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Evaluating the impact of Fourth Industrial Revolution on Education in the rural areas in South Africa

Research Article

Miehleketo Chavalala

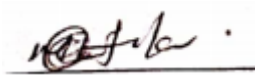
WITS Business School

Thesis presented in partial fulfilment for the degree of Master of Business Administration to the Faculty of Commerce, Law, and Management, University of the Witwatersrand

30th April 2021

DECLARATION

I, Miehleketo Chavalala declare that this research report entitled 'Evaluating the impact of Fourth Industrial Revolution on Education in the rural areas in South Africa' is my own unaided work. I have acknowledged, attributed, and referenced all ideas sourced elsewhere. I am hereby submitting it in partial fulfilment of the requirements of the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. I have not submitted this report before for any other degree or examination to any other institution.



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ABSTRACT

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Thesis title: **Evaluating the impact of Fourth Industrial Revolution on Education in the rural areas in South Africa**

The purpose of this research study is to evaluate the impact of Fourth Industrial Revolution (4IR) on education in rural areas in South Africa. This research investigates the following objectives, which are: the impact of 4IR technologies on education and how these technologies can improve the education system in primary and secondary schools in South Africa; the quality of education system in South Africa and factors contributing to the poor education system; how to bridge the gap between the marginalised communities, rural public schools, and urban private schools. The study is focused on public schools in the rural areas in South Africa.

Qualitative research strategy has been applied in this research study, interviews have been conducted to afford the researcher an opportunity to interact with stakeholders from the education sector and telecommunication industry. The sample and targeted population of the interviewees are educators from rural schools, former students from rural schools who are in the ICT sector, educators from higher education and 4IR committee member(s). The research strategy applied has been relevant and provided the researcher with a unique in-depth involvement and understanding of the issues contributing to poor education in South Africa. The literature conducted in this study research exhibit that the interview schedule was the most suitable instrument to use to collect data for this research study.

One of the findings in this research study is that the powers of administering schools are invested in School Governing Bodies (SGBs) and School Management Teams (STMs). Many parents in rural schools who form part of these bodies are not well-educated and can hardly make an informed decision to benefit learners. Therefore, the adoption of 4IR will centralise the education system and provide equal benefits to learners across the country. The adoption of 4IR on education will have a positive impact and enhance learners' development in rural areas through robotics concepts. The findings of this research study show that the Department of Basic Education and the South African government are not ready for Fourth Industrial Revolution. However,

there are signs for opportunities. The findings show the obstacles that can delay the adoption of 4IR to facilitate teaching and learning in rural public schools to bridge the gap that exist between rural public schools and private schools in the cities. The findings show that 4IR can transform the South African education system to compete with the world by producing scholars that are innovative and creative. The findings indicate how communities can transform through digital infrastructure developments to accommodate 4IR in learning in rural schools. This research study's findings indicate ways in which the South African government can take to accelerate the adoption of 4IR in the education sector.

Key words: 4th industrial revolution; rural public schools; teacher; learners; technology; basic education

Johannesburg, 30th April 2021

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DEFINITION OF KEY TERMS AND CONCEPTS

4IR – Fourth Industrial Revolution

AI – Artificial Intelligence

ANC – African National Congress

COSATU – Congress of South African Trade Unions

Covid-19 – Corona Virus Disease 2019

CSI – Corporate Social Investment

CSV – Creating Shared Value

DBE – Department of Basic Education

ICASA – Independent Communications Authority of South Africa

ICT – Information and Communication Technology

IoT – Internet of Things

MBA – Master of Business Administration

ML – Machine Learning

MTN – Mobile Telephone Network

NAPTOSA – National Professional Teachers Organization of South Africa

National Department of Education

NSC – National Senior Certificate

PC4IR – Presidential Commission on 4IR

RDP – Reconstruction and Development Programme

SA – South Africa

SADTU – South African Democratic Teachers Unions

SGB – School Governing Body

SMT – School Management Team

Stats-SA – Statistics South Africa

TA – Thematic Analysis

TQF – Total Quality Framework

WBS – Wits Business School

1 INTRODUCTION TO THE RESEARCH

1.1 Background and context

The aim of this research paper is to evaluate the impact of the Forth industrial revolution on education in the rural areas in South Africa. The concepts and terms used in conceptualizing this research paper will be briefly introduced in (section 1.2) before getting into the research conceptualizing. (Section 1.2) takes a reader through the research conceptualization with focus to the research problem statement and further discuses in sequential format the research purpose statement, research questions and research propositions. Chapter 2 has a more specific and detailed discussion on the research context. The research conceptualisation section provides the research problem statement (Section 1.2.1) and consequently the purpose of this research (Section 1.2.2) as well as the research questions (Section 1.2.3). The delimitations and assumptions of the research study are in Section 1.3 while we discuss the significance of the research study in Section 1.4 and provide a preface to the research report in Section 1.5.

1.1.1 Defining the Fourth Industrial Revolution

Digital technology is spreading at a higher rate across many sectors and business operations are undertaking radical changes due to the disruptive effects of technology innovations. 4th industrial revolution can “facilitate students” learning experience and transforms the workplace, this revolution provides opportunities in the education sector to “harness innovations that are associated with 4IR and enhance the teachers and learners’ experience” (Oke, 2020). 4IR brings together digital, physical, and biological systems, it is an advancement of the previous industrial revolutions. 4IR will change the way we do things and improve the quality of life for populations around the world (Schwab, 2016).

1.1.2 Role of the Department of Basic Education

The Department of Basic Education (DBE) should focus on bridging the gap between public schools and private schools. In the year 2015/ 2016 in the World Economic Forum, the South African basic education system was ranked 138 out of 140 countries. Stats SA have exhibited that only 50 learners make it to Grade 12 out

of the 100 learners that started school, and out of the 50 learners that make it to Grade 12, only 40 learners pass and only 12 learners will qualify for entry at the university level (Spaull, 2013).

1.1.3 Challenges faced by learners in public schools in the rural.

There is a huge gap between public schools in rural areas and public schools in urban areas and private schools in South Africa. Learners in public schools in rural areas continue to experience issues of no textbooks and stationaries, this occurrence seems to be an annual event particularly in Limpopo, which pose a serious challenge for learners as they must resort into sharing textbooks (Mamokgere, 2019). Most schools in rural areas have no water and toilets facilities for learners. These are luxury for most learners attending schools in the rural of Limpopo as "schools often experience water shortages despite having boreholes within the school premises" (Mukwevho, 2020).

1.2 Research conceptualisation

1.2.1 The research problem statement

In Limpopo and most part of the rural areas in South Africa, there have been textbooks crisis since 2012. In a 2019 academic year, several schools in the province reported a shortage of stationery and textbooks which resulted into a challenge for learners, this occurrence seems to be an annual event particularly in Limpopo, which pose a serious challenge for learners as they must resort into sharing textbooks (Mamokgere, 2019). Villages in Giyani have not been having running water for 10 to 15 years despite a project that was budgeted for R500million to over R3billion meant to supply 50 villages in Giyani which in turn affects schools from not having water supply. These are the villages that had water running from communal taps during apartheid government and early years of the current government (Moloto, 2019).

The Covid-19 pandemic has exposed the lack of serious intervention by our government in developing schools' facilities in rural areas, many schools have been operating for years without water and toilets. The minister of Basic Education said in

her report that, “Department of Basic Education entered into an implementation protocol agreement with the Department of Human Settlements, Water & Sanitation to ensure that no school should operate without water” (Lekabe, 2020).

1.2.2 The research purpose (aim and objectives) statement

The purpose of this research is to interrogate how the Fourth Industrial Revolution (4IR) and its technologies influence the South African government and department of basic education to accelerate development in public schools in the rural villages of South Africa. Firstly, I will review the theory of 4IR to understand its dynamics and opportunities. Secondly, I will collect data and analyse it to support the activities and inputs needed to improve development in the rural. Lastly, I will interrogate the data to explore how this data can be used by the government to benefit the society and learners. This research will explore how the Fourth Industrial Revolution can accelerate the human skill development in the rural villages in South Africa.

1.2.3 The research questions as well as where applicable accompanied by research propositions

1.2.3.1 **Question 1:** What has been the focus of the current government on public schools and rural development?

Proposition: The government's development plan should be refocused and be aligned to 4IR to help provide a road map for rolling out technology resources in schools in the rural.

1.2.3.2 **Question 2:** Do we have infrastructures that support technology in rural areas and are people living in rural areas technology driven?

Proposition: The current government need to support telecoms companies with spectrum and build more network towers to support the use of technology in schools and for online learning.

1.2.3.3 **Question 3:** What is the understanding of 4IR in rural areas, are young people living in the rural aligned to technology and its capabilities?

Proposition: More time need to be invested by government, department of telecoms and department of basic education to align young people to the

world of technology and ICT. With the help of private sectors in the ICT space to invest more on customer shared value in the rural schools.

1.2.3.4 Question 4: What development changes can 4IR bring in the rural communities to improve lifestyles?

Proposition: Early exposure and understanding the dynamics centred around 4IR technologies can help our people to be more innovative and create our own technologies that will make sense to us.

1.2.3.5 Question 5: Do people living in rural areas perceive 4IR as a threat or an opportunity for growth and development?

Proposition: Infrastructures and right resources can help young people in rural areas to think out of the box from an early age and be innovative and not only be exposed to technology at higher learning institutes.

1.3 Delimitations and assumptions of the research study

The assumptions of this research study are that the stakeholders of basic education in South Africa such as unions and members of government in power will not be receptive to answer the qualitative questions and not as authentic as they can in answering the questions to protect their positions in government and unions. The root causes of the problem are teachers' unions, government, and department of education's employees as we continue to witness disagreements to reaching a consensus of working together between the two parties to improve the standard of basic education in South Africa (Mafisa, 2017). SADTU was found to have violated the system in six provinces by selling principals positions in exchange for cows (News24, 2015). SADTU is one of the COSATU's affiliations with most members and the government in power is affiliated to COSATU which results in COSATU having powers over the department of education.

1.4 Significance of the research study

This research is conducted to help government and the department of basic education redefine the strategy about our education system and align the curricula in our schools to the Fourth Industrial Revolution. Significant improvement for our education curriculum is a requirement to ensure that graduates are employable in the new world of digitization, internet of things and technology as business operations are undertaking drastic changes due to the disruptive effects of technology innovations (Oke, 2020). Covid-19 pandemic has proven that there is a huge gap that exist between public schools and private schools in the country, we witnessed a delay on reopening of public schools as teachers and parents raised concerns about health issues in public schools. Covid-19 pandemic also proved the discrepancy in public and private schools where majority of leaners from public schools were at home for months without getting any education whilst leaners from private schools continued to learn through online home schooling. 4IR technology in the education sector can enhance human skills and influence pupils to be more innovative through artificial intelligence and data analytics (Oke, 2020).

2 LITERATURE REVIEW

2.1 Research problem analysis

2.1.1 Department of Basic Education - Quality of Education

The quality of education in lower education (primary and secondary schools) in South Africa is deteriorating. We have seen the minister and department of basic education changing curriculum a couple of times since the dawn of democracy in the country. The pass mark rate has changed from 50% to 35% in recent years which also has a psychological effect on some of the young people's performance and dedication towards achieving great results. The minister and department are more focused on celebrating the numbers than quality, earlier this year in January when Minister Angie Motshekga of Basic Education announced results for the 2019 National Senior Certificates (NSC) examination, the minister and her department were excited that the 2019 pass rate of 81.3% has reached the highest recorded pass rate in the last 25years (Etheridge, 2020). However, the minister and the department ignored the fact that only 44.55% have passed with admission to study a bachelor's degree in higher institutions as the Statistics South Africa (StatsSA) for pass rate per province shows in the below figure.

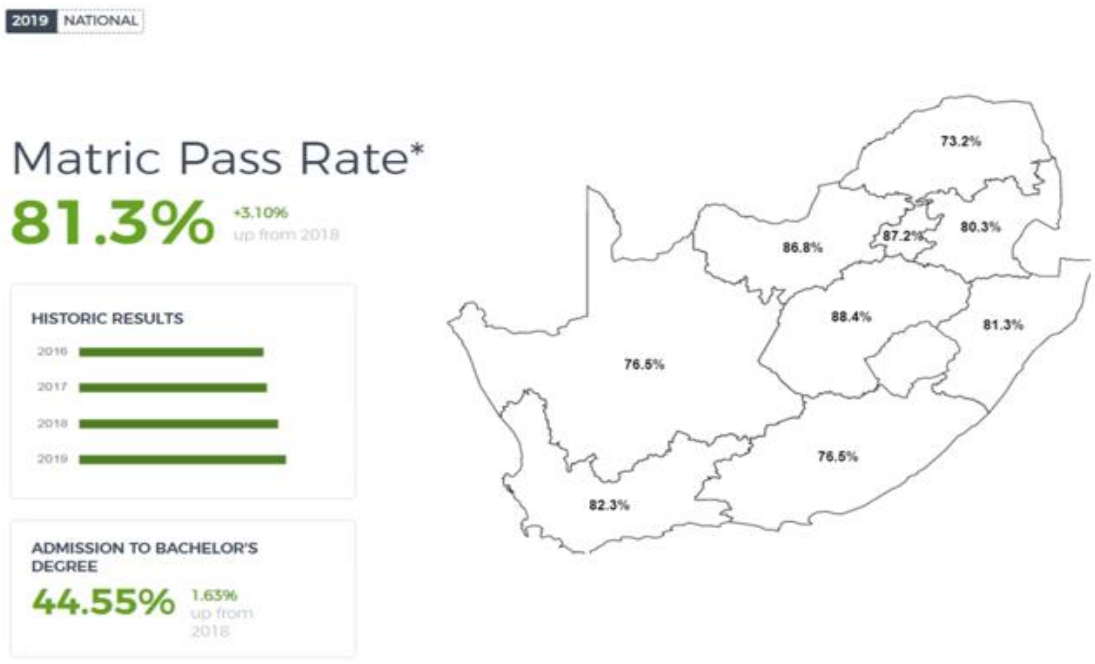

Figure 1: Matric 2019 pass rate per province in South Africa ***Source: StatsSA***

The 44.55% passed with admission to bachelors' degree recorded is not a true reflection of our quality of education because most pupils with these bachelor's degree pass do not get accepted to study degrees that are in demand and employable. To further articulate on the true reflection of our quality of education from lower level, it is the fact that the statistics provided by the minister and her department do not take into consideration the number of learners enrolled for Grade 1 schooling that were expected to matriculate in the year 2019 but failed to reach matric. The Statistics South Africa (Stats-SA) exhibited that only fifty (50) pupils out of the 100 pupils that started school in Grade 1 make it to Grade 12. Stats SA further elaborate that only 40 pupils pass matric out of the 50 learners that made it to Grade 12. However, only 12 learners qualify for entry at the university level (Spaull, 2013).

