September 2019

Education in the Age of the 21st Century

Responding to the challenges and opportunities of the 4th industrial revolution
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<td>Fourth Industrial Revolution</td>
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<tr>
<td>AAI</td>
<td>African News Agency</td>
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<td>MEST</td>
<td>Meltwater School of Technology</td>
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ACKNOWLEDGEMENTS

By Mr Lukhanyo Neer
Convenor, Education in the Age of the 21st Century Working Group

Our nation is facing some of its greatest challenges. In response, government continues to revise and introduce more robust policies and systems to meet current societal needs and to more intentionally address historical blockages. And while our nonprofits, philanthropists and other social sector leaders have stepped-up to fill gaps, increase their impact and serve more people in need, we know that the social challenges we face today are too complex for any single actor to fully address on their own. We know that dramatic, community-wide progress requires the engagement of all sectors in a community: civil society, academia, business, and government pulling together, in the same direction.

As the world economy transforms and becomes increasingly characterised by the exponential growth of smart technologies, increased digitisation and inter-connectivity, as well as a shift in the skills and competencies required to drive productivity, the pre-eminent question for both overdeveloped and underdeveloped nations in the 21st century is how to prepare for the long-lasting, life-altering changes that are being ushered in by the Fourth Industrial Revolution.

While research efforts on the Fourth Industrial Revolution have picked up over the years, many focus on the global impact of exponential technologies. The Thabo Mbeki Foundation is interested in leveraging its convening power and influence to convene both public and non-public stakeholders to gather information and insights that have the potential to create outsized impact on Africa and its education systems.

The scope of the work undertaken by the Working Group was to holistically review the opportunities and challenges of education in the 21st century and to prepare and present directional recommendations and actions. These recommendations and actions aim to influence the evolution of the [South] African education system into one that will generate the human capital, and produce the skills necessary for [South] Africans to compete and thrive in the 21st century.

We are thankful for the distinctive contributions to the development of this report from our Working Group members:

Dr Wendy Ngoma; Prof. Nkidi Phatudi; Dr Kimberley Porteus; Prof. Elizabeth Henning; Prof. Thobeka Mda; Prof N’dri Assie-Lumumba; Mr Sam Paddock; Prof. Brian Armstrong; Ms Rapelang Rabana; Ms S’Onqoba Vuba; Mr Fred Roed; Dr Pali Lehohia; Ms Tinhiko Nkuna; Ms Athambile Masola; Mr Dean Villet; Mr Phathizwe Malinga; Mr Peter Tabichi; Dr Hasmukh Gajjar; Prof. Catherine Odora-Hoppers; Prof. Nnenesi Kgabi

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Heavy Chef; Kagiso Trust; Hollard Foundation; Uber; IBM; Schneider Electric; Intel South Africa; Sqwidnet; Henley Business School
A special thank you to our Research Partner, In On Africa, for their invaluable collaboration on the development of this report.

We are aware that a report alone, no matter how important, will accomplish little. Over the coming months and years, we intend to develop a range of tools and resources to help practitioners, policy-makers, and advocates improve educational outcomes and inform the next chapter in education in South Africa and the Rest of Africa. We welcome collaboration with like-minded partners. Those interested in working with us on the next steps should reach out to the Thabo Mbeki Foundation.
FOREWORD

By Mr Max Boqwana
Chief Executive Officer, Thabo Mbeki Foundation

The Thabo Mbeki Foundation is a non-profit organization established by President Thabo Mbeki post his retirement. It aims to support efforts aimed at promoting the achievement of Africa’s renaissance, and as such the Thabo Mbeki Foundation is committed to putting African youth at the center of Africa’s renewal, and enabling them to work together in solving the political, social and economic challenges that Africa faces.

The following Report on Education in the Age of the 21st Century comes as a result of a request by the Patron of the Thabo Mbeki Foundation, President Mbeki. During a Thabo Mbeki Foundation event with African youth focusing on the Fourth Industrial Revolution held in the year 2018, President Mbeki requested those present to conduct research and produce practical solutions, that can assist educators in the country to navigate the 21st century.

President Mbeki was concerned that, even though the country (and the continent) spends huge sums of money annually, to improve the state of education and therefore improve the further difficulties we face, many of our educators are often not prepared for the fast-paced changes we are experiencing. Naturally, we heeded the call.

