).

4.5.3. Quality of education in the context of 4IR

All the participants described the quality of the education they had received so far. They reported various factors impacting on the quality of their education.

> *Discipline is a very big issue here. Discipline is 100% the learners' fault and then the strictness is on the teachers and the hierarchy here. They're not as strict as they need to be, so then it gives these children this lackadaisical approach towards things which is not helping anyone.* (P9, Male, 16)

> *The quality is good, it's very good but then sometimes teachers don't come to class. So, we end up falling behind with the work. Like right now, we're behind with Geography. He [the teacher] hasn't been coming.* (P14, Female, 17)

> *Paper at our school is a problem, it's a big problem. Like I said, paper makes our lives easier because then you can just paste and get done with it. But when there's no paper at school, you have to unfortunately write down the notes. That can also be a problem because when you have to write down the notes, let's say it's load shedding, the smartboard would be off. Let's say you don't have data on your phone, and they have to send the work over WhatsApp, how are you going to get the work? (P12, Female, 17)*

Participants also reported their subject choices as influencing the quality of their education. Most participants in this study reported doing subjects like geography, life sciences, tourism and business studies. Very few took mathematics and science, while several of them had swapped these subjects for others especially mathematical literacy, due to difficulty coping or having failed those subjects. Most participants also reported wanting to do subjects that their schools did not offer.

> *I would've liked to do CAT [Computer Applications Technology] as an extra subject, not that I would change it with any of the subjects that I'm doing, no. Or…because there are some schools that are like engineering schools. So, if our school had those subjects it would be cool.* (P10, Female, 17)

> *Yes, CAT, computer classes. It's a bit of a turn off because for career choices, the research I've done, most places are looking for I.T. and without CAT there's no way*

> *you'll get in. It doesn't really affect what I want to do after school but with the learnerships that are going out at the moment, it limits me because most companies are looking for I.T. subjects.* (P8, Female, 17)

Many of them also described their overall perception of the quality of education based on the factors mentioned above.

> *I would describe our school as an A plus school because…let me look at it from this point of view, in matric at our school we get all the support from everyone, from all our subject teachers, the principal and management we get all the support. In terms of resources, we are never told that there aren't worksheets. Even if there's no paper, they would make a plan or they ask some of the learners to bring paper. With textbooks yes, sometimes there aren't enough textbooks […] But for me, our school offers the best education.* (P7, Male, 17)

> *The quality of the education here is not so nice for me, it doesn't grab me, it doesn't keep me interested because there's nothing really. Yes, you learn what you have to but there's nothing extra that you learn and that you can say 'I have a certificate for this or for that,' there's nothing.* (P11, Female, 19)

The narratives above indicate that disciplinary problems among learners, absenteeism among teachers and the lack of or limited resources at the schools impact on the quality of the education that grade 12 learners, in this study, have received. Not only are learners ill-disciplined but the disciplinary actions taken are insufficient. Absenteeism among teachers, and challenges such as lack of paper or electricity cuts result in grade 12 learners falling behind with the syllabus. For this group of learners, the subject offerings at their schools also impact their prospects after school in terms of their skills and what opportunities might be available to them. Most learners had mixed perceptions of the overall quality of the education at their schools with some feeling that it is good, while others feel that it is lacking. These narratives show that it is the confluence of and interplay between several factors that these learners perceive that impact on the quality of their education. The findings correspond with those of Uleanya and Ke (2019), who found that formal education in African nations is unprepared for the 4IR, instead, Africa is still contending with issues associated with the Third Industrial Revolution. That is, computer and communications technology development and use have not been successfully achieved in many African countries. It is evident that the schools in this study are still battling challenges related to discipline, teacher absenteeism and insufficient resources, reminiscent of the apartheid schooling landscape (Hoadley, 2007 in Lam, Ardington and Leibbrandt, 2011). Moreover, the subject offerings at the schools in this study are not remotely aligned with the skills and knowledge required for the 4IR; in fact, neither of the schools even offer basic computer literacy subjects. According to research findings by Setyaningsih (2019), ICT

literacy is a crucial skill in which learners need to be trained in order to fully participate and compete in the 4IR. These findings clearly illustrate that the quality of the education that the group of learners in our study are receiving cannot be described as progressive; it is out of touch with the developments of the 4IR in terms of subject offerings, resources and issues related to governance at schools. As Bhalla and Lapeyre (1997) note, limited access to opportunities such as adequate education and training (in this case, a schooling experience that is not aligned with the developments of the 4IR) influence one's ability to fully participate economically and socially. This suggests that as a result of a poor quality of education, these learners will experience degrees of social exclusion from life and work in the 4IR.

4.5.4. Challenges of schooling in the context of 4IR

Grade 12 learners in this study described various obstacles that they have experienced during their schooling careers.

Many of them reported personal challenges such as the loss of a relative and difficult family circumstances as impacting on their schooling.

> *Okay during my matric…two months back something disturbed me with my studies, which is that my grandmother left us. She was staying with us. She was the breadwinner actually. So, I couldn't come to school because I had to go and help at home. That also impacted my schoolwork. But now I just do the work because it's my last year at school.* (P1, Male, 21)

> *So, at times our phones are not charged or the phone that you use, the screen isn't big enough or it doesn't open some of the PDF files which the tablet is designed to do. So, yes it affects our schoolwork. Normally I go to the internet café, but you know, at times there really isn't money at home. It doesn't… I would call it luxury stuff; it doesn't cover luxury stuff because internet is a luxury. So, at times there isn't money for me to go to an internet café.* (P7, Male, 17)

Most learners also described structural challenges such as electricity issues, resources at school and the covid-19 pandemic as impacting on their schooling.

> *Maybe just the electricity problem that we experience in our community. I get up at three o'clock every morning to study. Sometimes the electricity is off at that time and when I really need it, sometimes I don't get the chance to study because then the power is off. If it comes back on at four or five o'clock then I'll use that time to study because I start getting ready for school at half past six.* (P6, Female, 17)

> *They also don't have paper at school, so they send the work on the groups. Like if there's Life Science work and there's no paper, they send it on the group, and you just have to write it in your book. Sometimes I leave my phone at home, like today, so I had to share with someone. So, it's tough at school ma'am.* (P17, Male, 20)

> *Covid-19 did, especially last year because it all started last year. We were at home for a very long period of time. We fell behind, we had to push with the work and stuff. Okay, we had [WhatsApp] groups, but it didn't always help us, like I said data is also a problem. Even now, for me covid is difficult because you never know who has covid at school or who the next person has been in contact with….* (P12, Female, 17)

The schooling experiences of learners in this study are affected in various ways by personal factors such as death of a family member, and difficult financial circumstances at home. Their experiences are also affected by factors beyond their control such as power cuts in the area, the lack of resources at school and the coronavirus pandemic. These challenges result in learners being unable to attend school or do their schoolwork effectively, and thereby possibly falling behind or not producing quality work. To cope with such challenges, learners take initiative and personal responsibility such as waking up early in order to study, prioritising their studies and sharing resources where possible. Although the Department of Basic Education deployed various platforms using television and radio stations to continue teaching and learning during the pandemic (Mhlanga and Moloi, 2020), none of the participants mentioned using any of those. Mhlanga and Moloi (2020) also highlight government's partnerships with network providers to offer zero-rated applications and educational websites. However, according to participants in this study, internet access was still a challenge due to the cost of mobile data. These experiences of grade 12 learners in the context of the 4IR, especially those related to lack of finances, lack of resources at school and the impact of the coronavirus pandemic, highlight the unpreparedness of these schools for teaching and learning in the 4IR. The findings suggest that if families and communities are still facing difficult financial circumstances, which is a harsh reality given the high unemployment rates in South Africa, and learners are not sufficiently supported with the necessary devices nor other resources, in order to undergo learning in a reasonably effective and efficient manner, then government and the schooling system should re-evaluate incorporating the 4IR in schooling. Therefore, the lack of resources and infrastructure should first be adequately addressed so that 4IR technologies and more appropriate teaching practices can be optimally implemented in schooling.

4.5.6. Life goals and the 4IR

Most participants reported having plans or desires to further their studies after school. They mentioned several different academic qualifications as well as their motivations for choosing those particular fields. In addition, participants described other goals for their lives after school in terms of becoming independent and supporting their families.