Since the dawn of democracy, the education system is treated as a single democratic system from the national level and the department of education do not recognize education in the rural separately. With this approach, the conditions of the rural schools can be addressed at the provincial and district levels (Gardiner, 2008)

2.1.2 Impact of Unions on Education in South Africa

Unions such as the South African Democratic Teachers Unions (SADTU) and National Professional Teachers' Organisation of South Africa (NAPTOSA) play an influential role in different sectors such as education, public sector and corporate, unions are critical in shaping the basic education in South Africa and are expected to play a meaningful role. Legally and constitutionally, the expectation from teachers trade unions is to partner with Department of Basic Education and work on improving the education system in the country through the involvement of the teachers trade unions' members. However, the South African Democratic Teachers Union and other teachers' unions seem to have their best interest at heart than to improve the working conditions of teachers and the standard of education in public schools in the country (Mafisa, 2017). SADTU is one of the Congress of South African Trade Unions (COSATU)'s largest trade union affiliates with membership higher than 260 000 members in South Africa and COSATU is an affiliate of the governing party (ANC), this affiliation has given SADTU powers over the department of education for years.

2.1.3 Government and Society

The South African government is not doing enough to enforce collaboration between stakeholders in our education sector, stakeholders such as department of basic education, unions, parents, and schools governing bodies (SGBs) by implementing policies that will hold all stakeholders accountable. It is the government's responsibility to influence parents to be more involved in their children's school activities and provide necessary support to teachers in public schools with the right policies and improved infrastructures (Spaull, 2013). It is the government's responsibility to ensure that facilities in public schools meet at least the basic requirements and ensure that each school has access to water, toilets facilities, stationary and other basics as defined in the bill of rights for children in our constitution. Scholars have argued that the lack of educated individuals to form part of the committees for schools governing bodies (SGB) in the rural public schools is contributing to the issues associated with quality of system in the schools (Modisaotsile, 2012). The government and the department of education have in the past gone head-to-head with South African Democratic Teachers Union and other teachers' unions over teachers who were not being paid by the department for months. In the year 2016 in Kwazulu-Natal, more than 500 teachers struggled for about a year to have a living after experiencing non-payment from the department, yet the department expected teachers to deliver good quality of education to learners while struggling for food and transport money (Hans, 2016).

Educational policies and constitutions in South Africa emphasize on access to same quality of learning and teaching for all learners. However, 26years later since the dawn of democracy, many schools in rural areas still face a challenge of lack of classrooms, stationaries, and poor services such as water, internet, and electricity facilities (Gardiner, 2008).

2.1.4 Challenges faced by communities in rural areas

There is uncooperativeness between parents and teachers in rural public schools, mostly influenced by poverty, for example, some learners are expected to wake up early and carry out domestic duties before they go to schools because they don't have

domestic workers to perform the duties unlike kids in urban arears and private schools. This led to leaners starting their day while already tired and having teachers to punish learners for late comings (Gardiner, 2008).

The issue of water is a challenge for the entire country as South Africa is considered one of the driest countries in the world (Segal, 2009). With the water crisis continuing in South Africa many villages in Giyani have not been having a running water for 10 to 15 years despite a project that was budgeted for R500million to over R3billion meant to supply 50 villages in Giyani, this failed project is affecting schools in those villages from not having water supply. Some of these villages had water running from the communal taps during apartheid government and early years of the current government (Moloto, 2019).



Figure 2: Classrooms in rural areas

Classrooms are still a challenge faced by many rural public schools in South Africa, the South African Schools Act says that the School Governing Bodies (SGBs) must ensure that quality of education is provided to learners. However, non-teachers and parents in most past of the rural areas that form part of the School Governing Body are uneducated individuals that cannot discuss finances and other critical matters for the schools' development (Plessis, 2019). Limpopo province as a case in point, the lack of textbooks and stationery is an annual crisis in the rural public schools, learners must share textbooks and are often behind with the syllabus (Mamokgere, 2019).

2.2 Research knowledge gap analysis

South Africa should refine the education system in the country and create a culture of education from an early age and inspire eldest to continue learning. Our government needs to prioritize the value of education in the country and learn from countries like Finland that is having the best education system in the world (Wood, 2018). Partnership with countries offering the best education system and introduce exchange programs for teachers to go into these exchange programs for knowledge and skills developments.

To address the issue of education in rural areas, South African government needs a broad vision as a result that rural areas are facing more challenges such as poverty, unemployment, water scarcity and other basic services. Therefore, the department of education have articulated that "improving schooling in rural areas must go beyond fixing schools only" and have a plan to develop and address issue of poverty and promote social cohesion (Gardiner, 2008).

The education sector has been hesitant to accept the use of technology to facilitate learning and teaching despite technology advancement, this can also be influenced by the fact that the country lacks skilled teacher that are knowledgeable with technology. To enhance students' learning experience in 4IR, the use of digital technology should be "compatible with the leaner centred approach" as it is beyond using e-material and computers especially that this revolution is anticipated not to have effect only in the economy but how we will live life from a personal point of view (Oke, 2020).

With the 4IR technology, it is anticipated that most current jobs will be redundant due to requirements of automation and digitization for operational processes, see figure 3 below. However, researchers argue that as 4IR progresses, professional capabilities will evolve to meet the required skills and align to the digital transformation opportunities (Oke, 2020).

Today: 2018	Trending: 2022	Declining: 2022
Analytical thinking and innovation	Analytical thinking and innovation	Manual dexterity, endurance, and precision
Complex problem-solving	Active learning and learning strategies	Memory, verbal, auditory, and spatial abilities
Critical thinking and analysis	Creativity, originality, and initiative	Management of financial, material resources
Active learning and learning strategies	Technology design and programming	Technology installation and maintenance
Creativity, originality, and initiative	Critical thinking and analysis	Reading, writing, math, and active listening
Attention to detail, trustworthiness	Complex problem-solving	Management of personnel
Emotional intelligence	Leadership and social influence	Quality control and safety awareness
Reasoning, problem-solving, and ideation	Emotional intelligence	Coordination and time management
Leadership and social influence	Reasoning, problem-solving, and ideation	Visual, auditory, and speech abilities
Coordination and time management	Systems analysis and evaluation	Technology use, monitoring, and control

Figure 3: Skills demand across sectors, 2018 vs 2022 **Source: World Economic Forum 2018**

The adoption of 4IR in the education sector will present the opportunity to improve how learners are taught and be aligned to the world of digitization. 4IR technology in the education sector will not be limited to the use of computers only but present opportunities to develop an ecosystem to facilitate the sharing of "learning materials and data analytics" to understand what learners need (Oke, 2020).

4IR technology will introduce the adoption of robotics and computational thinking for learners from an early age to help developing them on problems solving skill and enhancement on collaboration and teamwork (Bers, 2013). Leaners' interest and aspirations for the application of Science, Technology, Engineering and Mathematics can be captured by the concept of using robotics and participate in the technological world at an early age as it is crucial to align learners to the world of technology that we live in with the ability to think computational. With robotics, computational thinking can be effectively introduced to learners as it involves the ability to sequence the coding commands needed to program a robot (Chalmers, 2018)

Scholars and teachers argue that the inclusion of robotic systems as a subject in early education (primary school) can speed up the development process for learners on learning digital technology and present them with a different kind of human and organizational values. Robotic system will introduce learners to Information and Communication Technology (ICT) and help to develop their logical ability and creativity. An early introduction to robotics for kids will increase their capabilities

and teach them machine learning and programming, it will develop their thinking into considering robotics as a “normal method of operating” (Scaradozzi, 2014)

2.3 Qualitative attributes or quantitative variables key to the research

Digitization on education is considered the process of aligning the educational method of teaching to the new era of technology by adopting the use of digital format from the traditional method of teaching and ensure that pupils understand the objectives of education. The management of early childhood care education can be improved effectively with the adoption and application of digitization in the education system (Kadir, 2019). Lin (2006) have argued that the adoption of digitization in education from early days of a child does improve the child’s “self-esteem” and “strengths” through “collaboration and game-based learning” and help to develop variety of practices that encourage independency. Digitization is not a single dimension; it creates an environment where information can be conveyed in many different methods and provide an opportunity to develop an intellectual resource-based mechanism for students to improve on their “skills, lifelong learning and continuous education” (Kadir, 2019).

Artificial Intelligence (AI) in the education sector will create a culture of inclusive and bridge the gap between isolated communities, people living with disabilities to the rest of the privileged societies, the AI technologies will improve on accessibility to quality education to the marginalised people (Pedro, 2019). Learning analytics from a young age will be beneficial for learners and empower them with “powerful resources” to make informed decisions and acquire better education. However, scholars argue that “bridging the AI skills gap goes beyond the adoption of increasingly powerful technologies to facilitate education” p.12. This will mean that how the method of learning and content delivered will need to be reconsidered (Pedro, 2019).

Robotics technologies have been introduced and adopted in various sectors which includes education, health sector, motor industry and many more. With the world changing at a fast pace due to technology, researchers aspire that every primary

school learner is granted the opportunity to computing and at secondary level, learners should have the privilege to work with robotics and microcontroller to build systems (Eguchi, 2014).

Gartner Inc (2017), defined Internet of Things (IoT) as the "network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment" p.53 (Banica, 2017). The educational environment in higher learning have been changing in the past couple of years from the traditional education to online learning, however, in lower level there hasn't been many changes in our country. To keep up with the new world, basic education must no longer ignore the disruption of technology and how technology is influencing education in today's world to create a collaborative model of education to achieve real student-centred learning. The adoption of using the Internet of Things in lower education can create collaboration and a function to connect learners with others from a distant as internet of things has already modified the traditional way of teaching in higher institutes (Mohamed, 2018). The new technology has a major influence on education and other sectors and how we live our lives by "associating everyday objects with the capabilities of internet and Big Data analytics" p.54 (Banica, 2017). Internet technologies influences education in many aspects and the Internet of Things (IoT) can offer improvements of learning and teaching in lower education with access of materials and the collection of data from any internet connected devices (Banica, 2017).

The importance of data mining and data analytic software (Big Data analytics) is that the academic performance feedback can be provided immediately to learners and teachers. With the development of computerized learning modules, students' assessment can be enabled in a real-time systematic way (West, 2012). The adoption of Big Data analytics can allow teachers to mine the learning patterns of learners and understand how they master their modules. With this approach, teachers can analyse the underlining patterns to predict students' outcomes such as dropping out and realize students that need more attention for development. This technology can evaluate how learners will perform on their examinations through predictive and diagnostic assessments (West, 2012).

2.4 Framework(s) for interpreting research findings

Framework is a process and method applied to interpret the data collected and findings for the research study, and for qualitative research data, these methods have been applicable and used since the 1980s for management and analysis of qualitative data (Gale, 2013). Framework method is part of the analysis methods that are used to interpret qualitative research data same as thematic analysis and qualitative content analysis that is most preferred as a result that it provides flexibility, it is not a single dimension (Gale, 2013). As a researcher, one needs to carefully select the process or method. To this study research, a qualitative research strategy will be applicable and applied and qualitative research comprises of several methods to interpret and analyze the research findings. The qualitative methods that are employed are grounded theory, empirical phenomenology, protocol analysis, ethnography, and discourse analysis (Elliott, 2005).

This research study will adopt an interpretive qualitative approach to allow the researcher to explore and connect to the stakeholders and participants' view on 4IR in a basic education system (Oke, 2020). With this framework approach, participants will be provided with an opportunity to construct a meaningful interpretation of the transformation in the education sector based on their understanding and knowledge of 4IR (Oke, 2020). Interpretative framework is a philosophical prospective which a researcher uses to approach the study development design, data collection, analysis, and interpretation (Chumney, 2015). Interpretative frameworks shape the world view of the researcher and influence the goals and methods of the research, so it is important for the researcher to determine which framework best fit philosophy of the research study and the goals of the research study. However, the researcher can apply multiple interpretative frameworks for one research study (Chumney, 2015). Interpretative frameworks are generally grouped into two categories which are social sciences and social justice (Chumney, 2015). Social science theories shape how the researcher can review the problem and interpret the data and social justice theories have the specific goal of adjusting problems and calling for change within the context of a specific issue (Chumney, 2015)

Total Quality Framework is commonly applied in a qualitative research study and it is a complete perspective to create, manage and interpret the quality research designs

and to evaluate the probability that a qualitative research study will provide valid and useful information that the study is intended to (Roller, 2015). This framework encompasses of four components that are interrelated, namely, the credibility, the analysability, the transparency, and the usefulness (Roller, 2015).