President Mbeki’s call to action recognises education as the bedrock of tomorrow’s innovations and the classroom as a key site for ensuring that South Africa is prepared to meet the challenges and opportunities of the 21st Century. Without adequately prepared human capital, South Africa cannot hope to overcome major development challenges, such as poverty and inequality. Wherefore the greatest investment that we can ever make is to invest in the minds of young Africans, whose future relies on understanding themselves, challenges they face and their preparedness to be in the forefront of finding solutions to Africa’s many intractable challenges.

We believed it necessary therefore that those who engaged in the research and work towards producing the Report must be those who share a similar vision with us regarding the renewal of the African continent. This Report thus reflects the necessary level of engagement, by the highly qualified multi-stakeholder working group, with the topic at hand as well as a deep-seated understanding of the context that it has been written for.

This report includes several implementable and practical recommendations along with specific action steps that state and non-state actors can take to ensure that the continent’s education systems, and all its players, are equipped to thrive in the 21st century.

This report has been developed by a broadly represented Working Group supported by a Steering Committee made up of independent thought leaders, under the guidance of their Convenor. The development of the report has been iterative and collaborative and we have appreciated opportunities to engage with the Working Group and the Steering Committee. Their recommendations are presented here for discussion, feedback and continued engagement. I invite you to read this report and consider its recommendations.

To conclude, we wanted to place on the record the Thabo Mbeki Foundation’s thanks to the many people and organisations involved in completing this report. Without the hard work and of all these individuals and organisations, the report would not have been possible and that would rob future generations of these great insights which will guide them as they seek to stamp their own thoughts on this very important subject of technology and education.

As part of the Thabo Mbeki Foundation African Renaissance initiatives, this report gives us an opportunity to declare that we must face Africa’s challenges together with confidence and a shared sense of purpose.
PREFACE

By Professor Catherine Odora Hoppers
Professor Extraordinarius in Education
Former SARCHI DST/NRF Research Chair in Development Education, University of South Africa

The future is not some place we are going to; it is the one we are creating. The paths to it are not found but made, and the making of it changes both the maker and the destination.

Schaar 1981

Education comes from the Latin word "Educare" which means "to bring up" or "to rise". According to Aristotle, "Education is the creation of a sound mind in a sound body, is the process of training man to fulfill his aim by exercising all the faculties to the fullest extent as a member of society". Dewey defined education as the process of continuous reconstruction of experience.

Judging that a national philosophy of education of any country or region must be embedded in the national/regional development ideology and understandings of that country, of which the country’s philosophy of education must drive, African countries have sought to move beyond their colonial subjugation, repression and exclusion to engaging their people to produce analyses and responses to the legitimate concerns that confront humanity on the continent (Waghied, 2016).

Accordingly, Julius Nyerere and George Kneller define education as the process in which society deliberately transmits its cultural heritage from one generation to another. Nyerere went further to state that education is a process of the development of one’s consciousness to think, decide and act; hence it should be aimed at improving people’s physical and mental freedom, to increase their control over themselves, their own lives, and the environment in which they live.

Therefore, if taken in a life-long perspective, education can be termed as forming the basic needs of one’s life. Education cures the different social evils and discrimination from society. An educated person contributes a greater share to the national development. Education promotes sisterhood and brotherhood, fraternity, liberty and establishes justice. It is a process of rediscovering oneself and contributes to bring peace and harmony in society.

Education is the process of facilitating learning, or the acquisition of knowledge, skills, values, beliefs, and habits. Any place which has a formative effect on the way one thinks, feels, or acts may be considered educational.

The methodology of teaching is called pedagogy, and it may vary from one context to another, or from one era to another. Educational methods of transmission include storytelling, discussion, teaching, training, and directed research. Education frequently takes place under the guidance of educators, but learners may also educate themselves. The consciousness to think, decide and act may be against old transmission messages, which have often led to indoctrination, and as a method of “reconstruction”, education often leads to unhealthy materialism.

Many 21st century problems, such as global warming, poverty and unemployment, youth unemployment, the gender gap, literacy, rural-urban divides, corruption, conflicts, quality of education and the governance of knowledge systems require solutions that are systemic – that is, just one specialty cannot address these problems but rather an entire system, crossing several disciplines, “multiple ways of knowing”, and values from different cultural settings is needed to find a solution.