> *I want to go to university to study medicine, either at Wits or at UCT in Cape Town. After studying I obviously want to get a job and the first thing I'll do is buy a house and take my mother out of [the informal settlement] to a better place. Then I want to buy myself a car and also buy my mother a car. That's what I want to do. I want to be a cardiologist.* (P14, Female, 17)
>
> *I want to study nursing, in particular I want to do midwifery. I don't know, it's just my love for children, I guess. [I want] to be independent. By that I mean earning my own money, being able to purchase a home or a car and then obviously after that I would like to help my parents with my brothers as well, like pay for their schooling and so on. I'd like for them to go to a better school.* (P4, Female, 17)
>
> *I'd say to go to university and study further, so that one day I can get out of the poverty or the environment that I'm in and have a better life for myself and my family. I wanted to study T.V. presenting. I want to be a presenter. So far, no ma'am, I haven't really applied to university or bursaries*. (P20, Male, 18)

These narratives indicate that grade 12 learners in this study have high aspirations for their lives in comparison to their current circumstances. Their aspirations primarily involve obtaining formal qualifications which will enable them to take up different professional jobs. Their main respective motivation for choosing their particular paths appears to be the desire for financial freedom so that they are also able to help provide for their families. These particular narratives speak about striving for better lives for themselves and their families. According to Kerckhoff (1995), there exists a relationship between the attainment of children's social status over time and that of their parents, based on their social status of origin and educational attainments. When considering these participants' social status of origin and their parents' educational attainments and occupations, in most cases, participants' aspirations exceed their parents' educational attainments and occupations. For example, participant 4 describes her desire to study nursing and eventually become a midwife. However, her parents' highest level of education are grades 11 and 12 respectively; they have both previously worked in a warehouse and are both currently unemployed. The progression of these learners' social status will only become evident over time, as in if, and when they enter the labour market, and whether they manage to fulfil their aspirations for tertiary education. However, the possibility of these learners changing their social status of origin is already evident based on their progress to grade 12 and the nature of their career goals, which, in several cases outdo the educational attainments and status of their parents' jobs (Kerckhoff, 1995).

Moreover, the career aspirations of these young people are far removed from jobs and skills linked to the 4IR. Literature on the changing nature of work indicates that many jobs in various sectors will be at risk due to automation associated with the 4IR. These jobs include, blue and white-collar

jobs (Marwala, 2020), and the impact will be felt even more so by young people who do not have the digital and technological skills to be able to compete in the 4IR economy. The next section discusses how the learners in this study may find themselves among those who will face difficulty accessing work, given they do not appear to have the required skills for jobs of the future.

4.5.7. Skills and knowledge for life after school

When asked what skills participants perceived to be helpful to their chosen career paths, most participants described their innate characteristics.

> *I think I'm a hard worker and I have people skills. When you're a biomedical engineer you need to know how to work with people because you're going to be interacting with a lot of people, a lot of patients and stuff.* (P10, Female, 17)

> *Communication skills because I'm good at communicating. I think another skill would be listening skills. I feel like if I'm a teacher one day and there's a child with a problem or something and they come to me, I could actually listen to what they're going through and also help them with whatever they're going through.* (P12, Female, 17)

Participants were also asked about the knowledge they had of their chosen career paths. Responses ranged from not having the necessary knowledge, to knowing that there is a market for their chosen careers.

> *We learnt that you can help people in many different ways. You can try to understand their situation better in different ways and help sort it out from your perspective. I just need English and Life Orientation to become a social worker, and just computer classes.* (P13, Female, 17)

> *It's [copywriting] something in a company…it's an act of…like if the computers are on a good point or form, something like that yes. Maybe they can't rob money because the computers can scan the money so that they can't be robbed. So, it's something like that.* (P18, Male, 18)

> *It's like a…yes, a degree. So, basically what a biomedical engineer does is that I make equipment, I work with technology that helps doctors, like they get to do their jobs better. I work with patients and doctors. So, maybe someone needs a robotic arm, I get to make that. It's about making the lives of the patients better, something like that. There is a university for biomedical engineering. I even checked the job growth, and it was like 14%, which is pretty good. So, I will get a job.* (P10, Female, 17)

The narratives above show that grade 12 learners in this study do have skills that they perceive will be useful to them after school. They perceive their personal characteristics such as being hard workers, having people skills and good communication skills as beneficial skills for them after school. However, participants' knowledge of their chosen careers appears to range from being

vague, unclear and limited, to knowing exactly what it is about and even what the job market looks like in South Africa. This indicates that these participants may done some research about their chosen careers or simply heard about it from others. The limited or lack of knowledge could have implications for their experiences of tertiary education, insofar as them enjoying and completing their studies. It could also have implications for their overall success in life. Additionally, the skills mentioned by this group of learners are not related to skills needed for work in the 4IR, such as critical thinking, problem-solving and ICT literacy (Setyaningsih, 2019). Sen (1999) notes that one's access to economic opportunities is based on the education and training received. In the context of the digital literacy and technological skills of the 4IR, which learners in this study seemingly lack, their employability in the 4IR economy looks bleak. In other words, while aspects of the country and economy are moving towards the 4IR, the conditions in schools remain poor and too underdeveloped for that context. This infers that learners in this study will be ill-prepared for life and work in the context of 4IR, which will lead to their exclusion from that kind of society. Clearly, poor education, as experienced by these learners, has serious consequences for social status attainment over time and one's overall position in societal power structures.

4.5.8. Exposure to helpful opportunities during schooling

When asked about the opportunities they had been exposed to that they perceived would help them achieve their goals after school, most participants described opportunities outside of school. These opportunities included help from relatives and opportunities in church. Many others reported not being exposed to any helpful opportunities at school or outside of school.

> *Yes, I've been to something like an aviation academy with a friend of mine, where they teach people the basics of how to fly and things like that. Then I have an uncle in Pretoria, he's also a pilot. So, I've asked him for help, but he said maybe we can see next year when I've finished school.* (P3, Male, 17)

> *My mother's eldest sister said she's going to take me to a…what is it called? I don't know what it's called but it's something they host for matriculants every year, like an expo thing where they guide you and so on. But that's only happening in September.* (P8, Female, 17)

> *In church when I was still at Sunday School, I would do these Bible studies and I would be the first one to raise my hand to share my ideas. I would go and teach the others that were lazy to study. So, that's another experience.* (P12, Female, 17)

> *There are no school trips, nothing like that at school. Nothing like career guidance, either ma'am. My brother is my mentor but there's nothing like that here.* (P17, Male, 20)

For these participants, assistance from friends and relatives as well as the church, has been helpful to them insofar as learning certain skills and learning about their chosen careers. While they may not have had these opportunities at school, having a relative who supports them and shows an interest in their goals and plans, appears to be valuable to these participants. However, the lack of directed activities such as career guidance and mentoring, could have implications for the eventual choices these participants end up making upon matriculating (completing grade 12), even where they have noted wanting to further their education. These findings suggest a relationship between a learner's socio-economic background, the quality of education they have received as a function of their socio-economic status, the opportunities they have or have not been exposed to, the skills and knowledge they have acquired as a result of their schooling, and their life goals and ultimate life outcomes. Sen (1999) argues that impeding one set of instrumental freedoms, in this case a learner's social opportunities in terms of their education and lack of participation in social and cultural activities, negatively impacts on other freedoms such as their economic facilities and protective security.

Furthermore, Kerckhoff (1995) states that one's social status of origin combined with the kind of education received, has bearing on one's social status later in life by means of the status of the jobs one is able to take up. In other words, because of their socio-economic backgrounds, learners in this study have received the type of education that is not attuned to developments of the 4IR. They have also not been exposed to opportunities outside of school that could equip them with some skills and knowledge linked to the 4IR. As a result, certain aspirations have been cultivated which are also not attuned to developments of the 4IR and the changing nature of work. Therefore, the capabilities of these learners have been hindered which will aggravate their already low socio-economic status, ultimately leading to further experiences of social exclusion and poor socio-economic outcomes.

PART TWO: KEY INFORMANTS

4.6. DEMOGRAPHIC PROFILE OF KEY INFORMANTS

Table 4.3: Demographic profile of key informants

INFORMANT	ROLE
1	Geography & social science teacher ICT support
2	Life Orientation teacher ICT support
3	Maths & Maths literacy teacher ICT support
4	Principal
5	English teacher Head of Department (English)
6	Principal
7	Institutional Development & Support Officer (IDSO)

Table 3 above displays the characteristics of the key informants in this study. Four of the informants were secondary school educators teaching various subjects, two of them were secondary school principals, and one was an IDSO responsible for overseeing the management of both schools in this study. Three of the informants also played an ICT support role in addition to their teaching roles.