Credibility in a qualitative research guides the researcher about the completeness and accuracy of the data a qualitative research study is gathering (Roller, 2015). Analysability relates to the completeness and accuracy of the data to be analysed and interpreted (Roller, 2015). Transparency – responsible for completeness and full disclosure of all aspects of the research in the documentation of the study (Roller, 2015). Usefulness connects to the goal of the research, with focus on value of the findings and recommendation from the research study (Roller, 2015).

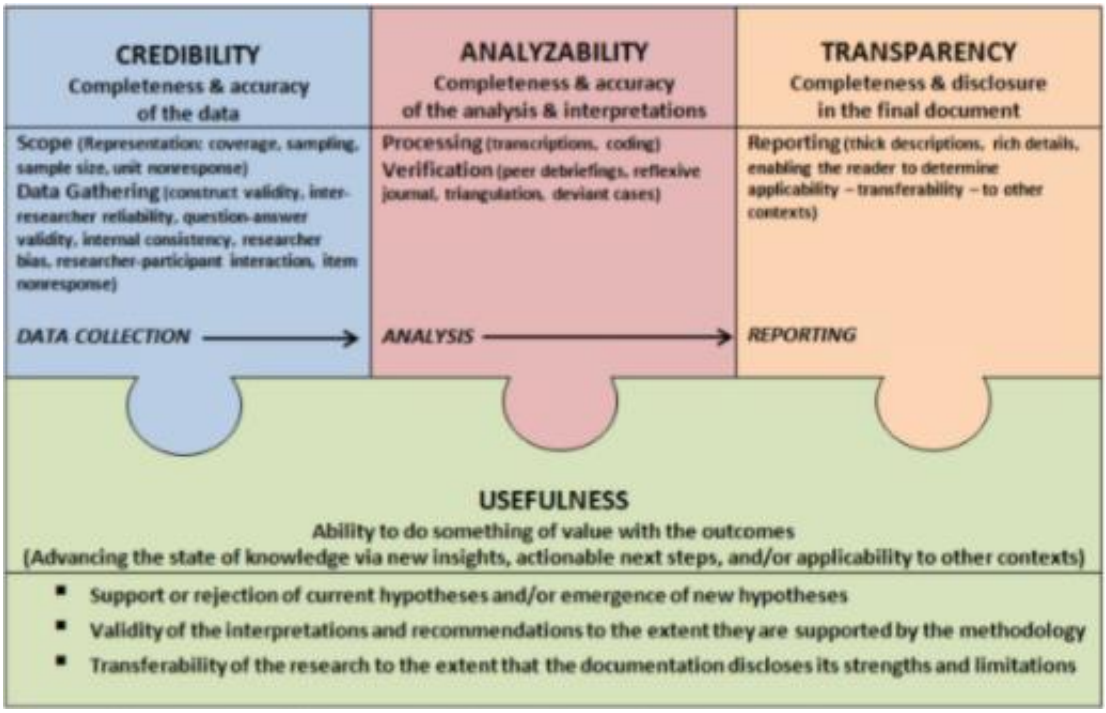

Figure 4: Total Quality Framework Approach

2.5 Summary and conclusion

2.5.1 Summary of literature reviewed

This chapter focused on reviewing the existing literature on research topics that are similar and related to the application of technologies on education system across the globe to discover ways on how South Africa and the Department of Education can use technology to improve education in the rural public schools and disadvantaged

schools. It also aimed at learning from other countries that have successfully implemented the same technologies to improve learning and teaching in primary and secondary schools. A literature has been reviewed with focus on the 4IR's components such as Artificial Intelligence and Machine Learning, Robotics, Internet of Things (IoT), Big Data analytics and Digitization. The literature on these mentioned components of the 4IR technology was centred around how the technologies were implemented and how these technologies can improve the education system and provide equal opportunities to all children to bridge the gap between the marginalized communities, less privileged and the privileged societies. The literature further focused on how the South African government can adopt the use of technologies to align children to the new world of technology. The literature also outlined on how the South African government should move swiftly about refining the current education system from the lower level so that our education system can produce graduates that are employable in future because most of the current jobs will be redundant. The literature reviewed on challenges that are faced by learners in the rural public schools and communities, other factors such as poverty and the scarcity of services like water and electricity in rural communities. Lastly, the literature was reviewed on factors contributing to the poor education system in the country while focusing on stakeholders such as the Department of Basic Education, Teachers' Unions and Government in power and what they have tried and failed.

2.5.2 Proposed research strategy, design, procedure, and methods arising from the literature reviewed

The qualitative research design will be applicable and used for this research study, the qualitative strategy and method will be suitable to help understand the researcher about the importance of managing an early childhood care education in the digital and technology world. The qualitative research strategy will provide the researcher an opportunity to engage with stakeholders involved in managing and producing the best quality education system for learners in lower level from a personal perspective and align pupils to the new world of fourth industrial revolution (4IR), as well as developing employable individuals. Interviews with decisions and policy makers of our education system will be conducted. The impacted stakeholders such, teachers

and former rural public schools' students will be interviewed to gather information on how the current education system is benefiting and preparing learners of this new world of digitization and 4IR. Research questions centred around the identified attributes of the qualitative research will be asked to the interviewees during the interview about a proposed new education system to improve the current education system in our country with specific focus on bridging the gap that exist between rural public schools and urban private schools. Integrating the characteristics of the 4IR such as Robotics, Internet of Things (IoT), Digitization, Artificial Intelligence (AI) and Machine Learning (ML) and Big Data analytics into basic education.

3 RESEARCH STRATEGY, DESIGN, PROCEDURE AND METHODS

3.1 Research strategy

The most significant element in a research study is to determine an appropriate methodology of the research and define an overall plan that will guide on how one will go about addressing the research process (Wedawatta, 2011). Other scholars have alluded that the research strategy sets a direction on how the process of the research should be conducted, and further argued that the research strategy that is selected based on research objectives and questions becomes proper (Wedawatta, 2011). Scholars are suggesting that there are three distinct research strategy approaches that can be used when conducting a research which are: the qualitative, the quantitative and the mixed method (Bryman, 2006).

This research aims to evaluate the impact of the fourth industrial revolution on education in the rural areas in South Africa and interrogate the use of fourth industrial revolution's technologies in education. For the purpose of this research study, the qualitative research strategy approach will be used. This research strategy was applied to provide the researcher with the unique in-depth involvement and understanding which can be a challenge to experience with quantitative strategy approach. Qualitative research strategy provides the researcher with a dynamic approach and opportunity to build up on answers provided by the respondents on real time, which cannot be achieved with a structured approach, with qualitative approach; valuable conversation with different opinions and deeper understanding of the subject can arise (Tiley, 2017).

Kaplan and Maxwell (2005) have applied the qualitative strategy in the research to evaluate the computer information systems with the aim to "understand particular situations by investigating the behaviour of the people in these situations and the context within which they act" p.32 (Kaplan, 2005). They derived from this strategy, the benefits of understanding the "influence of social and organizational context on system use and how systems' users perceive the meaning of the system" p.33 (Kaplan, 2005). The benefits that this research study will derive from the qualitative

strategy approach is the in-depth understanding and connection to the respondents from the personal perspective during the interviews.

3.2 Research design

The research design informs the process on how data will be collected for the purpose of the research study depending on the research strategy applied. Bryman (2012) alluded that the research design is complemented by five generic research designs which are: cross-sectional, case study, experimental, longitudinal, and comparative. For this research study, the research design applied is the case study approach and the comparative research design was used with the aim to make comparison with different countries where similar studies have been conducted and succeeded in terms of implementing the same proposition in the education system. Kaplan and Maxwell (2005) have applied the comparative research technique in their research to evaluate casual processes for computer information systems users and to understand the behaviour of systems' users and the context within which they act (Kaplan, 2005).

3.3 Research procedure and methods

To establish the research methodology, it comprises of an approach to the entire process of a research study, starting from the foundation of the theory and collection of data, analysing the data, and developing solutions to problems that have been investigated (Wedawatta, 2011). Remenyi et al (2003) defined the research methodology as an "overall approach put in place to address the problem in a research process, from the theoretical underpinning, to the collection and analysis of data" p.4 (Wedawatta, 2011).

3.3.1 Research data and information collection instrument(s)

The research data collection instrument is a process or method that involves the collection of large amounts of data for the research study (Sutton, 2015). The research data collection instruments comprise of the two common instruments which are the observation schedule and an interview schedule. The literature conducted in this study research exhibit that the interview schedule is the most suitable instrument

to commit to for the purpose of this research study. Furthermore, this literature will commit to the semi structured interview schedule and unstructured observations with focus on conducting open minded interviews to gather the data. Some of the questions that will be included in the instrument will be sourced from previous research studies of related topic(s) and some questions will be constructed by the author based on literature done in the education system.

In the study "management strategies for e-learning system as the core component of systemic change", a qualitative research strategy was applied with the main purpose being to examine the "e-learning system" as the core component of the systemic change with the four management functions which include planning, organizing, guiding, and monitoring (Ghavifekr, 2012). The researcher applied semi structured interviews and structured observations to collect data for the research study.

3.3.2 Research target population and selection of respondents

3.3.2.1 Research target population

Knowing your target population allows a researcher to investigate further on structured topics as they come up during the interview discussions, a target population refers to the group of people and constituents that the study intend to focus to (Ayala, 2011). When planning to do a qualitative research study it is important to define the target population so the researcher can identify the sample (Roller, 2015). The target population of this research study is the policy and decisions makers of the South African education system, stakeholders in education system and ICT. The targeted population will be subjected to 10 interview questions that will be discussed in-depth. The benefit(s) that will come out of this target population is that the South African governament and the department of education will have the opportunity to refine the basic education system to create equal access to education and close off the existing gap.

The study conducted by Oke et al (2020) about the "innovations in teaching and learning to explore the perceptions of the education sector in the 4th industrial revoluion" is designed to explore the value and readiness of the education sector for 4IR (Oke, 2020).

3.3.2.2 Research Sampling

Sampling is a process or technique to select a suitable set of respondents from a large group of people for the purpose of survey and draw conclusions about people from the selected sample (Mugo, 2002). There are several types of samples that can be applied for both qualitative research and quantitative research and differ in a manner that they are chosen for a particular research strategy (Mugo, 2002). For the purpose of this research study, a convenience sample is chosen as it best suits this qualitative research study. The sample for this research study will be the 15 selected participants who will be interviewed from different sectors to allow a diversified feedback.

The researcher, Oke et al (2020), applied a sample consisting of 23 key participants from the education sector to collect data about the "innovations in teaching and learning to explore the perception of the education sector on the 4th industrial revoluion" study researh as "10 interviews are recommended for phenomenology studies" p.8 (Oke, 2020). The benefit(s) of applying a sampling strategy for purpose of this research study will be that it is more reasonable and economic advantage to deal with a smaple than a larger population.

3.3.3 Ethical considerations when collecting research data

Many areas in a professional space have ethical standards but the "ethical standards for doing a professional research are stricter" p.48. Neuman (2014) alluded that, the researcher needs to know what is "legitimate or not" to do in a professional research study and ethics can help researcher to define such (Neuman, 2014). The ethics form is attached. The ethics clearance certificate was obtained from Wits Business School prior to collecting data and conducting interviews.

I am a modular part-time MBA student at Wits Business School doing this research as part of my requirements to complete the programme. I confirm that the information gathered for this research will be used solely for the purpose of this academic applied research project. The identity of all the participants who will take part of the interviews conducted for this research study and survey questionnaires will be protected as confidentiality and anonymity is considered when conducting

this research. I will provide a consent form to participants to assure them of the anonymity and confidentiality of this research study.

3.3.4 Research data and information collection process

In a research, data collection is a process of gathering information and ensure that measurement of data on variables of interest is considered to answer the questions asked for the research, test the hypothesis, and assess the outcomes. It is important to be accurate on collecting data to maintain the integrity of the research (Dudovskiy, 2018). There are four types of collecting data for research purpose which include: "participant observation or ethnography, interviews (face to face, telephone or internet-based, focus group discussion, the use of documents". For the purpose of this research study, physical and virtual interviews will be applied as a mode of data collection. Telephonic interviews will also be conducted for those without necessary resources for virtual meeting platforms.

The benefit(s) of having interviews as a mode of collecting data will be beneficial to sense the enthusiastic to bring change to the education system in the country by those with power to change policies. I intend to store the raw data of my interview recordings with the interviewees and transcribed the audio recordings to store in my google drive cloud.

3.3.5 Research data and information processing and analysis

3.3.5.1 Research data and information processing

Data processing is a set of methods and steps applied on data to verify, interpret, organise, transform, and integrate to enable information to be extracted from the data (Anagnostou, 2015).

Interview transcripts form part of the raw data in a qualitative research, transcription is a process of transferring the verbal message into written words (Poland, 2002). When conducting the interviews with participants, notes will be drafted down in a notebook during both physical and virtual meeting while audio recording is taking place. After the interview, I will go through all notes and audio recording to do a

formal write up to ensure that there is no transcript errors and no valuable information is ommtied from the interview.