4.7. DISCUSSION OF FINDINGS

Table 4.4: Framework of analysis

THEMES	CATEGORIES	SUB-CATEGORIES
Understanding 4IR and technology in schooling	Defining 4IR	Fast, easy access to resources, people, information.
		A new way of life.
		4IR vs ICT integration in education
	Teacher attitudes towards technology use for schooling	Creating 'hype' only to be disappointed
		Resistance to change
		Optimistic despite challenges
	Advantages of using technology for schooling	"Makes things easier"
		Preparing learners for their futures
		Cuts down costs of resources
		Teachers and learners stay up to date
Teaching in 4IR	Subjects and curriculum content	No 4IR/ICT subjects or curriculum
		Content delivery in line with 4IR
		Technical and vocational subjects
	Fully ICT schools	Already classified by GDE
		Vision for full ICT implementation
	Impact of covid pandemic	Accelerated adoption of technology use in schooling
		Data costs and devices for online learning
Technological resources and infrastructure	How devices are used	Smartboards as large displays
		Syncing devices
		Electronic textbooks & study material
	Challenges with using devices	No internet connectivity
		Theft of devices
		Electricity and cable theft
		Lack of training
Planning, implementation and impact of 4IR in schooling	Training and support	Teacher-driven ICT support
		Ongoing formal training
		Limited training
	Twinning of schools	Township school twinned with former model C school
		Benefits of twinning
		Challenges with twinning
	Schools' preparedness for schooling in 4IR	Schools halfway ready.
		Schools are not ready.

Table 4 presents four major themes, categories and sub-categories from interviews with seven key informants, namely: understanding the 4IR and technology in schooling; teaching in the 4IR; technological resources and infrastructure; and planning, implementation and impact of the 4IR on schooling. These themes emanated from two of the four research questions posed to the key informants, namely:1) How is the Fourth Industrial Revolution understood by teachers, and Institutional Development and Support Officials (IDSOs) in the Ekurhuleni South Education District? 2) What are the perceptions and experiences of teachers and IDSOs on the preparedness of secondary schools in the Ekurhuleni South Education District for teaching in the 4IR?

4.7.1. Understanding 4IR and technology in schooling

Most of the key informants were able to define or describe the 4IR in their own words.

> *Information at your fingertips basically, being able to reach the world from your bedroom, learning from the toilet. It's exciting. I mean our lives…you can go have a look in any classroom, the moment a teacher leaves, the phones come out. The moment a teacher allows you to use your phone to learn from, learners are immediately more interested.* (Teacher 3)

> *I understand that it's a new approach for traditional ways of doing things. There's technology that almost forms the image of the Fourth Industrial Revolution, but it's not just technology. It's a new approach to the way we live, the way we do things, and the way the global society interacts.* (Principal 1)

> *Okay, so the Fourth Industrial Revolution is basically a build up from the First Industrial Revolution where everything was 'machinerised', I'm not sure if that's the right way of putting it. That's when machines were developed, and mass production was developed. The Fourth Industrial Revolution is moving towards a phenomenon where we don't do things by paper anymore, life becomes easier for us, jobs are more electronic, and the uses of the internet and mobile cell phones and laptops take dominance in society. So, it's not a way of learning, it's basically a way of life that society needs to adapt to.* (Teacher 4)

Informants also described teachers' attitudes towards technology use for schooling:

> *So that's basically…you're constantly how can I say, there are expectations created and then the things don't materialise, you understand? We're constantly being let down and it's difficult for people that are set in their ways, "it's just talk, you've been promising this for the last five or six years and we don't see any progress", you understand?* (Teacher 1)

> *The majority of them don't want to change, they're old school like that and it's literally an age thing because I've noticed the older ones still want this old method of pen and paper, printouts. The newer ones believe in this whole technology thing, not that they believe but they've embraced it, it's part of their time, their generation* (Teacher 2)

> *I think the resistance is just due to some ignorance – if you don't know what Excel can do for you, then you'll think "let me stay with what I know." But if you explore that and see how quickly you can calculate and how the data can be processed, then you will grab on to that. We just need to show them this is how you teach that concept and it's much easier. I know teachers will grab on to that if you give them proper training and you explain to them how they can utilise these things*. (Principal 1)

Furthermore, informants described their perceptions of the advantages of using technology for schooling:

> *Yes, we have smartboards. [School C] has the smart TVs which is obviously a lot better than what we're using at the moment. But we have very nice smartboards. A lot of our content is loaded on there, so it's become a lot easier to present lessons, a lot more enjoyable, a lot more interactive, a lot more interesting. The issue: internet access.* (Teacher 3)

> *Our schools can benefit from ICTs with eBooks where there's no expenditure on physical textbooks that we lose easily and vandalise and whatever. So, it's an opportunity, there's serious opportunity for us. So, in education and definitely in teaching it has a serious place because otherwise we are not preparing our learners for their futures. That's how it goes – we must prepare them for their futures and the world is going in that direction.* (Principal 1)

> *So, once we have a platform where a learner is able to go on, even if they are absent because of covid or whatever illness, if we can have a platform where we record the lessons and even if it's a cloud based thing like Google, it would be nice because the learners would log in and not miss out on anything. So, is there a place for technology? 100%*. (Principal 2)

From the narratives above one can see that key informants' understanding of the 4IR is varied. It is not only perceived as being new and offering improved ways of doing things, but also about integrating more technology into schooling. Most educators are eager to incorporate the 4IR into teaching and that where there is resistance to change, it tends to come from older teachers. The informants in this study also recognise some of the opportunities presented by the 4IR for schooling. These opportunities – also observed by the grade 12 learners – include making lessons more interesting and interactive, cutting down on the cost of resources and allowing learners and teachers to stay up to date in cases of absence from school. These findings in part correspond to the work of Kaya and Balta (2016) who found that using a technological response system in the classroom improved learner engagement and made lessons more interactive. Likewise, Srivastava (2018) found that one advantage of technology integration in schooling is the convenience and flexibility that allows learners to access content at any time and place. However, like the grade 12 learners, the informants in this study did not report any advantages of technology use related to improved learner

performance. This is in contrast to the work of Kaya and Balta (2016), who reported that using a smart response system helped point out the gaps in learners' knowledge and assisted teachers with understanding where learners had difficulty. This suggests that teachers in this study are unaware of the potential positive impact that technology use can have on learners' academic performance.

Although the informants in this study did not explicitly name any 4IR-related technologies, their descriptions of electronic textbooks, use of smart LED boards rather than chalk boards and use of cloud-based platforms for learning show that they are aware of some of the indicators of the 4IR. Moreover, an important aspect of successful ICT integration in schooling is the attitudes of teachers towards technology use. The positive attitudes of most teachers are encouraging since it does not appear to be something that needs to be addressed, especially among younger teachers. However, there appears to be some resistance among older teachers, which Oke and Fernandes (2020) argue may reduce their motivation to adopt 4IR technologies in teaching. In other words, there is great potential for the positive attitudes of teachers and their knowledge of the 4IR – albeit limited – to be harnessed to better integrate technology in teaching and learning, in order to provide a schooling experience that is more aligned with the developments of the 4IR. This requires appropriate resources and infrastructure, as well as relevant training be provided. Similar to the findings of Oke and Fernandes (2020), perhaps teacher motivation in underfunded schools such as these is a challenge due to the lack of technology resources and classrooms that are not designed to support e-learning.

4.7.2. Teaching in 4IR

In describing their experiences of teaching during 4IR, informants discussed current subject offerings and curriculum content at their respective schools.

> *I will say mathematics is close to just assisting learners at least to get into that field. But there's nothing in the curriculum, not even the normal 'how to turn a computer on and off' because those are skills that we must have these days – how to print something from an email, how to send an email. There's nothing in the curriculum that I know of that will be able to assist learners in that regard. That's my problem with curriculum these days – it's outdated, and we are also not moving with the times.* (Principal 1)

> *No [subjects and content are not in line with 4IR], it's not but the delivery can be for any subject depending on how creative an educator is. As opposed to having traditional stalls on the school playground, you can have an online store where learners can log in and buy the products. So, it just depends on how willing the teachers are to mediate ICTs in education because not many teachers want to do it.* (Teacher 4)

> *It's mainly the hardware, not really the subjects because the subjects are determined by the SGB of the school. So, we do have technical subjects, but we are not classified as a technical school, so there's a difference. So now, what the community and the previous SGBs looked at is the fact that there a lot of learners who will not have the capacity to go to…not really the capacity but the financial backing to go to university and even to FET (Further Education and Training) colleges sometimes. But what they looked at was giving the learners skills that when they exit grade 12 at least they've got a skill that they can take with them. That's why we've got welding, fitting and we've got electrical studies incorporated in the school.* (Principal 2)

Informants also discussed the classification of schools as full ICT schools.

> *I'm looking at this school, every single class here with a smartboard, every learner with a tablet, Wi-Fi connectivity at the school in such a way that we mustn't even struggle with connectivity issues. More than three labs for learners to put ICT on to the curriculum and to look at our curriculum differently, not only the normal maths and sciences, but look at technical maths and technical science and to bring in robotics and coding and even just basic ICT skills or computer skills because some learners don't even have the exposure just to a basic skill*. (Principal 1)

> *Okay, our school is classified as an ICT school but that's a lie. As an ICT school we are supposed to have smartboards in each and every classroom, which we don't. We only have 24 smartboards at the school currently. We are also supposed to have laptops for all the teachers and tablets for each and every learner.* (Principal 2)

Informants further discussed the impact of the covid-19 pandemic on their experiences of teaching.

> *So that's why I'm saying there's lots of value in going the digital route as far as education is concerned. Just look at what covid has done now. If it wasn't for covid then I don't think we would've adopted technology as rapidly as we have. If we had the resources… some of our teachers even tried doing it the WhatsApp way by using their own data to try and get lessons to some of the learners.* (Teacher 1)

> *Our biggest challenge really came in with the lockdown last year when we were supposed to learn online. But you know children are… we are a no fee-paying school so you can imagine people have issues in their homes, so children cannot afford that data. So, we suffered quite heavily with that, we basically taught via WhatsApp, you know.* (Teacher 3)

Informants' experiences of teaching do not demonstrate any knowledge and/or skills of the 4IR in terms of subject offerings and curriculum content, and resources and infrastructure available at the schools. The schools do not currently offer any ICT subjects such as Computer Applications Technology or Information Technology. This is especially concerning given that the one school is classified by the Gauteng Department of Education as an 'ICT school', albeit that the school has very limited ICT infrastructure and resources and no ICT subjects. Based on the current curricula and the subject offerings, Uleanya and Ke (2019) would argue that these two schools are

underdeveloped and unprepared for teaching and learning in the 4IR. Little teaching and learning occurred at these undeveloped schools during the covid-19 pandemic as they could not afford the technology required to operate online. The absence of electronic learner devices, and a lack of access to data or Wi-Fi, were the biggest contributors to the negative impact of the pandemic on school children. This finding concurs with the work of Mhlanga and Moloi (2020) who found that due to poverty which limits access, many learners were still unable to access data and educational websites during the hard lockdown period. Consequently, online teaching and learning could not be implemented effectively during school closures. The implication of this for these underprivileged learners is that they were once again left behind, while better resourced schools and learners were able to keep up and continue with the curriculum. Following Bhalla and Lapeyre's (1997) definition of social exclusion, because of these learners' lack of access to economic resources and goods in the form of new technologies to ease their schooling, their integration into society after school would be affected due to the poor quality of education they received; i.e. not aligned with new technological developments, and which would not equip them with the necessary skills and knowledge required in the 4IR context post-secondary schooling. This could subsequently result in the further exclusion of already underprivileged learners.

4.7.3. Resources and Infrastructure

Informants discussed at length, the resources and infrastructure at their disposal, in terms of how technological devices are used and the challenges they experience with using those devices.

> *So basically, we were given a product and you have to figure it out all on your own and that is why you'll notice, if you walk around, you'll see these things: I don't have something to write on so I must get something to display the information. Here and there I'll try and download a video for myself and I tell the kids "there in your textbook it's just going to show you a picture, here is a video clip where you can follow the process." But in many cases, it's just being used as a large display and then the learners have to write from the board and so on.* (Teacher 1)

> *I use the smartboard. That's life and I call it life because all of my lessons are on my laptop, so I take my HDMI cable and I connect it to the smartboard. And everything I have on my laptop, everything I've downloaded while I was browsing the net is on there and I can project it to the learners. The Department has also given us dongles with data on them. So, if I think of something creative in class, then I can quickly search for it on the net and show it to my kids* (Teacher 4)

> *Majority of our learners come from a place where there's no electricity. Because not every learner is able to charge the tablets, majority of the time you'll find that the learners are really not interested in it because 'why bother because we cannot even charge this thing.' And the quality of the tablets are not very good. The tablets that we*

> *had are not Wi-Fi enabled yet. Then, you must also remember that once a school has been classified as an ICT school, the community knows about it and the community knows the value of what is in the classrooms. That's why there are a lot of break ins in order for them to take what they need from the smartboards.* (Principal 2)

The schools in this study primarily used smart LED boards, as opposed to the traditional chalk boards. However, not all classrooms were fitted with smartboards nor did the schools have internet connectivity to enable the smartboards to be connected to the internet. As a result, in most cases teachers used the smartboard only to display learning material from textbooks, tests and activities. In other words, the smartboards were not used optimally. The narratives also indicated that learners at both schools were supposed to have received tablet computers for learning. However, at the time of this study, they had not. The informants reported that synchronising learner devices with the teacher's laptop or the smartboard in the classroom was an effective way of integrating technology in schooling. However, as a result of the absence of these tablets and internet connectivity, this was definitely not happening at these schools.

Broader community issues such as a lack of access to electricity, the theft of power cables, as well as theft of devices and damage to the smartboards have created even greater challenges with integrating technology at these schools. As found by Sikhakhane, Govender and Maphalala (2021), load shedding and the rampant theft of power cables in this community, hinder the effective use of these technologies. Consequently, teachers often have to revert to traditional teaching methods using paper and textbooks, which are often under resourced. These findings are consistent with Gulati's (2008) study which found that the lack of resources and infrastructure, and socio-economic conditions in developing countries contribute to the educational gaps of learners. At the schools during this study in 2021 and in the context of the 4IR, there were no computer skills being taught nor did learners have any access to computers in the school setting. In contrast, a study by Adeosun (2010) revealed that at least 29.85% of teachers in Nigeria actually taught computer skills. This highlights how far behind these schools are in comparison to other countries on the African continent.

4.7.4. Planning, implementation and impact of 4IR in schooling

The informants in this study discussed their perceptions of the planning, implementation and impact of 4IR and ICT integration at the schools. Informants described the different training and support they had received.

> *But even with that when they came to install the boards, there was no formal training provided to the teachers. So, we're about two or three that just took the initiative to…if*

teachers have enquiries about how to do this…I mean those boards have been here at the school for the last three or four years…I went to another class yesterday because I had to compile a report for the service provider about the boards that we have issues with. The teacher only discovered yesterday "hey but there's material, I've been asking around and here's material on the board." (Teacher 1)

They came to train the teachers and whatever, which is a good thing but then what happens is that they leave, the burden is handed over to the ICT team. And like I said the ICT team is first teachers. So, if you have to choose between the two then you'll rather first fulfil your role in the classroom. (Teacher 3)

Informants from School B as well as the IDSO discussed the process of twinning in which that school was participating.

You see, because we are twinned with School C, everything that is in School C needs to be replicated in School B. So, part of the perks of being a twinned school is smart-boards, tablets and laptops for every teacher, every learner and every classroom. But four years later we're still waiting. We're still waiting, so not everything has materialised the way the government promised. (Principal 2)

GDE has a system, in fact the idea came when we were saying we want to bridge a gap between the so-called ex-model C schools and our township schools. So they came up with the idea of twinning schools. School C is very good when it comes to ICT. One challenge is that School B is no fee-paying school and when you go to School C, there's a lot of money there because children are paying school fees. So, School B has to wait for the GDE to give but that side, because they've got funds, they can always do whatever. (IDSO)

All informants perceived the implementation process as not having been planned properly given there were several safety and security concerns. Informants further asserted that learners were currently not being adequately prepared to live and work in the 4IR. Most informants stated the schools were not yet ready for schooling in the 4IR.

Yes, we're not ready. We're far from being ready. There are still a lot of things that need to be fixed like policies. There's still a lot like security, I think the security is very compromised. Teachers need to be on board because a lot of teachers are a bit resistant. So, we have a long way to go but hopefully eventually we'll get there. (Teacher 4)

School B per se, I'll rate School B as still in amber. It is not green; it is not red but amber for one simple reason: most people know how to use the skill. Though not all of them have access but we are getting there. Our intention is to make sure that we push them so that we end up being in green. (IDSO)

I brought in a few companies just to come and check what I have and where I can add, and what path I should lead and follow. I thought we at least had something because we

> *have 27 smartboards, we have our own small computer lab that we started, we have a small network, we have some routers for internet, we have the GDE router also. The experts came and they shocked me to say, "actually you guys have nothing as yet, so it means you start from zero." It's not workable for what we plan to achieve and all that.* (Principal 1)

From these accounts one can see that the ICT training provided to teachers is lacking in that it is limited in both time and content, and not ongoing. Although the smartboards have been at the schools for three or four years, there has never been any formal training provided to teachers on how to use them. This has resulted in some teachers taking the initiative to learn on their own, and others only recently discovering that the smartboard is loaded with crucial teaching material. The narratives also indicate that much of the ICT support offered to teachers comes from their busy colleagues as opposed to dedicated ICT support staff. As a result, teachers often split their time between their teaching and ICT support roles. Various literature indicates that technology integration and use at schools is strongly linked to the professional development and support of teachers (An and Reigeluth, 2012; Levin and Schrum, 2013; Mathevula and Uwizeyimana, 2014; Derbel, 2017). As these findings show, both are greatly lacking at the schools in this study.