Thematic analaysis (TA)is the mothod applied in a qualitative research to identify, analyze and interpret the meaning of patterns or themes within the qualitative data. For the purpose of this research study, thematic analysis (TA) will be used as a tool to provide access and systematic procedure to generate codes and themes from the data, and summarize the content of the data (Clarke, 2016).

3.3.5.2 Research data and information analysis

In a qualitative research there are a couple of the principles of data analysis that can be used to analyse data, which include content analysis, thematic analysis, coding, interrater reliability (Belotto, 2018). These principles of data analysis can be used in a qualitative research to create the researched data into a meaningful information. For this research study literature, content analysis will be applied to analyze data as scholars regards it as the most flexible method to use, content analysis is not a single method analysis, it has three different approaches, namely: conventional, directed and summative (Hsieh, 2005). Content analysis will be applied in this research study to provide flexibility in analyzing the text data.

3.3.6 Description of the research respondents

This research study will target most the stakeholders in our country's basic education from policy makers' perspective, members from the office of the minister of basic education and higher education, university's vice chancellor (s), members of executive from the office of the minister of telecommunications services, executives from telecommunications service providers, teachers' union members, teachers, lecturers championing 4IR from higher institutes, former learners from rural public schools, traditional leaders from rural communities, members of school governing bodies and possibly member(s) of the South African national assembly. In terms of age, it will be determined by the positions they are holding in the targeted sectors.

3.4 Research strengthens—reliability and validity measures applied

Reliability and Validity are both critical factors and at the centre of measurement for any research, they are imperative in establishing the credibility and truthfulness of the research findings (Neuman, 2014).

Reliability means dependability or consistency of how the methods have been applied or will be applied throughout the research (Neuman, 2014).

Validity refers to the truthfulness and how matching it is between the measure and how a researcher conceptualizes the idea to fit with the actual reality (Neuman, 2014).

There are four ways to ensure that the research is reliable in a qualitative research strategy and the data collected should be consistent and accurate. The four ways to consider in a qualitative research to ensure reliability of measures are to "clearly conceptualize constructs, the use of precisely level of measurement, using multiple indicators and the use of pilot tests" p.118 (Neuman, 2014). The journal of "Management strategies for e-learning system as the core component of systemic change for a qualitative research analysis" by Ghavifekr et al (2012). The aim was to scrutinize the "e-learning system" as the core component in changing the system with focus on planning and organizing and monitoring (Ghavifekr, 2012).

There are several ways to ensure the validity of the research, scholars have alluded that the research validity must compromise of the data that is credible and accurate, and dependable, for the valididy of the research, the reseacher must exhibit truthfulness and reality in the research study (Elo, 2014).

3.5 Research weaknesses—technical and administrative limitations

The aim of this research study is to evaluate the impact of fourth industrial revolution on education in the rural areas in South Africa, with this research study, I highly anticipate chances of defensive respondents from some of the targeted individuals who have been part of the current failing education system in the country. Government and union officials might not be receptive to participate in the

interviews. This research study will be very appealing provided that physical meetings are conducted so the interviewer can have a connection from the authentic level point of view by respondents, but with Covid-19 pandemic and lockdown regulations, the physical meetings with stakeholders might be a challenge.

4 PRESENTATION OF RESEARCH RESULTS

4.1 Introduction

This chapter presents the key results from the primary data collected through interviews with the interviewees. The results presented here using thematic coding tables are derived from the semi-structured and unstructured interviews conducted. This primary data has been collected from 15 participants with a vast industry experience from different sectors and a diversified ethnic group, the primary analysed data is presented using the thematic coding tables as the theme identified to present the analysed data.

Having conducted interviews from a sample of participants who from different sectors, it has presented me as the interviewer with a wide-ranging perspective and understanding about my topic, and it resulted into longer interactions with most participants as a result that the interactions were very insightful for people who are embracing the use of technology. The preliminary data captured from each participant, required a thorough review through key words transcribed in the notes book and recordings. Interpretive codes have been used to support the demonstrated arguments on each thematic table. The chapter has been set into a structured different section which are a review of the sample participants, key concepts and analysis of key themes derived from the research questions, supporting themes derived from the participants' feedback and the thematic casual map unfolding all the themes.

4.2 Review of the Sample

Letters of permission requesting for interviews were sent to 25 people and 15 people responded within the set time and interviews were scheduled and conducted for the purpose of collecting data for this research study. Some participants have initially agreed to participate in these interviews but were later no longer available because of delay to receive an ethics clearance certificate from the school ethics committee. The feedback from all respondents have been analysed to contribute to this research study as a result that each respondent added value in their own way. The researcher

has opted to conduct the interviews through virtual meetings due to Covid-19 restrictions. All interviews were conducted through virtual meetings except one respondent due to connectivity issues.

The respondents included four executive members from private sectors, senior executive from higher education, lecturer(s) from higher learning, senior management from education sector in lower education, principal(s) and teacher(s) from secondary schools and professionals from different sectors which includes telecommunications and mining industry. Out of the 15 respondents, 11 respondents were male, and 4 respondents were female. The age group of the respondents ranged from 30 years old to 55 years old, with many of the respondents aged between 30 and 40 years. The research title attracted most respondents who are at the peak of their careers. Those who are 50s and above seemed to fear engaging in a technology related topic as they see themselves as the "born before technology". The respondents included both genders, different ethnic groups, and different tribes from different geographical locations with different upbringing experience. An inclusive diversity has influenced the researcher to gather a broad perspective about technology and education. The respondents are currently based in Gauteng, Limpopo, and Mpumalanga provinces; however, they originally come from Limpopo, Eastern Cape, and North West provinces.

4.2.1 Demographics Characteristics of the Participants

This Table 1 shows the demographics of the respondents, names of the participants and their organisations were intentionally excluded to protect their identities.

Respondents no	Gender	Age (years)	Education Level	Designated Position	Sector	Industrial Experience (years)
1	Male	30	Master's Degree	University Lecturer	Education	7
2	Male	33	BSc Mining Engineering	Mining Manager	Mining	11

3	Male	53	Master's Degree	Circuit Manager	Education	31
4	Male	31	BTech Degree Elec Engineering	School Teacher	Education	11
5	Male	39	PhD	Deputy Vice Chancellor	Education	20
6	Male	31	BTech Degree Elec Engineering	Engineer	Telecommunications	10
7	Male	35	Postgrad Dip Digital Business	AWS Infrastructure Engineer	Telecommunications	13
8	Female	52	Master's Degree Public Management	School Principal	Education	28
9	Female	39	MBA & MSc	Executive	Telecommunications	16
10	Male	37	MBA	CIO	IT	11
11	Female	48	PhD	Senior Lecturer	Education	24
12	Female	30	Honors Degree	School Teacher	Education	7
13	Male	32	CA	Executive	Telecommunications	10
14	Male	35	Masters (PhD candidate)	President's 4IR Committee	Energy Innovation & 4IR Commissioner	12
15	Male	40	BSc Computer Engineering	4IR Executive	Telecommunications & Media	17

Table 1: Demographics Characteristics of the Participants

4.3 Understanding of the Fourth Industrial Revolution (4IR)

Table 2 focuses on the key statements and quotes drawn from the participants during the interview sessions when addressing the brief understanding of what the Fourth Industrial Revolution is.

Participant no	Key Statements Quoted from Interviewees	Preliminary Codes
1	"Advanced technologies used in industries to simplify things and improve production"	Technology Machines
2	"Terming the current developments and changes that industries are taking and how technology and internet are impacting production and industrialisation"	Internet & technology
3	"An advancement in embracing technology in our everyday life"	Technology
4	"Machines taking over but not replacing human intelligence"	Technology Machines
5	"Fourth Industrial Revolution (4IR) refers to a confluence of technologies, it furthers 3IR.	Confluence of technologies
6	"Advancement of the previous technologies and moving to new technologies such as AI, Cloud Computing, IoT, Big-Data, 3D-printing and Robotics	Technologies
7	"Changes happening around the world on how we do things, influenced by internet connection"	Internet
8	"Ways in which technology has advanced to influence our everyday living today"	Internet
9	"Coming together of technologies, physical and biology, merging of silos to work together"	Technology
10	"4IR is about utilizing of technologies to industrialise our economy and develop our country"	Technology enabler
11	"More about production and innovation using technologies"	Technology
12	"Technology assistance to make our lives better"	Technology
13	"Pace at which humanity innovates is increasing and rate of rapid innovations are causing major disruptions"	Innovations
14	"Confluence of intelligent technological domains"	Physical and Biological
15	"Set of accelerating technologies leading new industries, they	Digital, Biological,

	across the digital, biological and physical"	Physical

Table 2: Understanding of the Fourth Industrial Revolution (4IR)

The use of technologies and internet connection have been the key words in almost each of the respondents, with the focus on improving production and the way we live. Key codes are confluence of technologies, technology, internet connection, digital and machines.

4.4 Readiness on using 4IR to facilitate teaching and learning

As per Table 3 below, the table speaks to the readiness on using Fourth Industrial Revolution's technologies to facilitate education in rural public schools. An average score of 3.3 on the readiness, the contributing factors to this scoring are lack of infrastructure developments in rural areas, current curriculum and teachers that are not tech-savvy. Scale of 1-10, with a "1" equals to poor and a "10" equals to excellent.

Participant no	Scale (1-10)	Key Statements Quoted from Interviewees	Preliminary Codes
1	3	"Basic Education not ready in public schools and Teachers' mindset needs to be changed"	Mindset, Internet, Infrastructure, Resources
2	4	"Tertiary level has proven to be ready but at lower education it is still a serious challenge in public rural schools"	Infrastructure, Technology savvy
3	4	"Not enough efforts from Basic Education and policies are against the use of electronic devices at schools"	Policies
4	4	"Tertiary is slowly getting there but at lower education, we are not ready; most teachers are still struggling with basic things like using a computer"	Internet, Computers, Skill
5	3	"Readiness has great variation due to South Africa's past"	Unevenness, Variation

6	4	"Many schools have not yet introduced the use of technology and have no basic requirements like internet connection, Computers and Labs"	Resources, Internet, Computer Labs
7	3	"Very few schools are doing online learning from private schools and possibly non from public schools, and this was a result of an influence by pandemic"	SABC, Sentech, Medium
8	2	"Schools in rural areas are not ready, no internet connections, computer labs and computer skills for both learners and teachers"	Computer Labs, Network Connection, Electronic Devices
9	3	"In SA you find extremely poor and extremely rich people, many people are poor with no basic needs such as water, roads, clinic and jobs"	Infrastructures, Network Connectivity
10	3	"In rural areas, we are not empowered with basic infrastructures"	Infrastructure, Internet
11	4	"In rural public schools, they don't have internet connection and electronic devices"	Infrastructure
12	5	"Schools in rural areas are much dependant on Government and there is less knowledge in understanding the use of technology devices"	Technology
13	4	"Covid-19 has proven that we have not mastered the basics of online learning in public schools, we are way years behind"	Computer Labs, Technology Devices, Spectrum
14	2	"Maths & Science not in a good space in SA and reality is that they are at the heart of 4IR"	Maths, Science
15	1	"Curriculum is still way outdated and no clear plan and structured way to upskill teachers"	Curriculum, Structured plan

Table 3: Readiness on using 4IR to facilitate teaching and learning

4.5 Infrastructure development to integrate 4IR on education

On Table 4, the respondents have highlighted the issue of no network connectivity, no basic infrastructures such as water & electricity and no computer labs/ electronic devices.

Participant no	Key Statements Quoted from Interviewees	Preliminary Codes
1	"Government must subsidise telecoms companies to build network towers" "Government investing on gadgets and tight security"	Connectivity
2	"Department of Education needs to be intentional and partner with Telecoms' service providers to improve connectivity"	Partnership, Connectivity
3	"Connectivity is no longer a luxury, it's a must have, almost every device in our homes needs activation"	Connectivity
4	"Building of cyber centres with computers connected to internet in public rural schools"	Cyber centre, Internet
5	"Utilize a simple cost-effective technology (innovation) and enable strategic partnerships between private and public sectors"	Innovation, Cost effective technology
6	"SA Government should apply digital lens to their socio-economic development strategies"	Internet connection
7	"The backbone of 4IR is internet connection"	Internet connection
8	"A need for computer labs and internet connection"	Computer labs, Internet connection
9	"The country must focus first on basic needs like water in schools, roads infrastructures, clinics and jobs to support the use of technology" "Great education system and teachers"	Basic needs of infrastructures, Education system
10	"A need to empower rural areas with infrastructures will enable people with internet connection and address skills revolution"	Infrastructure empowerment, Skills revolution
11	"Infrastructure for high-speed internet access and smart devices are necessary for 4IR adoption in rural public schools"	Cloud-based, High-speed internet

		connection
12	"Build classrooms with computer labs and internet connection and broadband rollout"	Computer labs, Internet connection
13	"Spectrum is a critical enabler to unlock 4IR, Government need to allocate more spectrum to service providers"	Spectrum allocation
14	"Digital infrastructures should be built as a complement to physical interaction"	Digital infrastructure
15	"Shared infrastructures and every school must have a 3D-priniting to facilitate and connectivity"	Shared infrastructures, 3D-printing, Connectivity

Table 4: Infrastructure development to integrate 4IR on education

4.6 Policy makers and stakeholders on education

As per Table 5 below, respondents have emphasized on the issue of policies that drives partnerships between public & private sectors, and that the policy makers need to be strategic about their policy decisions making.