In an attempt to develop or improve one of the schools, School B has been paired with a former Model C school, School C. (This twinning process is also used to reinforce the integration of ICTs in schooling.) However, as pointed out by the informants in this study, School B is a no fee-paying school with very limited resources and infrastructure whereas School C is a fee-paying school and is, therefore, far better resourced. Chertok, Mittelberg, Laron and Koren (2013) found that typically, in twinning processes involving one high-income and one low-income school, there are significant organisational differences in terms of the structure, demographics, size, and staffing of the respective schools. This not only impacts on the twinning process but may also cause a sense of inferiority among learners and educators from the less privileged school (as illustrated by the narratives of the IDSO). Therefore, the twinning of a township school with a former Model C school presents questions regarding power relations and equitable partnerships as highlighted by Gallwey and Wilgus (2014).

Makgakga (2016) and Papadakis (2016) highlight the purpose of twinning as improving learner outcomes. However, the informants in this study did not mention this when discussing the twinning of these schools. Finally, the narratives on schools' preparedness for teaching and learning in the 4IR indicate that the schools in this study are not fully prepared. This unpreparedness stems from what seems to be poor planning in terms of putting in place policies and security measures to guard against theft and damage to resources and infrastructure, the lack of resources and infrastructure,

insufficient training and professional development of teachers, and inadequate ICT support for teachers. As the literature shows, these measures are central to successful ICT integration in schools and ultimately, to schooling that is aligned with the 4IR (An and Reigeluth, 2012; Levin and Schrum, 2013; Mathevula and Uwizeyimana, 2014; Derbel, 2017; Skhephe, Caga and Boadzo, 2020; Sikhakhane, Govender and Maphalala, 2021).

Researcher observations of infrastructure and management of schools

While this was not an ethnographic study and the researcher did not take extensive notes, there were some observations made on the infrastructure and management of the schools. The two schools seemed to run very differently despite being located in the same community and facing the same challenges. For example, School A is located in a recently rebuilt school building and is still in good condition. While not all the classrooms were fitted with the smartboards, the premises were always clean and tidy. The researcher noted that in classrooms where there was a smartboard, the teacher mostly talked from the front of the room, and learners took notes. The researcher noted that some teachers, at times, dictated from a textbook and learners took notes accordingly. There was always a sign-in book, hand sanitiser and personnel were stationed at the main entrance. The school had more than one photocopy machine, the principal and deputy principal each had an office with a desktop computer and printer that were connected to the school's network. Each administrative staff member had a desk with a desktop computer.

At School B, the researcher observed in total, two printers/photocopiers. The two deputy principals shared an office which had one desktop computer and also served as a copy room. The principal had a separate office with a laptop computer. There were several prefabricated classrooms where the grades 8 and 9 learners were accommodated. Despite this school being classified by the Gauteng Department of Education as an ICT school, not all the classrooms contained the smartboards. The classrooms which were equipped with a smartboard were called "smart classes" and were supposed to have additional power sockets for learners to plug in their tablet computers. However, the researcher did not notice additional power sockets and as mentioned by the informants and learners, at the time of this study the school had not received its learner tablet computers. The researcher did, however, note that the smartboards were always on and in use, albeit that the teacher was mostly talking from the front of the room and learners were taking notes from the board. On two occasions, the researcher noted that learners were using the smartboard to watch a movie while the teacher was out the classroom. One of the participants from this school mentioned that sometimes learners had a free period when a teacher did not show up to class and they would use the time to watch cartoons or movies on the smartboard.

Additionally while there was always a security guard present at the main entrance, hand sanitiser and a sign-in book were not always available. The researcher noted that the administrative staff at reception often huddled together in front of heaters in their office space. Two final observations made were that at times, the window at reception was closed, and often the researcher was not attended to immediately.

4.8. INTERPLAY BETWEEN THE FINDINGS

This section presents some commonalities and discrepancies between the findings from the different groups of participants in this study, as well as the researcher's observations during data collection at the schools. Subsequently, an attempt is made to present an argument for what this means for the grade 12 learners and the schools in this study.

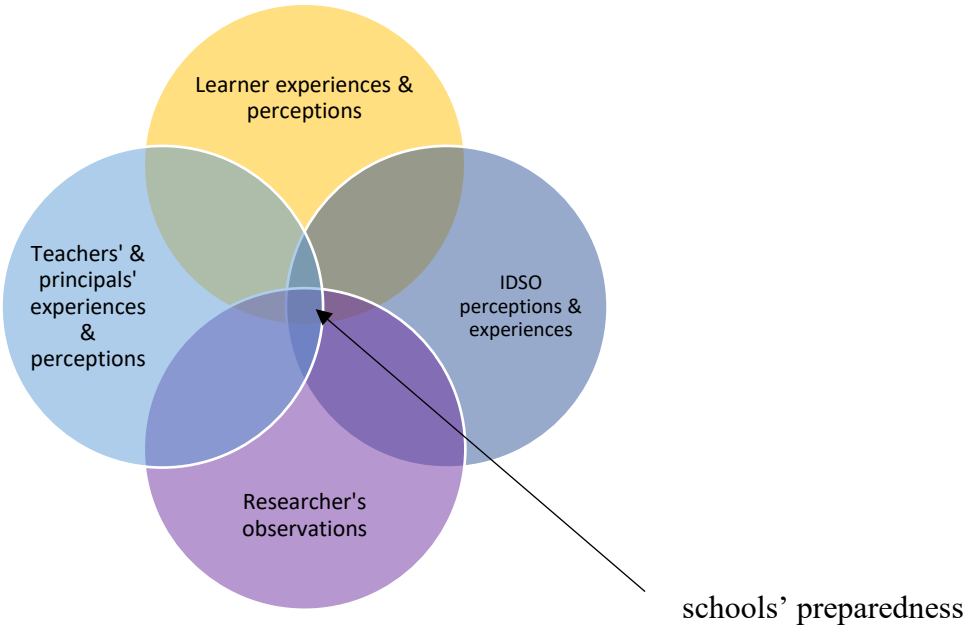


Figure 4.1: The relationship between different sets of findings

Figure 3 shows the relationship between the findings from the different groups of participants as well as the researcher's observations of the schools. The overlapping parts of the circles represent similarities between the findings, while the centre point where all four circles intersect represents the convergence of all the findings, which indicates that the schools in this study are not fully prepared for teaching and learning in the 4IR. All participants in this study agreed that the smartboards were very useful to teaching and learning, since they could be and were used to display various types of media, making lessons more interesting and interactive. They also agreed that since the smartboards were loaded with teaching and learning materials, learners were able to stay up to

date with the syllabus even in cases where teachers were absent. They further agreed on the challenges experienced with the smartboards and other devices due to theft, power outages, and lack of access to devices and internet connectivity. All the participants also agreed on the impact of the covid-19 pandemic in terms of school closures and falling behind with the syllabus, as a result of a lack of access to devices and internet connectivity. A huge challenge was that the schools had not received learner tablet computers at the time of this study. Finally, the learners' descriptions of disciplinary problems and teacher absenteeism, reflected what the researcher observed during data collection at the school.

Essentially, the findings of this study show that learners from low socio-economic backgrounds have limited access to good quality educational resources, and a schooling experience that incorporates newer technologies and teaching practices. Status Attainment Theory as described by Kerckhoff (1995) helps one understand how learners' experiences of schooling in the 4IR impact upon their employability, and their consequent status in society. This in turn helps one understand how social stratification may be perpetuated by institutional arrangements, in this case the school, and how this might manifest in the socio-economic outcomes of learners currently, and later on in life.

There are some inconsistencies between the findings from the different groups of participants. First, while the key informants were able to provide their interpretations of the 4IR, the grade 12 learners were not. While these interpretations were not exactly in line with the literature, it is encouraging to find that role players such as the informants in this study, have a basic understanding of the role of 4IR in schooling and are able and willing (see 4.7.1) to participate in its activities, provided that the necessary resources, infrastructure and training are provided. The fact that the learners could not articulate an understanding of the 4IR, indicates that it does not form part of the curriculum, at least not for the subjects that they are taking, and also that teaching is not done in a way that purposely and meaningfully incorporates the topic. For Sen (1999) this constitutes capability deprivation. In other words, the social opportunities (i.e. education) of these learners affects their economic facilities (i.e. participation in the labour market). According to Sen (1999), deprivation of one set of freedoms has a direct or indirect impact on other freedoms. Because learners are not equipped with 4IR-related skills and knowledge at the school level, this has implications for how they will be able to engage with the technologies and opportunities presented by 4IR after school.

Second, there are some inconsistencies regarding the twinning of School B and School C. The Principal 2 described the school's relationship with its twin as good. However, the IDSO mentioned

that the relationships between the management teams as well as the learners from the two schools needed to be strengthened. The IDSO also mentioned that the two schools needed to make better use of the resource-sharing component of twinning. Because School C is classified as an ICT school and due to the twinning process, School B has also been classified as an ICT school. However, at the time of this study the school did not have all the necessary ICT infrastructure and resources, and neither of the schools had any ICT subjects. Instead, School B offers technical subjects such as welding, fitting and machining and electrical studies, which according to the principal, are more relevant for this community given that not many learners are able to continue their studies at a tertiary level, due to finances. The aforementioned findings raise questions regarding the usefulness of the twinning of School B, given its specific socio-economic context. Twinning as described by the informants in this study also does not seem to correspond with the intentions of the process as per the literature. This raises questions about whether this decision was thoroughly thought through and based on evidence or was simply haphazard as it appears to be.

Third, teachers' descriptions of how they used the smartboards differed. Teacher 4 was the only one who described her use of the smartboard in a manner that appeared to indicate effective, optimal use of the board. She was also the only one to mention that the Gauteng Department of Education had allocated data dongles to teachers, which enabled her to connect the smartboard to the internet. All the other informants described challenges with internet connections, and mentioned that they often used their own resources such as mobile data to connect to the internet. Teacher 4's description was also inconsistent with the researcher's observations of how teachers used the smartboard i.e. teachers primarily speaking from the front of the room and learners writing notes from the board.

4.9. CONCLUSION

This chapter has presented the major findings of a research study to assess the preparedness of schooling for the Fourth Industrial Revolution, using the case of two secondary schools in the Ekurhuleni South Education District in Gauteng Province. The findings from interviews with grade 12 learners reveal seven major themes, namely, understanding the 4IR and technology use for schooling; technology used at school; quality of education during the 4IR; challenges of schooling in the 4IR; life goals; skills and knowledge for life after school; and exposure to helpful opportunities. The findings from interviews with teachers, principals and an IDSO reveal four major themes, namely, understanding the 4IR and technology use in schooling; teaching in the 4IR; resources and infrastructure; and planning, implementation and impact of the 4IR in schooling. Although most learners in this study could not articulate what the 4IR is about, they did show some awareness of some of 4IR-related technologies. In contrast, most teachers were able to describe the

4IR in their own words, indicating that they have a basic understanding of the concept. The findings indicate that the teachers and learners in this study experience various challenges relating to the implementation of teaching and learning that is aligned with the 4IR. The major challenges are the lack of technology and other resources and infrastructure at schools, and insufficient technology training and support for teachers. Overall, the findings suggest that the schools in this study are not prepared for schooling in the 4IR.

CHAPTER FIVE:

CONCLUSIONS AND RECOMMENDATIONS

5.1. INTRODUCTION

The concluding chapter presents the main conclusions of this study, in relation to the four research objectives. Recommendations based on the conclusions of this study are also offered.

5.2. SUMMARY OF MAIN FINDINGS

5.2.1. Objective 1: To investigate how the 4IR is understood by learners, teachers and the IDSO in the Ekurhuleni South Education District

The learners in this study were not aware of and could not articulate an understanding of the 4IR. However, they did show some awareness of 4IR-related technologies such as 5G technology, automation, artificial intelligence and robotics. Conversely, the teachers, principals and the IDSO were able to articulate an understanding of the 4IR, though their interpretations were not necessarily aligned with the literature. They understood the 4IR as fast and easy access to resources, people and information; they perceived it as a new way of life and they made the distinction between 4IR and ICT integration in education. The learners and key informants alike, noted the advantages of technology use for schooling such as making teaching and learning easier and more interesting, as well as allowing teachers and learners to stay up to date with the syllabus.

5.2.2. Objective 2: To determine what the perceptions and experiences of teachers and IDSOs are on the preparedness of secondary schools in the Ekurhuleni South Education District for teaching in the 4IR

The perceptions and experiences of informants in this study indicate that the schools in this study are not prepared for teaching and learning in the 4IR. While one school is classified as an ICT school, both schools lack sufficient ICT infrastructure and resources to implement teaching that is 4IR-aligned. The schools seem to only have smart LED boards and they experience several challenges such as no internet connectivity, issues with electricity and the theft of power cables and devices which impact on how the technology is used. The covid-19 pandemic has also significantly adversely impacted teaching and learning, and the lack of ICT resources and infrastructure have been the biggest contributors to poor learning during this period. Additionally, teachers have not received adequate training and do not enjoy sufficient support to successfully integrate the 4IR in teaching. Neither of the schools currently offer any ICT subjects and curriculum content does not seem to contain any knowledge required to prepare learners for the 4IR.

5.2.3. Objective 3: To find out what learners' experiences are of schooling in the 4IR

Of the technologies available for learning, learners reported using mostly the smart LED boards and their smart phones. However, challenges with load shedding, theft of power cables and technical difficulties with the smartboards affect how well teaching and learning takes place. Learners also experience challenges with their smart phones such as lack of access to data or Wi-Fi which makes it difficult for them to access activities sent via WhatsApp Messenger. These challenges often result in learners falling behind with their schoolwork. Issues with discipline, teacher absenteeism, lack of resources and infrastructure and subject offerings at schools, impact on the quality of education this group of grade 12s have enjoyed. Personal challenges such as death of a relative and difficult family circumstances have also negatively impacted learners' experiences of schooling. Additionally, structural challenges such as the covid-19 pandemic, poor school infrastructure and lack of resources have also adversely affected the schooling experiences of this group of learners.

5.2.4. Objective 4: To ascertain how learners perceive their schooling experiences to help them after school

Despite the socio-economic background of learners and their experiences of schooling, they have high aspirations for their lives, which are mostly related to academic qualifications and professional work. Overall, the skills that learners perceive to be useful to them after school, are innate personal characteristics and not necessarily acquired skills as a result of their education. Additionally, learners in this study do not seem to have the type of skills required for work in 4IR such as basic ICT literacy. While most learners in this study have not been offered career guidance and/or mentoring, many of them have relatives and community connections which they perceive as being beneficial to them after school.

5.3. MAIN RECOMMENDATIONS

Based on the major findings, the following recommendations are made:

5.3.1. Recommendations to schools and the district

The Ekurhuleni South Education District office in partnership with the schools should formulate and implement measures to protect resources and infrastructure from damage and theft. These measures should also cater to improve retrieval of learner devices that are often not returned due to loss or theft. One such measure could be a penalty of a fine for learners who do not return devices at the end of the school year. Another measure could be that learners are given a device to own for the duration of their high-school career. The aim of such measures is that once learners take ownership of such resources, they will take better care of them, i.e. the devices.

5.3.2. Recommendations to the Gauteng Department of Education

The provincial department of education should offer better training and professional development to teachers so that they are better equipped to use the technologies available to them, even though they are limited. The training should focus on how to use the technologies in the classroom as well as how to use the technology to prepare lessons, activities, etc. The provincial department should also consider deploying ICT support teams to offer onsite ICT support to teachers. This is so that teachers do not have to split their time between their teaching and ICT roles and can dedicate more time to teaching. It is also so that ICT queries can be dealt with immediately, as opposed to teachers having to troubleshoot as they go along or taking the time to teach themselves after school.

In terms of the twinning of School B perhaps it could have been implemented gradually by starting with first pairing teachers of certain subjects. In this way, certain teaching practices could have been imparted in order to improve the learning outcomes in School B. The twinning could have later focused on ICT integration as policies, resources and infrastructure were put in place. The Gauteng Department of Education should also consider improving the incorporation of the 4IR and related topics in to curricula. Although the learners in this study knew about 4IR-related technologies such as 5G and robotics, most of them had never heard of the concept itself.

Perhaps the department, districts and/or schools should also consider employing counsellors based at the schools who can offer career guidance and psychosocial support to learners. These counsellors could assist learners with making subject choices more in line with their career and/or life goals. These counsellors could also offer learners resources regarding all the options available to them after school.