Participant no	Key Statements Quoted from Interviewees	Preliminary Codes
1	"Telecommunication companies must invest in improving connectivity in rural areas". "Strengthening the laws and holding people accountable"	Connectivity, Accountability
2	"Government must ensure that Telecoms companies give back more relevant and meaningful CSI projects through policies"	CSI projects
3	"SGBs and SMTs must change policies governing schools and prioritize connectivity in schools"	Policies, Connectivity
4	"Funding of schools through partnership with technological companies and policies around teaching must be revisited"	Funding, Partnership, Policies
5	"Policymakers should incentivise private sectors and Stakeholders should include disruptive innovators and influencers, who have the ability [and capability] to foster online education with local relevance"	Incentivise, Disruptive innovators and influencers
6	"Government should approach private sectors like Telecoms	Sponsorship

	companies for assistance"	
7	"Policies need to be translated into strategic plans and change policies around cadre deployment" "Collaboration of SOEs like SABC and Sentech to offer online teaching through tv channels"	Collaboration, Policies, Strategy, Deployment
8	"Partnership between government and private sectors" and "Policies should be constantly reviewed to improve schools in the rural"	Partnership, Policy review
9	"Policy makers must insist that ministers come together to provide the basic service delivery needs"	Basic needs, Service delivery
10	"Government must take a deliberate move and provide incentives, and partner with private sectors"	Incentives, Partnership
11	"Include courses such as AI, Robotics and Coding as part of the curriculum and level up maths"	Change the curriculum
12	"Adjust the curriculum to align with the current needs and firm decision on using technology to facilitate education"	Curriculum, Technology
13	"Policy makers are at strategic level and need do analysis and assess every value chain and develop strategies that can be implemented"	Strategic analysis, Value chain
14	"Policy makers need to intensify the notion of policy learning"	Policies
15	"Shared model and incentives for the adoption of these technology"	Incentives, Shared model

Table 5: Policy makers and stakeholders on education

4.7 Impact of 4IR on Society

As per the Table 6 below, the respondents have highlighted on how Fourth Industrial Revolution can bring about positive changes and developments in rural areas if it is implemented because it will require infrastructure developments.

Participant no	Key Statements Quoted from Interviewees	Preliminary Codes
1	"Many people who are less informed about 4IR make unfounded remarks and don't realise developments that can be accelerated with 4IR"	Mindset, Mentality

2	"Availability of the digital space shaping the way we live" "When 4IR is rolled out properly with good infrastructure, it will create more part-time employment to students"	Digital space, Employment
3	"Change is invertible, and we have to position ourselves and embrace it to avoid playing catch up to the rest of the world"	Mindset, Globalization
4	"4IR will create a learning development environment and online libraries"	Learning development
5	"4IR has the potential to transform society while at the same time, 4IR brings about significant ethical, emotional and cybersecurity issues"	Transform society, Ethical, Emotional, Cybersecurity
6	"4IR will bring about development changes and connectivity to rural communities"	Development, Connectivity
7	"Government to find better ways to collaborate with citizens"	Collaborate
8	"Increase inequality when looking at current state of the nation but improve quality of life when there are infrastructure developments"	Increase inequality, Quality of life
9	"Boundaries and geographical limitations can be removed with 4IR"	Boundaries, Limitations
10	"Investments of broadband in rural areas and connectivity"	Broadband, Connectivity
11	"The adoption of 4IR and skills set can be utilized to empower our economy"	Economy
12	"Better ways of living, doing things online like shopping"	Shopping online
13	"Major disruption due to the pace at which humanity innovates and livelihood will become better" "Intent for 4IR to be human inclusive"	Disruption, Humanity innovates
14	"Machines don't innovate, it is people who innovate"	Innovation
15	"People located in rural areas will have an opportunity to be highly skilled"	Highly skilled

Table 6: Impact of 4IR on Society

4.8 Impact of 4IR on Job losses and creation

On Table 7, the perception is that some jobs will be redundant and new jobs will be created, people will need to reskill themselves to be aligned with the new world.

Participant no	Key Statements Quoted from Interviewees	Preliminary Codes
1	"People are uncertain about change and fear of losing jobs, 4IR will create more new jobs and people need to reskill themselves"	Reluctant
2	"4IR will provide an opportunity for students to have more part-time jobs and graduate with working experience"	More opportunities
3	"The job market has changed, and we need to align the society"	Globalisation
4	"Many teachers fear that machines will take their jobs and expose their incapability"	Machines
5	"4IR is a catalyst to educational strategy rather than a replacement and the education paradigm is likely to be a hybrid one"	Catalyst to educational strategy
6	"More jobs will come out of 4IR, people will need to reskill themselves"	Re-skilling
7	"High level of ignorance and lack of knowledge on how 4IR can benefit people with new careers"	Knowledge
8	"Fear of the unknown, teachers think 4IR will take their jobs"	Lack of knowledge
9	"Open up for more opportunities"	More opportunities
10	"Not skilled jobs will be taken away 4IR but will bring more than 50% of new jobs"	New jobs, Re-skilling
11	"New jobs creation for new skills set"	Job creation
12	"Teachers will be overlooked by technology and lose jobs"	Losing jobs
13	"Automation will result to others losing jobs, but new jobs will be created and an opportunity for reskilling"	Automation, Job losses, Re-skilling
14	"This change is not presented well hence the fear of losing jobs, if 4IR is rolled out as a complement, people will need to reskill themselves"	Re-skilling
15	"Teachers should be open for reskilling and taking on different roles within education"	New jobs created, Old jobs redundant, Re-skilling

Table 7: Impact of 4IR on Job losses and creation

4.9 Contributions of 4IR in public rural schools

As per Table 8 below, respondents' perceptions with confidence are that the 4IR change the mindset of a child in rural public schools and teaches them to be more innovative and bridge the gap that exists between public and private sectors.

Participant no	Key Statements Quoted from Interviewees	Preliminary Codes
1	"Learners can learn new relevant skills and improve their innovations abilities"	Innovations, Relevant skills
2	"Notes can be digitized and makes it flexible and more efficient" "Create effectiveness in the education system"	Efficiency, Effectiveness
3	"Pushing e-papers and enhance productivity using technology, and learners must be taught and assessed online to align with the rest of the world"	Techno savvy, Technology devices
4	"Proactive learning and exposure for learners"	Learning development
5	"Shortcomings of our public schools can be complemented by technology"	Technology
6	"Leaners and teachers will be motivated to think creatively and be exposed to more information"	Creative thinking
7	"Digitized lessons and skills in the form of recordings"	Digitization of lessons
8	"Learners will have an option to learn even without the presence of a physical teacher and new skills can be discovered"	Discovering of new skills
9	"Mindset of a child in a public rural school will change with the exposure to different things"	Mindset
10	Bring new opportunities in terms of learning and prepare learner to be ready for the market"	New opportunities
11	"4IR will create more social interaction between learners and teachers, and more exposure to technology"	Social interaction, Exposure to technology
12	"4IR will change their lifestyles and they will be able to invent"	Invent
13	"Right content or syllabus accredited in the digital platforms to benefit rural public schools"	Right content and syllabus

14	"4IR will provide an opportunity for virtual reality"	Virtual reality
15	"Learning management system, study tools and early childhood education"	Learning management

Table 8: Contributions of 4IR in public rural schools

4.10 Bridging the gap between public rural schools and private schools

As per Table 9, the respondents' perceptions about bridging the gap between rural public schools and private schools in the cities is presented below on how the 4IR will expose learners from rural public schools to new ways of doing things and help them to think creatively and have access to unlimited information.

Participant no	**Key Statements Quoted from Interviewees**	**Preliminary Codes**
1	"Young people in rural public schools can use the resources that comes with the adoption of 4IR to be more innovative and compete with the rest of the world"	Creativity, Innovations
2	"4IR can solve challenges that learners have in rural areas like; walking many kilometres to schools, not able to go to school when the weather is bad" "Learners will have the opportunity to understand in their preferred languages"	Solving challenges, Preferences
3	"4IR technology embracement will serve as an equalizer between rural schools and schools in the cities"	Equalizer
4	"Learners in rural public schools will get an exposure to technology"	Exposure to technology
5	"A 4IR transformative approach can bridge the gap of inequality between rural public schools and private schools"	Transformative, Inequality
6	"Access to more information and online labs remotely"	Access to information
7	"Expose learners to knowledge sharing with others from different schools around the world"	Knowledge sharing
8	"4IR will help teachers to be more efficient and learners to be	Efficiency, Creative,

	creative and innovative"	Innovative
9	"Ability to dream bigger and have youth that are problems solvers. Learners in rural public schools will be able to connect with the world"	Problem solvers, Connect with the world
10	"Through IoT learners will be able to connect from different locations and with 4IR technologies learning capability can be enhanced"	Connect from different locations
11	"Gaming, cloud-based knowledge sharing between rural and urban schools and create an interest in mathematics"	Knowledge sharing, Creating interest in Maths
12	"Equip learners to think beyond their capabilities and ability to think independently"	Thinking beyond and independently
13	"Digital centres to expose kids at young age to allow learners to experiment and build codes"	Digital centres
14	"Expose rural public schools' learners to what is happening in the cities and around the world and start imagining"	Exposure
15	"Tech learning and broad online learning for rural kids"	Tech learning

Table 9: Bridging the gap between public rural schools and private schools

4.11 Confidence in 4IR technologies – Opportunities and Threats

On Table 10, the respondents' perceptions are that 4IR can be both an opportunity for growth and a threat, the change needs to be managed well.

Participant no	Key Statements Quoted from Interviewees	Preliminary Codes
1	"Teachers are reluctant to changes in public schools compared to private schools because they see 4IR as something that will control them"	Threat
2	"Parallel implementation is a challenge in a unionisation nation, DBE must reform teachers with constant training"	Constant trainings
3	"Learners must use technology to deepen their knowledge and	Opportunity, Mindset

	understanding of the subject"	
4	"4IR should be perceived as an opportunity for growth"	Opportunity
5	"Potential growth if the recommendations of the Presidential Commission on 4IR are implemented"	Potential growth
6	"Opportunity for growth and development leading to producing skilled graduates"	Opportunity for growth, skilled graduates
7	"4IR is a threat to people who want to remain in a comfort zone but a huge opportunity to those who embrace change"	Threat, Opportunity
8	"Everything has positives and negatives, as a threat our information can be used without consent but on a positive side there will be open market for new jobs"	Threat and Opportunity
9	"Opportunities will be endless with the adoption of 4IR"	Endless opportunities
10	"Jobs to be lost for unskilled teachers but a great opportunity for the growth of our country's economy"	Unskilled teachers, Great opportunity
11	"An opportunity for growth and development, and should be embraced"	Opportunity
12	"Great opportunity for growth, aligning us for future to come"	Great opportunity
13	"Not debated and discussed enough with the public, there is both adamant and acceptance to a certain degree, 4IR will happen with or without us"	Opportunity to make everyone better
14	"4IR presents both threats and opportunities, threats need to be managed well"	Opportunity, Threats
15	"Great opportunity for growth but not overlook the risk associated with"	Great opportunity, Threats

Table 10: Confidence in 4IR technologies – Opportunities and Threats

4.12 4IR increasing productivity

As per Table 11 below, the perception from the respondents is that the adoption of 4IR will increase productivity in schools.

Participant no	Key Statements Quoted from Interviewees	Preliminary Codes
1	"4IR will change the mind of learners and teachers"	Mindset
2	"Conceptual, 4IR is affecting productivity positively but in reality, when looking at SA's infrastructure is a different game"	Infrastructure
3	"Productivity will increase as compared to manual labour"	Increase productivity
4	"4IR will create efficiency in the education sector"	Efficiency
5	"4IR will enhance productivity and as productivity gain will enhance tax collection"	Enhance productivity, Enhance tax collection
6	"Learners will be more creative and learn a lot in a short space"	Creative
7	"Increase efficiency in a learning space"	Efficiency
8	"Increase production, efficiency for teachers and skills development"	Productivity, Efficiency, Skills development
9	"When you are exposed to new things, you develop, productivity will increase"	Develop, Productivity
10	"4IR can rebuild our economy and more developments"	Rebuilding of economy
11	"Will increase productivity"	Productivity
12	"Positive contributions towards learning"	Positive
13	"Private & Public sectors' partnership can definitely enable an eco-system to a massive opportunity for growth in SA"	Compete at global level
14	"4IR will enhance teaching and learning"	Enhancement of productivity
15	"Human intervention will be required with quiet a lot of teachers with different capacity"	Human intervention, Capacity requirement

Table 11: 4IR increasing productivity

4.13 Sectors' contributions in accelerating development in public schools

Table 12 below, shows how the respondents' organisations are contributing and can contribute to the acceleration of developments in rural public schools.

Participant no	Key Statements Quoted from Interviewees	Sectors	Preliminary Codes
1	"Identify communities and nature them, community engagements with focus to 4IR" "Projects that will teach communities about 4IR"	Education	Creating awareness
2	"Giving out mobile laboratories with computers in schools around Mpumalanga"	Mining	Creating an interest in the space
3	"Raising awareness in all spheres of influence and enforcing all schools to have internet connections"	Education	Awareness
4	"DoE should ensure that teachers get proper training about 4IR"	Education	Trainings
5	"In collaboration with strategic partners, we could enable a virtual school"	Education	Virtual school, Strategic Partnership
6	"Building of 5G towers to enhance the speed and offering scholarships"	Telecoms	Connected society
7	"Building of towers for internet connections and better network coverage, free data bundles to schools"	Telecoms	Free data bundles, Network coverage, Internet connection
8	"Training of teachers and creating awareness"	Education	Trainings. Creating awareness
9	"Extending the reach to rural areas with connectivity and exposing graduates to different areas within a corporate environment"	Telecoms	Exposure, Bursaries, Internships, Network connectivity and coverage
10	"CSI program supporting disadvantaged communities"	Gambling Board	CSI programs
11	"Assist with funding to get connected and smart devices in rural public schools"	Education	Funding, connected devices, Smart devices
12	"Providing access to intern and computers and	Education	Access to internet

	help teachers to adapt to changes" and "Retraining of teachers in the education sector"		connection, Retraining of teachers
13	"Creating digital society across the continent and build platform enablers through connectivity"	Telecoms	Digital society, Platform enablers, Connectivity
14	"Public & Private sectors must shift and invest differently on things of the future with focus to investment on technology"	Energy Innovation & 4IR Commissioner	Investment, Collaboration, Technology investment
15	"Created Nandi app to help kids in high schools with subjects, and building digital platforms and connectivity"	Telecoms	Nandi app, Digital platforms, Connectivity

Table 12: Sectors' contributions in accelerating development in public schools

4.14 Thematic Map

The data presented in this chapter using thematic tables can be summarised using the thematic map analysis and coding. In a qualitative research study, interviews are often used as a structured way to collect research data, for multiple interviews conducted from different people, a causal mapping can be used to map and link the interviews, as causal mapping is an instrument that enables researchers to make sense of situations using causal map diagram (Behfar & Trochim, 2002). The purpose of a thematic analysis is to identify patterns or themes in the research data to address a research (Behfar & Trochim, 2002). In a qualitative research study, a framework of thematic ideas can be stablished using thematic coding which involves identifying of channels of text (Maguire & Delahunt, 2017). Thematic coding methods or Code based analysis can be used to reduce text data into manageable summarised categories (Behfar & Trochim, 2002).

The Thematic causal map below on figure 5 demonstrate the key enablers and relationships of the technologies of Fourth Industrial Revolution and its impact on education and society. The understanding of Fourth Industrial Revolutions and technologies determines the perceptions around 4IR and its impact on jobs losses, jobs creation, productivity, threats, and opportunities. With, a knowledgeable understanding of the 4IR enhances one's interest on technology and lead to a positive perception, however, with reservations for risks associated with technology. There is a perception that the Fourth Industrial Revolution will replace human intervention and result in people losing jobs because of lack of awareness and knowledge. The Fourth Industrial Revolution will establish new opportunities and requires people to reskill themselves to align with the technologies.

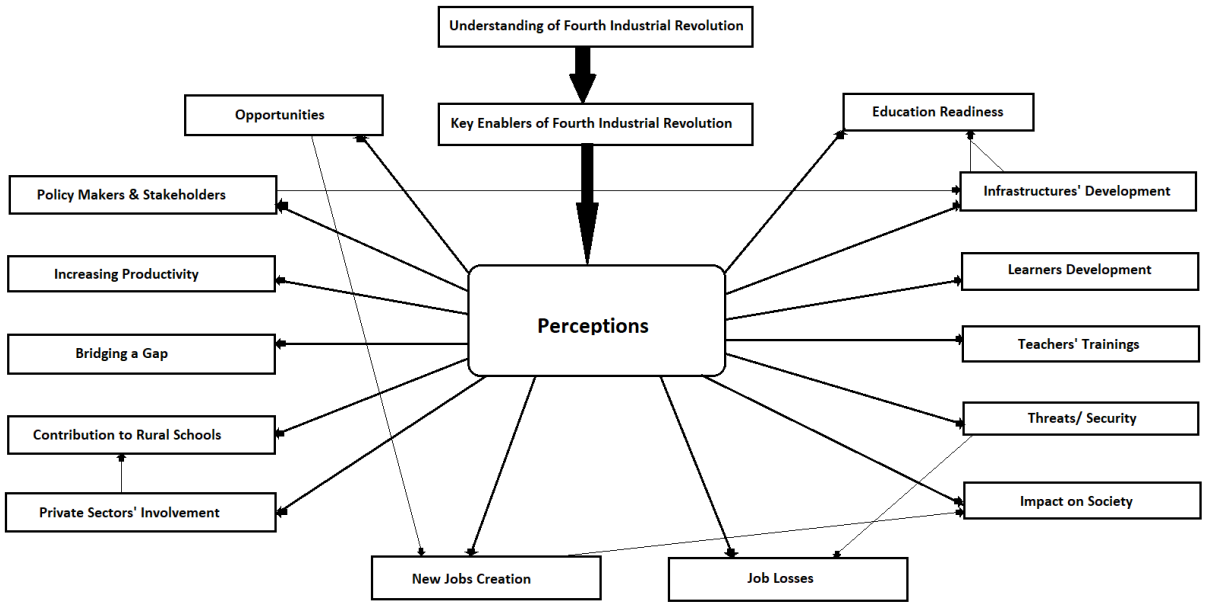

Figure 5: Thematic Causal Map

4.15 Conclusion

The data presented in this chapter was collected through semi-structured and unstructured interviews of 15 participants from different industries and ethnic groups. The purpose of having a diversified group was so that the data can vary as people would be more likely to have different experiences and perceptions. The data has been presented and arranged on a more understandable way and easy to interpret

using thematic coding tables. Thematic causal map has been used to demonstrate the key enablers and relationships of 4IR technologies and the education system to visualise to readers how the data was summarised using the thematic coding tables. The relations between different themes demonstrated in the thematic causal map are supported with explanation on the impact of Fourth Industrial Revolution on education and how the society can influence the success of 4IR on education in rural public schools. The thematic coding tables are accompanied by a brief explanation of the respondents' perceptions on themes and the data presented in this chapter 4 is discussed in details on chapter 5 to answer the research study questions.

5 DISCUSSION OF RESEARCH FINDINGS

5.1 Introduction

In this chapter, the data collected and presented in chapter 4 through the thematic tables are discussed in more details to address the research questions. The findings and discussion drawn from the presented results incorporates the literature to address the research questions.

The discussions begin with the understanding of fourth industrial revolution (4IR) and its readiness to facilitate education in the rural public schools in South Africa. The discussion explores further on respondents' view on things that can hinder the progress on our education system, confidence in 4IR technologies, impact on society, job losses and creation, contributions of 4IR on education and conclude with what respondents' organizations are doing and can do to help facilitate the acceleration of fourth industrial revolution's technologies in rural public schools.

5.2 Understanding of the Fourth Industrial Revolution (4IR)

The analysis done after conducting the interviews with the participants, the responses have shown that people who have better understanding of what Fourth Industrial Revolution is, are the ones in the Telecommunications sector as telecoms is one of the key enablers to drive Fourth Industrial Revolution. They have demonstrated a deep understanding of Fourth Industrial Revolution. In the education sector, the respondents from basic education did not have much understanding as compared to the respondents from higher education. However, all respondents have contributed to their best capabilities to the research studies.

Looking at Table 2 which captured all 15 respondents' understanding of the Fourth Industrial Revolution, the respondents had common preliminary key codes which are technologies and internet connectivity. These primary key codes are aligning with the definition of Fourth Industrial Revolution as cited in the literature review.

> The Fourth Industrial Revolution is advancing the Third Industrial Revolution, 4IR is a combination of technologies blurring the lines between digital, physical, and biological spheres (Xu, David, & Kim, 2018).

"Fourth Industrial Revolution (4IR) refers to a confluence of technologies. It furthers 3IR (enabled by transistors [microelectronics] which brought together computing and communications [via the internet]) through artificial intelligence (AI)" **Respondent 5**.

> "The Fourth Industrial Revolution is more than just a change driven by technology, it is powered with disruptive innovations to positively impact core industries", p. 93 (Xu, David, & Kim, 2018).

Respondent 14 had a close similar definition when responding to the understanding of the 4IR, he said "The Fourth Industrial Revolution is the confluence of intelligent technology domains of; the cyber, the biological and the physical, with their associated societal implications, the paradigm is the convergence of these different domains which is the heart of the 4IR".

5.3 What is the level of readiness for the DBE and the country on embracing 4IR?

Looking at the analysis in conjunction with the literature conducted, all respondents have expressed how unready the country and the Department of Basic Education are when it comes to embracing the Fourth Industrial Revolution and facilitating online teaching and learning, particularly in the rural public schools. All respondents on a scale of 1-10 have rated less than 6, with many rated a score of 4, one respondent rated a score of 5, one respondent rated a score of 1.

> Lack of school buildings and resources like stationery are the basic needs that should be overcome before any technology resources can be implemented to

> improve access to quality education, without these basic needs, it will almost be impossible for learners to get suitable education (Herselman, 2003).

On Table 3, the key codes that were common from most respondents were infrastructure, internet connectivity, computer labs and computer skills. The respondents' perception about the level of readiness to embrace 4IR is very low, only one respondent gave a score of 5 out of all 15 respondents, 11 respondents gave 3s and 4s score, 3 respondents gave a score of less than 3. The respondents have argued that basic needs and supporting structures are still a challenge in South Africa with no signs of developing rural areas.

> One of the respondents took a different angle in responding to the readiness as someone who is part of the commission assembled by the State President, he said "Curriculum is still way outdated as it stands and there is no clear plan, the capability is an issue with no structured way to upskill teachers and no structured way to deliver this type of education, 4IR is largely driven and all schools will need at least one 3D-printing, devices are expensive and to get each scholar will be a challenge" **Respondent 15**.

One of the respondents who is the principal in one of the schools in the rural public schools did not hesitate to say that public schools in rural areas are far from being ready and to echo the respondent's statement, I struggled to have a virtual interview with the respondent through "Zoom" app to a point where I resorted into calling the respondent direct from a cell-phone to further conduct the interview. The respondent said, "Public schools in rural areas are not ready, network connectivity is serious issue and without connectivity there is nothing you can do to facilitate online learning, schools don't have computer labs and computer skills for both learners and teachers" **Respondent 8**.

> Looking at our country in the year 2020 during lockdown level 3, 4 & 5 due to Covid-19 pandemic, private schools continued to function, but public schools were closed, which serves to prove how the Department of Basic Education and the government are not ready to facilitate online education.

5.4 Changes that 4IR can bring on education in public schools in the rural

From the responses analysed on Table 8 and Table 9 in conjunction with the literature it has been found that the adoption of Fourth Industrial Revolution in the South African basic education, a lot of positives can come out of it and bridge the gap between rural public schools and private schools in the cities. The key codes noted by respondents are creative thinking, innovative, mindset, relevant skills, effectiveness, learning development, right syllabus, and tech-savvy.

> Fourth Industrial Revolution will disrupt the education sector by redefining new ways to deliver education to scholars with the shift from modes of teaching to modes of learning (Xu, David, & Kim, 2018).

Respondent 1 has alluded that "learners in rural public schools can have the opportunity to learn new relevant skills and improve their innovations abilities to help compete with kids in the cities and around the world"

> 4IR technology will introduce the adoption of robotics and computational thinking for learners from an early age to help developing scholars on problems solving skill and enhancement on collaboration and teamwork (Bers, 2013).

Respondent 11 indicated that "the adoption of 4IR in basic education can create cloud-based knowledge sharing between learners in rural public schools and private schools in the cities, 4IR will create more social interaction between learners and teachers, and more exposure to technologies such as gaming that can help to reignite the interest of Science and Mathematics in learners"

> Access to information and the use of technology is critical for learners and to the world of today to promote online learning and teaching, so geographical

locations shouldn't be a deciding factor on who get access to information (Herselman, 2003).

With the adoption of 4IR, learning material can be stored in the cloud or electronically for the ease of access for all learners and help slow learners to improve.

Respondent 2 indicated "how the education system can create effectiveness and flexibility with notes being digitized, the respondent further mentioned a lot of challenges that can be solved by the adoption of 4IR, i.e learners without schools in their home villages will not have to walk kilometres to school to acquire education and learners can still have access to education even when the weather is bad"

Information and Communications Technology (ICT) is a key enabler and driving force of the 4IR as it influences how things will be done in future (Herselman, 2003).

Respondent 6 alluded that "learners and teachers will be motivated to think creatively, and learners will have access to more information and online labs without an actual physical infrastructure to conduct labs.

Learners in rural public schools are expected to perform at the same level of their counterparts in private schools, yet in "most rural schools it is unlikely to find computer labs", p. 947 (Herselman, 2003). The adoption of Fourth Industrial Revolution in rural public schools can bridge the gap between rural and urban schools and provide an opportunity for learners in rural schools to have virtual labs through internet.

The gap that there is between public schools in the rural and private schools in the cities can be narrowed by rolling out of 4IR as part of the curriculum in the education sector.

Respondent 5 indicated how "the shortcomings of our public schools can be complemented by the use of technology particularly in rural schools and a

4IR transformative approach can bridge the gap of inequality between rural public schools and private schools in the cities".

5.5 The impact that 4IR will have on society

From the responses analysed on Table 6 in conjunction with the literature, 4IR will have a major impact on society particularly in rural areas, the adoption of Fourth Industrial Revolution can accelerate developments in rural areas and eliminates all the boundaries and limitations. The key codes noted in the respondent's responses are infrastructure developments, employment, mindset, security, inequality, quality of life.

> Many rural public schools are isolated from the "urban education mainstream", learners struggle with transport resources to travel to schools and rain can be an obstacle to schools in rural areas because there are no tar roads and gravel roads become dangerous (Herselman, 2003). The adoption of 4IR in basic education can help resolve these issues, however, basic infrastructures such as connectivity, electricity and electronic devices will need to be prioritised to influence the success of 4IR in learning and teaching in rural public schools.