5.3.3. Recommendations for further research

This qualitative study was limited in that it only explored the experiences and perceptions of learners, teachers, principals and one IDSO from two secondary schools in one schooling district. Future research could employ a nation-wide quantitative study and include other stakeholders such as policymakers and educational experts. Further research could also use a mixed method design to include extensive ethnographic observations to determine exactly how technologies are used in the classroom, and the teaching methods used by teachers in the context of 4IR. Document analyses of curricula could also be included to determine exactly what is contained in curricula as it relates to the 4IR. How effective the twinning process of School B and School C has been remains unclear and future research could also investigate this.

5.4. CONCLUSION

This chapter has offered the main conclusions of a study assessing the preparedness of schooling in the 4IR, as they relate to the objectives of the study. Recommendations are made to the schools and Department of Basic Education at the provincial and district levels. Recommendations for future research have also been made. This study contributes to informing government, academics and organisations working within the basic education sector of the current state of affairs in schools, as it relates to the challenges that schools experience in integrating 4IR and ICTs in schooling. The study also raises questions regarding the readiness of learners for life and work in the 4IR, given the myriad of challenges they experience while schooling in the 4IR context.

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APPENDIX A

University of Cape Town
Department of Social Development

Parental Consent Form for Research with Learners

Name principal researcher: Zena Haynes
Student no.: HYNZEN001
Contact no.: 0745698038
Email address: HYNZEN001@myuct.ac.za

Title of Study: The Preparedness of Schooling in the Fourth Industrial Revolution: The Case Study of the Ekurhuleni South Education District Community in the Ekurhuleni Municipality.

Introduction:

Your child is invited to participate in a research study being conducted by Zena Haynes, a student in the Department of Social Development, at The University of Cape Town.

Purpose:

The purpose of the study is to find out how schools in Ekurhuleni South Education District are using technology in the classroom and teaching learners about new technologies associated with the Fourth Industrial Revolution.

Procedures:

An interview will be done with your child about his/her experiences of schooling in Ekurhuleni South Education District and his/her ideas and opinions about using technology for schooling. Due to covid-19 lockdown and social distancing regulations, an online interview will be done

via WhatsApp or Zoom meeting. Data will be supplied to your child in this case. However, if your child does not have access to a smartphone or computer, a face-to-face interview will be done. The interview will not be more than an hour long and will take place after school.

Risks and Discomforts:

There are no immediate risks associated with this study. The study will be explained to your child and he/she will be given a chance to ask questions at any time during the interview. Your child will also be made aware that he/she does not have to share any information which they do not wish to share.

I, _____ (parent/guardian) of _____ (child's name), give permission for my child to participate in this study.

If you have any questions/concerns, you are welcome to contact Zena on the number above. Please return this form to Zena through your child.

_____

Parent/Guardian's signature

_____

Date

APPENDIX B

University of Cape Town
Department of Social Development

Assent Form for Learners to Participate in a Research Study

Name principal researcher: Zena Haynes

Student no.: HYNZEN001

Contact no.: 0745698038

Email address: HYNZEN001@myuct.ac.za

Name of study: The preparedness of schooling in the Fourth Industrial Revolution: The case study of Ekurhuleni South Education District Community in the Ekurhuleni Municipality

I understand that I have been asked to participate in a study about: Finding out how schools in Ekurhuleni South Education District are using technology in the classroom and teaching learners about new technologies associated with the Fourth Industrial Revolution.

I will be asked to **talk about my experiences of schooling in Ekurhuleni South Education District and my ideas and opinions about technology.** This will take about **60 minutes**. I understand that I do not have to participate. If I do participate, I can quit at any time.

I also understand that **I do not have to answer any questions I don't want to answer** or do anything I do not want to do.

My parents, teachers, or anyone else will not know what I have said or done in the study. No one but the researchers will know.

I understand that this interview will be recorded and only available to the researcher for research purposes.

If I have any questions or concerns about the study, I can call and ask the researcher about them.

When I sign my name, this means that I agree to participate in the study and that all of my questions have been answered. I have also been given a copy of this form.

Name of participant: _____
Signature: _____

Name of researcher: _____

Signature of researcher: _____

Date: _____

APPENDIX C

University of Cape Town
Department of Social Development

Consent Form for Research with Teachers

Name principal researcher: Zena Haynes
Student no.: HYNZEN001
Email address: HYNZEN001@myuct.ac.za

Supervisor: Dr Khosi Kubeka
Email: am.kubeka@uct.ac.za
Telephone: 0216503494

1. TITLE OF RESEARCH STUDY

The preparedness of schooling in the Fourth Industrial Revolution: The Case Study of the Ekurhuleni South Education District Community in the Ekurhuleni Municipality.

2. NATURE OF RESEARCH

One semi-structured interview will be conducted regarding the participant's experiences and perceptions of the use of technology in the classroom. Due to covid-19 lockdown and social distancing regulations, an online interview will be done via Zoom Meeting.

Audio recordings and transcriptions of interviews will be stored safely and treated confidentially.

3. PARTICIPANT'S INVOLVEMENT

The participant is required to participate in an interview and give honest information on the research topic. The interview will be about an hour long.

The participant is reminded that there are no right or wrong answers to questions.

4. WRITTEN CONSENT

4.1. I voluntarily agree to participate in this research study.

4.2. I have read the consent form and understand the information it contains and had the opportunity to ask questions.

4.3. I agree to my responses being used for research on condition that my privacy is respected and subject to the following:

- I understand that my name will not be disclosed but that a false name will be used and that the contents of the interview will be used in such a way that I will not be personally identifiable.

- I understand that this interview will be recorded and that the only person who may have access to the recording will be the principal researcher.

- I understand that I am under no obligation to take part in this study and that I can withdraw from this study at any stage.

Name of participant: _____
Signature of participant: _____

Name of researcher: _____
Signature of researcher: _____

Date: _____

APPENDIX D

University of Cape Town
Department of Social Development

Consent Form for Research with a School Principal

Name principal researcher: Zena Haynes
Student no.: HYNZEN001
Email address: HYNZEN001@myuct.ac.za

Supervisor: Dr Khosi Kubeka
Email: am.kubeka@uct.ac.za
Telephone: 0216503494

5. TITLE OF RESEARCH STUDY

The preparedness of schooling in the Fourth Industrial Revolution: The Case Study of the Ekurhuleni South Education District Community in the Ekurhuleni Municipality.

6. NATURE OF RESEARCH

One semi-structured interview will be conducted regarding the participant's experiences and perceptions of the use of technology in the classroom. Due to covid-19 lockdown and social distancing regulations, an online interview will be done via Zoom Meeting.

Audio recordings and transcriptions of interviews will be stored safely and treated confidentially.

7. PARTICIPANT'S INVOLVEMENT

The participant is required to participate in an interview and give honest information on the research topic. The interview will be about an hour long.

The participant is reminded that there are no right or wrong answers to questions.

8. WRITTEN CONSENT

8.1. I voluntarily agree to participate in this research study.

8.2. I have read the consent form and understand the information it contains and had the opportunity to ask questions.

8.3. I agree to my responses being used for research on condition that my privacy is respected and subject to the following:

- I understand that my name will not be disclosed but that a false name will be used and that the contents of the interview will be used in such a way that I will not be personally identifiable.
- I understand that this interview will be recorded and that the only person who may have access to the recording will be the principal researcher.
- I understand that I am under no obligation to take part in this study and that I can withdraw from this study at any stage.

Name of participant: _____

Signature of participant: _____

Name of researcher: _____

Signature of researcher: _____

Date: _____

APPENDIX E

University of Cape Town
Department of Social Development

Consent Form for Research with an Institutional Development and Support Official (IDSO)

Name principal researcher: Zena Haynes
Student no.: HYNZEN001
Email address: HYNZEN001@myuct.ac.za

Supervisor: Dr Khosi Kubeka
Email: am.kubeka@uct.ac.za
Telephone: 0216503494

9. TITLE OF RESEARCH STUDY

The preparedness of schooling in the Fourth Industrial Revolution: The Case Study of the Ekurhuleni South Education District Community in the Ekurhuleni Municipality.

10. NATURE OF RESEARCH

One semi-structured interview will be conducted regarding the participant's experiences and perceptions of the use of technology in the classroom. Due to covid-19 lockdown and social distancing regulations, an online interview will be done via Zoom Meeting.

Audio recordings and transcriptions of interviews will be stored safely and treated confidentially.

11. PARTICIPANT'S INVOLVEMENT

The participant is required to participate in an interview and give honest information on the research topic. The interview will be about an hour long.

The participant is reminded that there are no right or wrong answers to questions.