Respondent 8 demonstrated the positives and negatives on society when adopting 4IR's technologies, the respondent said "as a country we are still far from providing the basic needs such as water, proper roads, electricity, clinics and jobs, the adoption of 4IR at the current state will further increase inequality, however, it can improve the quality of life when infrastructure developments are prioritized".

> Many rural communities in South Africa have limited opportunities and market to generate income (Dlodlo, 2009), Fourth Industrial Revolution and all other developments that 4IR will need to be implemented in rural schools can impact

societies positively by exposing them to new things and new ways, a mind that is exposed to new things grows and be creative.

4IR can help solve all the problems for learners who don't make it tertiary level by changing their thought process and utilize the resources available to their advantage.

Respondent 1 mentioned that "the mindset of young people in rural areas will change and help communities to venture into techno-entrepreneurship with the new set skills".

New technologies like 3D-printing can lead to tech-entrepreneurs in rural communities and provide them with the opportunity to establish small companies at lower cost start-up (Xu, David, & Kim, 2018).

Respondent 2 said that "when the Fourth Industrial Revolution is rolled out properly with good infrastructures, it will create more part-time employment to students and unemployed people in communities, students will graduate will experience".

The fast growing of digital technologies through 4IR will empower poor rural villages with access to information and service to improve their standard of living (Ndung'u & Signé, 2020).

Respondent 6 indicated on "how more dedicated projects to educate communities about these Fourth Industrial Revolution's technologies can bring about development changes and resolve the network connectivity issues to rural communities".

5.6 How will Fourth Industrial Revolution impact jobs in the country?

From the responses analysed on Table 7 in conjunction with the literature, it was found that there is not enough awareness to the public and teachers to educate them about the opportunities that comes with Forth Industrial Revolution. The perception is that 4IR will take jobs away from teachers that are not skilled, and it will indirectly increase corruption, as it was witnessed with the project in Gauteng led by MEC of education when tablets and electronic devices were stolen, and schools broken into. Some respondents in the education sector fear that their privacy will be compromised by these technologies and some respondents noted the risk associated with the use of technology devices in schools which might expose learners to cyberbullying. Key codes that have been noted from the respondents are an opportunity for reskilling, new jobs to be created. All 15 respondents believe that new jobs will be created, and teachers need to be open for reskilling and take up new roles in the education sector.

> Robotics have the potential to improve the quality of our lives at work and outside work, "customized robots will improve the quality of existing jobs and create new jobs", p. 92 (Xu, David, & Kim, 2018).

Respondent 14 mentioned that "This change is not presented well hence the fear of losing jobs from teachers and the challenges associated with training to teachers, things are being rushed and it creates unsettlement. If 4IR is rolled out as a complement, people will need to reskill themselves".

> With the fast growing of digital technologies in Africa as a continent, the workforce is projected to be among the world's largest (Ndung'u & Signé, 2020). 4IR's digital infrastructures will contribute to new skills required for innovation and technology which will present a massive opportunity for growth.

"In South Africa, the variation is quite large. Some are sceptical about 4IR, the conversation is often about job creation *versus* automation. However, the reality of the situation is job creation *and* automation. Fourth Industrial Revolution is a catalyst to the educational strategy rather than a replacement and the education paradigm is likely to be a hybrid one" **Respondent 5**.

Researchers have argued that as 4IR progresses, professional capabilities will evolve to meet the required skills and align to the digital transformation opportunities (Oke, 2020). People will have to focus on reskilling themselve and be open for new jobs that require a set of skills, some jobs will be redundnat but new jobs will be created.

Respondent 9 indicated that "Forth Industrial Revolution brings upon new opportunities and more than 50% of new jobs will be created to cater the skilled individuals who are aligned to the 4IR technologies". The respondent further articulated that only those who don't want change will be affected and result in job losses.

> "Automation will result to others losing jobs, but new jobs will be created and an opportunity for reskilling is up for grabbing because Fourth Industrial Revolution is here with or without us embracing it" **Respondent 13**.

5.7 Confidence on Fourth Industrial Revolution (4IR) – Opportunities and Threats

From the responses analysed on Table 10 in conjunction with the literature, it was found that the Fourth Industrial Revolution presents both the opportunities and threats. The respondents have demonstrated that the awareness and trainings are key to increasing the confidence of teachers on 4IR. Looking at the key codes noted from respondents on Table 10, respondents emphasized the opportunity for growth.

> Technological knowledge has become a driving force to the world of today and for teachers to succeed in the 4IR era, they need to master the technological knowledge. (Marwala, 2017) have argued that teachers in South Africa are worried by the growing trends and developments brought by 4IR in the education sector (Mpungose, 2020).

Respondent 5 said that "South Africa has the potential to resolve the challenges if the recommendations of the Presidential Commission on 4IR (PC4IR) are implemented properly".

The challenges and threats that are associated with the Fourth Industrial Revolution and its technologies can be shifted from threats to opportunities in the era of 4IR.

> There are a variety of challenges that comes with the adoption of connected world through Fourth Industrial Revolution such as hacking and cybersecurity, these challenges need to be managed (Xu, David, & Kim, 2018).

Fourth Industrial Revolution (4IR) can be both a threat and an opportunity for growth, "Everything has positives and negatives, as a threat our information can be used without consent but on a positive side there will be open market for new jobs" **Respondent 8**.

> Lack of knowledge about Fourth Industrial Revolution in public schools creates an uneasiness around acceptance of these technologies.

Respondent 1 indicated that "many teachers are reluctant to changes in public schools compared to private schools because they see 4IR as something that will control them than seeing 4IR as an enabler to creating efficacy in the education space".

> The department of basic education needs to be deliberate about the developments of teachers in rural schools with technical trainings. Many teachers in rural schools lack technical skills and experience to use technological devices and internet, and such has resulted in many rural scholars not sufficiently prepared for tertiary studies where computer skills are indispensable (Herselman, 2003).

In South Africa, there is a shortage of skills, Mathematics and Science teachers, the adoption of 4IR can bridge the gap and digitized the skill in the form of recordings. In rural public schools, resources are a challenge, 4IR can provide an opportunity of centralizing the set skills needed.

Respondent 7 alluded that "Fourth Industrial Revolution is a threat to people who want to remain in a comfort zone but a huge opportunity to those who embrace change".

The respondents' perception about Fourth Industrial Revolution is that 4IR present greater opportunities ahead, however, they have reservations for threats that 4IR can establish in the form of privacy invasion, cyberbullying in schools and creating more gap between rural schools and private schools when looking at the current state of the country on employment and infrastructure development in rural areas.

5.8 Infrastructure development to facilitate teaching and learning on 4IR and

From the responses analysed on both Table 4 and Table 5 in conjunction with the literature, the data shows that infrastructure development holds a key to the success and failure of adopting Fourth Industrial Revolution in our educational sector to help facilitate teaching and learning through 4IR. The key codes noted from the respondents suggest that partnerships between government, private sectors, policy makers and communities are key. The analysis from all respondents shows that internet connectivity is a serious threat to adopting Fourth Industrial Revolution in rural public schools in South Africa.

Economic growth and development in many rural areas in South Africa is still an issue and largely compromised by lack of infrastructures and basic services, with many households relying on grant money and handouts (Herselman, 2003).

Respondent 1 indicated that the "South African government must be in partnership with telecommunications' companies". Telecoms is one of the critical enablers of the Fourth Industrial Revolutions and with the poor internet connectivity in the rural areas, telecommunications' companies will need to "invest on improving network connectivity in rural areas". Without connectivity

and electronic devices in rural public schools, online learning and teachings will fail, “South African government must subsidise telecoms companies to build network connectivity”.

Partnership between public and private sectors will be critical to the success and acceleration of digital development structures in the rural areas.

> **Respondent 13** mentioned that “policy makers are at a strategic level in any organisation, they need to do analysis and assess every value chain to develop strategies that can be implemented”. Telecommunications’ companies such as MTN and Vodacom have been struggling for years to convince ICASA to allocate them with a spectrum, **Respondent 13** further indicated that “spectrum is a critical enabler to unlock 4IR, therefore, ICASA and Government must allocate more spectrum to service providers”.

Lack of school buildings and resources like stationery are the basic needs that should be in place before any technology resources can be implemented to improve access to quality education, without these basic needs, it will almost be impossible for learners to get suitable education (Herselman, 2003).

> In rural areas there are no basic infrastructure such as water, clinics, electricity, jobs and etc, people care more about those basics than entertaining the use of technology. **Respondent 9** said that “government needs to start with the basic needs because digital infrastructures and electronic devices will be stolen, a hungry stomach is hard to manage”. The department of basic education needs to refocus its strategy by getting the right teachers in the system who are skilled for mathematics and science. **Responded 9** further indicated that “policy makers and ministers must come to together to provide the basic service delivery needs”.

The educational policies and constitutions in South Africa emphasize on access to same quality of learning and teaching for all learners. However, 26years have gone by ever since the dawn of democracy and many schools in rural areas still have no

means of basic needs like classrooms, stationaries, water, internet, and electricity facilities (Gardiner, 2008).

> Our people are not ready to consume the modern technologies while at the same time are not ready to contribute to the development and customization of these technologies for our local needs, technological developments is concentrated in the cities than rural areas.

Respondent 14 indicated that "we are in a hybrid world, the digital world should be a complement to the physical interaction because our education system is routed for physical interaction. Therefore, digital infrastructures should be built as a complement of what happens physically"

> In South Africa, the school policy framework is provided by the National Department of Education (NDE), but each province has its own education department which leaves the responsibilities of the administrations at the hands of provinces, districts, circuits and SGBs (Dlodlo, 2009). This notion needs to change and centralize the education system to bridge the gap of incompetency, the adoption of 4IR can merge things between provinces to provide equal quality of education.

Respondent 14 mentioned that "policy makers need to intensify the notion of policy learning and tap into what is happening in other departments to have a sense of what was done wrong and be corrected".

> The expansion of infrastructures from different sectors should be allocated to the education system, schools are reliant on different infrastructures, it can be energy infrastructure, road infrastructure, water infrastructure and digital infrastructure.

Respondent 5 indicated that "policy makers should incentivise private sectors and stakeholders should include disruptive innovators and influencers, who have the ability and capability to foster online education with local relevance".

> Partnerships between private and public sectors should be established in a strategic way that a consultative approach is at the heart of public and private sectors. A collective approach can help to develop an enabling culture to transform education through 4IR and reduce inequality through a digital bridge.

Respondent 5 mentioned that there is a need to "utilize a simple cost-effective technology (innovation) and enable strategic partnerships between private sectors, public sectors and local chiefs in rural areas".

5.9 The impact of Fourth Industrial Revolution on Productivity

From the responses analysed on Table 11 in conjunction with the literature, respondents believe that Fourth Industrial Revolution will increase productivity if infrastructure developments are in place. The key codes drawn from the respondents' analysis are an increase of productivity, efficacy, skills development, and rebuilding of the economy.

> Productivity in core industries, with the intervention of the 4IR will increase fifty times over the preceding age (Xu, David, & Kim, 2018).

Respondent 2 indicated that "in theory, the Fourth Industrial Revolution will positively affect productivity but in reality, when you look at SA's infrastructure development is far from being in shape".

> An early introduction to robotics for kids will increase their capabilities and teach them machine learning and programming, it will develop their thinking into considering robotics as a "normal method of operating" (Scaradozzi, 2014).

"When you are exposed to new things, you learn new things, your reality changes forever, your brain grows and you develop massively as an individual, therefore the possibilities for growth and developments are endless" **Respondent 9**.

> There are learners that are slow and require special attention from teachers, the adoption of Fourth Industrial Revolution can help teachers have a different approach to get learners up to speed. The use of 4IR technologies in schools can help teachers cover a lot of syllabus in a short space of time and easily locate what learners need.

Respondent 8 indicated that "4IR technologies will help learners to be more analytical and develop their creative thinking, 4IR will increase production, efficacy and skills development for teachers".

> Offering teaching through robotics, teachers can assist the system in teaching (Mpungose, 2020).

5.10 Sectors' contributions in accelerating development in rural public schools

From the responses analysed on Table 12 in conjunction with the literature, different sectors and organisations are contributing to communities but the contributions are not in line with the Fourth Industrial Revolution. The government must introduce policies that will enforce private sectors to contribute in a meaningful way that helps a kid from rural areas to develop their thinking. The key codes noted from the respondents' analysis are different as per sectors as many respondents focused on what their organisations are currently contributing to the communities.

To address the issue of education in rural areas, South African government needs a broad vision as a result that rural areas are facing more challenges such as poverty, unemployment, water scarcity and other basic services. The department of education have articulated that there is a need to improve schooling in the rural and the project

must not focus on fixing schools only, the state must collaborate with private sectors and develop a plan to address issues of poverty and promote social cohesion (Gardiner, 2008).

The South African government must partner with private sectors and have policies that enforces CSV (Creating Shared Value) so that private sectors can give back to communities in a meaningful way.

> **Respondent 3** indicated that the department of basic education should "raise awareness in all spheres of influence and enforce all schools to have internet connections through the partnerships with private sectors". Creating awareness will help teachers and scholars to develop an interest on technology.

"Identifying communities, nature them and have engagements with focus to Fourth Industrial Revolution, have projects that teaches communities about 4IR to create awareness" **Respondent 1**.

> **Respondent 5** indicated that there must be collaboration with strategic partners to help with enablement of virtual schools".

The virtual schools can help learners that are isolated in rural areas to be exposed to more information, provided that the digital infrastructures and electronic resources are in place.