12. WRITTEN CONSENT

12.1. I voluntarily agree to participate in this research study.

12.2. I have read the consent form and understand the information it contains and had the opportunity to ask questions.

12.3. I agree to my responses being used for research on condition that my privacy is respected and subject to the following:

- I understand that my name will not be disclosed but that a false name will be used and that the contents of the interview will be used in such a way that I will not be personally identifiable.
- I understand that this interview will be recorded and that the only person who may have access to the recording will be the principal researcher.
- I understand that I am under no obligation to take part in this study and that I can withdraw from this study at any stage.

Name of participant: _____

Signature of participant: _____

Name of researcher: _____

Signature of researcher: _____

Date: _____

APPENDIX F

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

SEMI-STRUCTURED INTERVIEW GUIDE FOR GRADE 12 LEARNERS
Assessing the preparedness of schooling in the Fourth Industrial Revolution: The Case Study of the Ekurhuleni South Education District Community in the Ekurhuleni Municipality

A. INTRODUCTION

My name and the purpose of this interview
Explain ethical considerations: voluntary participation; anonymity; confidentiality; audio recording of the interview.
No right or wrong answers

B. PARTICIPANT DEMOGRAPHIC INFORMATION

What is your name?
How old are you?
What grade are you in?
How do you identify in terms of gender?
How do you identify in terms of race?

How far did your parents/guardian go in school?
What work does your parent/guardian do?

C. PARTICIPANT HOUSEHOLD CHARACTERISTICS

With whom do you live?
Do you live in a formal or informal housing structure?

Do you have electricity in your house?
Do you have clean running water inside the house?
Do you have access to a computer or smartphone?
Do you have internet access at home?

D. COMMUNITY BACKGROUND

How many schools are there in your community?
Is there a public clinic in your community?
Is there a public library in your community?
Is there public transport in your community?
Are there any social problems in your community? If yes, what kind of problems would you say exist in your community?

Assessing the preparedness of schooling in the Fourth Industrial Revolution

1. **How is the Fourth Industrial Revolution understood by learners in Ekurhuleni South Education District?**
   a. What do you know about the "Fourth Industrial Revolution"? Have you heard about technologies like artificial intelligence, robotics, 5G technology and 3D printing? Do you know anything about these topics?
   b. What do you think the role of technology is in schooling? By technology I mean the use of computers, smart phones, tablets, smart screens instead of chalk boards in class and for your schoolwork.
   c. What do you think about the importance of technology in schooling?

2. **What are learners' experiences of schooling in the Fourth Industrial Revolution?**
   a. Tell me about the subjects you are currently doing – what are they and how are you finding them?
   b. Are there perhaps subjects you would have liked to do that are not offered at your school?
   c. What kind of technology-related resources and facilities do you have access to at your school?
   d. How would you describe the quality of education at your school? (In terms of the availability and condition of resources and infrastructure, teaching methods, absenteeism among teachers, discipline in the classroom)
   e. What are some of the challenges you have experienced during your schooling career?
   f. How have you coped with these challenges?

3. **How do learners perceive their schooling experiences to help them after school?**
   a. In terms of your life after school, what do you want to do?
   b. What kind of knowledge and skills have you gained that will help you reach your goals?
   c. What kind of opportunities have you been exposed to that may help you achieve your goals? (these could be extra classes, school trips, mentoring, leadership training, career guidance)

CLOSING

Thank you for your time.
Is there anything that you want to know before we finish?
Is there anything else you want to add?

APPENDIX G

KEY INFORMANT INTERVIEW GUIDE FOR TEACHERS

INTRODUCTION

My name and the purpose of this interview

Explain ethical considerations: anonymity; confidentiality; voluntary participation; audio recording of the interview.

No right or wrong answers

BACKGROUND

What is your name?

What is your role at the school?

Assessing the preparedness of schooling in the Fourth Industrial Revolution

1. **Understanding of 4IR**
   a. What do you know about it?
   b. The role of technology in teaching

2. **Perceptions and experiences of teachers of preparedness**
   a. Trainings received in line with 4IR
   b. Technology-related resources and facilities needed to teach 4IR
   c. Technology-related subjects and resources available to learners
   d. Perception of preparedness to teach 4IR content
   e. Challenges in implementing 4IR

General

a. Views about long-term impact of 4IR for the school and learners
b. Additional comments/recommendations

Closing

Thank you for your time.

Is there anything that you want to know before we finish?

Is there anything else you want to add?

APPENDIX H

KEY INFORMANT INTERVIEW GUIDE FOR PRINCIPALS

INTRODUCTION

My name and the purpose of this interview
Explain ethical considerations: anonymity; confidentiality; voluntary participation; audio recording of the interview.
No right or wrong answers

BACKGROUND

What is your name?

What is your role at the school?

Assessing the preparedness of schooling in the Fourth Industrial Revolution

3. **Understanding of 4IR**
   a. What do you know about it?
   b. The role of technology in teaching

4. **Perceptions and experiences of teachers of preparedness**
   a. Trainings received in line with 4IR
   b. Technology-related resources and facilities needed to teach 4IR
   c. Technology-related subjects and resources available to learners
   d. Perception of preparedness to teach 4IR content
   e. Challenges in implementing 4IR

General

   c. Views about long-term impact of 4IR for the school and learners
   d. Additional comments/recommendations

Closing

Thank you for your time.
Is there anything that you want to know before we finish?
Is there anything else you want to add?

APPENDIX I

KEY INFORMANT INTERVIEW GUIDE FOR INSTITUTIONAL DEVELOPMENT AND SUPPORT OFFICIAL (IDSO)

INTRODUCTION

My name and the purpose of this interview
Explain ethical considerations: anonymity; confidentiality; voluntary participation; audio recording of the interview
No right or wrong answer

BACKGROUND

What is your name?

What is your role at the Provincial Department of Basic Education?

Assessing the preparedness of schooling in the Fourth Industrial Revolution

1. **Understanding of 4IR**
   a. What do you know about it?
   b. The role of technology in teaching

2. **Perceptions and experiences of IDSOs of preparedness**
   a. Trainings offered to teachers
   b. Resources and facilities made available to schools
   c. Perception of preparedness of teachers to teach 4IR content
   d. Challenges in implementing 4IR

General

a. Views about long-term impact of 4IR for the school and learners
b. Additional comments/recommendations

Closing

Thank you for your time.
Is there anything that you want to know before we finish?
Is there anything else you want to add?

APPENDIX J

OOSRAND SECONDARY SCHOOL
SEKONDÊRE SKOOL OOSRAND

TEL: 010 0106416
FAX: 086 559 7398
GOEDEHOOP AVENUE / LAAN
REIGER PARK
1459

P.O.BOX / POSBUS 14038
REIGER PARK
1466
E-MAIL: OOSRANDSECONDARY@GMAIL.COM
peterj.arendse@gmail.com@gmail.com

07 April 2021

TO WHOM IT MAY CONCERN

Re: Zena Haynes: Letter of permission to do Research

The above-mentioned school hereby grant permission to **Zena Haynes** to do her research regarding her post graduate qualification at Oosrand Secondary School.

Thank you for taking cognizance of the above-mentioned.

Yours faithfully

P.J.Arendse
PRINCIPAL

GAUTENG DEPT. OF EDUCATION
OOS-RAND
SECONDARY SCHOOL
07-04-2021
DEPUTY PRINCIPAL: D.M. SAMPSON
TEL: 010 010 6416
P.O.BOX 14038, REIGER PARK, 1466

REIGER PARK SECONDARY SCHOOL

C/o Leon Ferreira Drive & Drommedaris Street
Reiger Park – Boksburg – 1459
Tel: 084 274 4402 / 082 554 6813
E-mail: principalrpss@outlook.com reigerparksecondary@outlook.

3 MAY 2021

TO WHOM IT MAY CONCERN

Permission is hereby granted for Ms. Gwyneth Haynes to conduct her research project at Reiger Park Secondary School. The school will endeavour to assist Ms. Haynes in any way possible to ensure that her project continues without any hindrance or obstacles.

We trust that Ms. Haynes's stay at the school, whilst conducting the research project, will be mutually beneficial to both parties and wish Ms. Haynes everything of the best with the research project.

We trust the above to be in order.

Yours faithfully

R.D. Tekana
DEPUTY PRINCIPAL

GAUTENG DEPARTMENT OF EDUCATION
REIGER PARK SECONDARY SCHOOL
2021 -05- 03
Cnr Leon Ferreira & Drommedaris Ave
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APPENDIX K

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Member of SAFREA

31/1/2022

This serves to confirm that the document entitled:

"Assessing the preparedness of the schooling system for The Fourth Industrial Revolution: The case of two secondary schools in the Ekurhuleni South Education District,"

by

Student: Zena Gwyneth Haynes

HYNZEN001

has been edited professionally on behalf of its author.

Frances Aron