> "Creating digital society across the continent and building of digital platform enablers through connectivity" **Respondent 13**.

Telecommunication companies have been investing on creating a digital connected society in Africa. In recent years, the ICT sector in Africa has continued to grow and this trend is continuing (Ndung'u & Signé, 2020).

Respondent 14 mentioned that “the public and private sectors must shift and start investing differently on things of the future with focus to investment on technology”.

5.11 Conclusion

The purpose of this chapter is to discuss the key findings of the empirical study from the analysis and use these findings to answer the research questions. The researcher has applied the qualitative research method to answer the research questions by presenting and analysing the findings from the interviews conducted. The key research questions were identified and reviewed through the interviewees’ reactions and responses to the questions while incorporated with the literature.

6 SUMMARY, CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

The purpose of this chapter is to conclude the research study, starting with the summary by reflecting on the objectives of the research study. A brief conclusion of the research study incorporating all the stages of the research and findings will be discussed and followed by a brief limitation of the research study. The brief recommendations of the observations will be discussed in this chapter.

6.1 Summary

4IR is revolutionizing the way we live, and how we do things, the technologies of Fourth Industrial Revolution and its enablers will bring together learners from different geographics and enable them to learn from each other (Herselman, 2003). One of the findings from this research study is that the powers of administering schools are invested in School Governing Bodies (SGBs) and School Management Teams (SMTs), the findings are that in many rural public schools, members of SGBs are not literate meaning they hardly can make any informed decisions to benefit learners. In South Africa, the school policy framework is provided by the National Department of Education (NDE), but each province has its own education department which leaves the responsibilities of the administrations at the hands of provinces, districts, circuits and SGBs (Dlodlo, 2009). This notion needs to change and centralize the education system to bridge the gap of incompetency, the adoption of 4IR can merge things between provinces to provide equal quality of education.

Service delivery is a critical issue in South Africa especially in the rural areas, many rural villages don't have access to internet connectivity, water, electricity, roads, health facilities and jobs. These are the basic needs that can determine the success or failure of the 4IR adoption in rural schools, the digital infrastructure needs to be complemented by other infrastructures. One of the observations is poor network connectivity in rural areas, I kept on losing connection during the interview process with participants who are in the rural.

Researchers have argued that the 4IR will shape the future through its impact on businesses and government with opportunities to improve the quality of lives through robotics and connected life through the internet of things (Xu, David, & Kim, 2018). The adoption of 4IR in the education sector will enforce the government to act swiftly in the infrastructure developments in rural areas, which will lead to communities being developed to improve the quality of life even outside school.

Fourth Industrial Revolution has a potential threat of massive labour job losses, however, higher paying jobs that requires skills are not likely to be replaced (Xu, David, & Kim, 2018). A developed country with developed communities present opportunities for skills development, new jobs that require new skills will be created by the adoption of 4IR. Fourth Industrial Revolution will improve productivity in rural schools and help teachers to cover full syllabus. 4IR will expose learners to more information through online libraries and help scholars to be more innovative to compete with scholars from private schools globally.

South Africa is relatively a youthful country with a population of about 56 million with a median age of 26 years of age. The youth are fascinated by living in a connected world, this is an advantage for a country like South Africa to be ready to embrace the Fourth Industrial Revolution's technologies, however, the government and private sectors need to play a role by partnering in order to create employment and develop digital infrastructures to support the adoption of 4IR. South Africa is too concentrated in big cities, infrastructure developments are in place in big cities to support the adoption of 4IR in schools. Rolling out of the Fourth Industrial Revolution in South Africa will require a strategic plan that must be executed to benefit everyone and not create further inequalities in the country by focusing developments only in the big cities. 4IR has a potential to increase the gap between the poor and the rich if not properly planned and executed, however, 4IR has more chances of closing the gap, provided that the development focus shift from the cities to small towns and villages.

6.2 Conclusions

The qualitative strategy approach has been applied in this research study to collect and analyse data, this approach explored the perceptions of each interviewee from different sectors and key stakeholders in the education sector in rural public schools in South Africa. The study has highlighted level of readiness of Basic Education in rural public schools when it comes to embracing 4IR to facilitate learning and teaching. The perception drawn from the analysis is that the South African government and department of basic education are far from ready to offer online education and to include in the curriculum some of the technologies of 4IR such as robotics. One of the findings from the study is that 4IR will present teachers and scholars from rural schools with an opportunity for knowledge sharing with others from different locations.

"Many South African rural areas are still below survival and remain disadvantaged with no access to basic infrastructures for economic growth and development" (2003, p. 945) (Herselman, 2003). The study has outlined the potential opportunities and approach that the decisions makers in the education sectors can take to improve the quality of the nations' education system and bridge the gap between rural public schools and private schools in the cities. The findings show that many are confusing 4IR for IT as schools in the cities are introducing the use of computers, 4IR is beyond the use of computers. 4IR is a confluence of intelligent technologies that will shape how we live and define new ways of offering education in schools.

The adoption of 4IR in a developed country with infrastructure developments in place can benefit the education sector, with opportunities for teachers to re-skill themselves for new opportunities, learners will have the opportunity to be exposed to a global stage, be innovative and think creatively. The application of Science, Technology, Engineering and Mathematics (STEM) through robotics' concepts will introduce learners to computational thinking. We live in a technological world; therefore, it is critical for learners to develop computational thinking at an early age in order to compete with the rest of the world, the Fourth Industrial Revolution through robotics can enhance these developments to scholars in rural areas.

Many countries in Africa have been having challenges in the health sector and recently worsen by the lack of infrastructures and qualified professionals, 4IR technologies can be a solution to these challenges by mitigating the threats and help build sustainable health care system (Ndung'u & Signé, 2020). South African rural villages are not an exception to the challenges of health infrastructures, to this day, clinics in rural areas operate without medications and no doctors.

Library facilities are a serious issue in South Africa, even many schools in urban areas don't have library facilities. Learners from rural public schools' matriculate without having seen a library before and let alone to know what its functions are (Herselman, 2003). The adoption of 4IR can introduce rural scholars to online libraries and expose scholars to more information, this will develop their thinking to be more innovative and think creatively.

6.3 Limitations

When doing a qualitative research study and conducting interviews, it has its own challenges as a result that you must deal with different characters and personalities, as the researcher I needed to exercise the capability to manage emotions because some participants were personally touched by this topic. Some participants were not easy to get more information from them as time was of a constraint and at times, they were uncertain about their responses. In a qualitative study, "uncertainties which are inherent in human language", (2009, p. 17), can be recognized during the interview process and in the analysis (Atieno, 2009).

The Covid-19 pandemic has been one of the key challenges that shaped the approach and how this research study was conducted, the country's Covid-19 restrictions have denied the researcher an opportunity to have a real connection with the interviewees. The researcher had to put the safety measures first by resorting into virtual interactions with the interviewees though the digital platforms, which in turn also became a challenge to conduct interviews with people located in the rural areas due to network connectivity issues.

A lack of time posed by the delays on receiving the ethics clearance certificate has also been a huge contributing factor to limitations to conducting my research, the delays resulted into not enough time to analyse my data and possibly driving to rural areas to interview people who were affected by the bad network connectivity. Receiving an ethic clearance certificate with only a month to go before submitting my research has made things difficult for me collect data, fortunately enough only few people who couldn't find time within their schedule due to last minutes invitations, but many responded to my invites.

It has been a challenge to get schools principals, teachers, and members of school governing bodies in the rural schools, many were uncomfortable with the research topic and the use of technology to conduct the interviews and they failed to commit to participate in the collection of data, however, few have responded and committed. Some of the interviewees would postpone the initial scheduled time of the interview due to high demands from their workplaces, however, in the end the interviews were conducted.

6.4 Recommendations

The recommendations here are constructed based on the findings of this research study, these recommendations are made for people in power and decisions-makers for our basic education system.

- A solid partnership between government and private sectors to accelerate digital infrastructure developments in rural areas.
- Government to enable Telecoms companies with spectrum allocation in return of zero-rating data for rural public schools' purposes.
- Our ministers must stop working in silos and collaborate to align infrastructure developments to our education system.
- The allocated budget by the state needs to be distributed in alignment to the technology infrastructures.

- A strategic plan on getting teachers certified through constant trainings on facilitating 4IR technologies.
- Centralization of skills and teachers who are experts in Mathematics and Science for knowledge sharing between schools in rural areas.
- Policies that bind private sectors and foreign companies into participating on CSV.
- CSI projects that are focusing on upskilling rural communities with the use of technology.
- Government should create YouTube channels designated for primary and secondary schools' contents to allow children to have extra lessons on their flexible schedules.
- Strategic partnerships with local chiefs, government, and private sectors.
- Basic infrastructure developments and robust digital infrastructure developments.
- Many rural areas have high energy from the sun, schools must have solar panels for electricity.

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APPENDICES

Appendix 1.1 – Data Collection Instrument(s)

Appendix 2.1 – Bio of the Researcher

Appendix 2.2 – Ethics Clearance Certificate

Appendix 2.3 – Informed Consent Form

Appendix 3.1 – Dully filled in data collection instrument(s)

Appendix 1.1: Data collection instrument(s)

Data Collection Instruments

- Virtual / On-site Interview
- Date of Interview

Introduction to the interview process

- Thanking the interviewee for agreeing to be interviewed
- Interview's time frame agreement
- Consent form discussion

Participants' Profile

Name……

Age Group……

Highest Qualification……

Area of Expertise (Sector)……

Industrial years of experience……..

Questions to be asked during interview?

1. What is your understanding on Fourth Industrial Revolution (4IR)?

2. What is the level of readiness for the education sector and the country on embracing 4IR to facilitate teaching and learning? Scale 1-10

3. Do we have infrastructures that support online learning in rural areas?

4. What do you think should be done in terms of infrastructure development to accelerate the adoption of 4IR in less privileged schools?

5. What do you think policy makers and stakeholders should do to accelerate the implementation and integration of 4IR in learning and teaching?

6. How do you envisage the contribution of the 4th industrial revolution in the education sector and the changes 4IR can bring to rural public schools?

7. Do you think embracing the 4IR's technologies such AI, Robotics and IoT will enhance learners' capabilities? If yes, how so?

8. What is the perception(s) relating to 4IR and its acceptance as a technology disruption across the education sector?

9. Do you think 4IR should be perceived as a threat or an opportunity for growth and development? Explain

10. How can your organisation / sector contribute in accelerating development in rural public schools?

I, **Miehleketo Chavalala** take this opportunity to thank you for your time and participating in this interview and being authentic in responding to all the questions. I thank you!!

Appendix 2.1: One-page bio of the researcher including declaration of interest in the research and funders, if any

2 St Davids Place

Parktown

Johannesburg

2193

To Whom It May Concern,

The Bio of the researcher and declaration of interest in the research study of: Evaluating the impact of Fourth Industrial Revolution (4IR) on Education in the rural areas in South Africa.

This research study is titled; Evaluating the impact of Fourth Industrial Revolution on Education in the rural areas in South Africa is solely conducted for the purpose of academic research project. I confirm that my interest in the study is for the academic research project for the Masters in Business Administration (MBA) program research project. I am an MBA student at Wits Business School and as part of the requirements to complete the MBA study program, I have to conduct a research project.

Yours Sincerely,



Miehleketo Chavalala

MBA Candidate

Student Number: 692496

Appendix 2.2: Ethics Clearance Certificate

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/BA692496/728
This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

Project title	The impact of the Fourth Industrial Revolution on development in a South African rural area
Investigator / Researcher	Mr Michleketo Chavalala
Nature of Project	MBA (Research Article)
Decision of the Committee	Approved unconditionally
Issue Date of Certificate	2021-02-19
Expiry date	Date of submission of the project report
Chairperson	Prof Anthony Stacey ☎ +27 11 717 3587 +27 82 880 4531 Anthony.Stacey@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

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

Signature

31/03/2021
Date:

Miehleketo Chavalala_692496 WB

Appendix 2.3: Informed Consent Form

Dear Sir / Madam

My name is Miehleketo Chavalala and I am a Masters' student in the Faculty of Commerce, Law and Management at the University of the Witwatersrand, Johannesburg at Wits Business School. As part of my studies, I have to undertake a research project, and I am investigating the impact of fourth industrial revolution (4IR) on education in the rural areas in South Africa under the supervision of Mr Lee Larbi. The aim of this research project is to interrogate how the South African government and all stakeholders in our education can adopt 4IR technologies to accelerate development in public schools.

As part of this project, I would like to invite you to take part in an interview / answering a questionnaire. This interview will involve myself as the researcher and will take less than one hour. With your permission, I would also like to record the interview using a digital device.

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

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send to you. With your permission the data collected from this research project will be stored in my personal protected laptop. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee, telephone +27(0) 11 717 1408, email hrec-medical.researchoffice@wits.ac.za

Yours Sincerely,

Researcher:
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Appendix 3.1: Dully filled in data collection instrument(s)

Consent Form for Miehleketo Chavalala's Research Project

Title of project: Evaluating the impact of Fourth Industrial Revolution (4IR) on Education in the rural areas in South Africa

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

(Please circle the relevant options below).

I agree that my participation will remain anonymous……YES……NO

I agree that the researcher may use anonymous quotes……..YES……NO
in his / her research report

I agree that the information I provide may be used……YES……..NO
anonymously after this project has ended, for academic
purposes by other researchers, subject to their own
ethics clearance being obtained.

Name of participant……

Signature……

Date……

Researcher……

Signature……

Date……