We are preparing our children to be aware of the past injustices and head for the future. They now need to not duplicate the particular skills of his or her master, but rather create a working environment through technical and social engagement, by doing real innovations not constrained by the old pedagogy. In this sense, 4IR proposes a technique of learning which advances autonomy and networks without mentioning the deep history of the systems of education which we must supersede.
If we are to develop an inclusive and out-of-the-silo attitude going forward, it is incumbent upon African leaders and policymakers to soberly and critically assess the growing hype and possibilities surrounding the 4IR and associated 21st century changes. For beneath the near ubiquitous celebration of this increasingly hegemonic discourse, lies a welter of hidden complexity, not least of which involves the possible rise of unanticipated forms of techno-colonialism alongside deepening intra-African inequality.

Therefore, we ask that the global community hear us when we call for a 4IR that is set on an inclusive and pro-social attitude, and a structural understanding of the way the global context has been managed historically. This will be integral if we are to succeed in making a better world through this initiative. It must be strategically mediated in line with uniquely African interests, critical contextual embeddedness, and an ideologically coherent African development agenda. Intra-African mobility and collaboration, central to advancing Pan-Africanism, also requires that we have ways of recognising the skills that people from other societies and educational systems have and which skills the education environment, moving towards the 4IR, could foster.

References
EXECUTIVE SUMMARY

With the salience of new technologies, the global economy is being transformed. The world is continually being characterised by smart technologies, increased digitisation and interconnectivity. In response to this change, countries across the world are tasked with having to answer the pertinent question of how to prepare for the long-lasting, life-altering changes that are being ushered in by the 4IR.¹

Following a recent event on the Fourth Industrial Revolution (4IR), held in September 2018, former President of South Africa, Thabo Mbeki, remarked, amongst other things, that he was concerned about whether South Africans in general, and educators in particular, are properly prepared to respond to the challenges that the 4IR poses.

While the 4IR will impact economies and education across the world, Africa faces its own particular challenges, given the current state of education, infrastructure, resources, and the historical contingencies nations across the continent are still tackling. Ensuring that the 21st century is an African century requires not only asking questions about whether Africans are prepared to respond to the challenges that the 4IR (and the 21st century more broadly) presents, but to do so in a way that is uniquely African, advancing the aims of the African Renaissance.

In order to tackle these issues, the Thabo Mbeki Foundation (TMF) has built a vision, strategic framework and action plan to prepare Africa and its various education systems for the 21st century, with a particular focus on South Africa. Together with a Working Group comprised of educators, academics, civil society, business, policymakers and thought leaders, the TMF aimed to tackle the complex question of what practical steps African nations need to take in order to lay the foundation for a successful transition through the 21st century.

The demands of the 4IR require a range of interconnected ‘21st century skills’, including critical thinking and creativity, but also digital skills for developing and operating new technologies. Nations across Africa, however, have largely inherited former-colonial systems of education that are inadequate for the demands of the 21st century. These systems encourage dependence and train students on how to memorise and reproduce ideas in order to pass exams – focusing largely on information transfer instead of critical thinking and creativity. Furthermore, the particularities of the educational context across the continent highlight issues such as the need for quality infrastructure and access to services and resources, before even turning to the provision of ICT-specific infrastructures and resources.

One key resource that is constantly in short supply is a pool of suitably qualified teachers. Education in the 21st century in Africa thus requires improving the quality and quantity of teachers. Governments have to increase the skills, knowledge and competencies of teachers through continuous training and retraining. Through implementing in-service training and re-skilling, teachers will be enabled to “keep up” with digitisation and related technological trends will help to improve the quality of teaching. Improving teacher quality will ensure that both teachers and students are innovative, critical thinkers fluent in digital technologies and can harness their educational benefits.

However, we need to be wary of treating Africa as a homogenous whole, not just overlooking idiosyncrasies between different countries but also within countries themselves. The rural-urban divide, specifically, remains a driving factor in continuing inequalities across the continent, where schools in rural areas often disproportionately lack infrastructure like electricity and sanitation, teaching and learning resources. The lack of funding for schools in rural areas has resulted in skills shortage as prospective teachers find it undesirable to teach in these schools. The importance of infrastructure in the learning and teaching context cannot be underestimated as it enables learners and teachers to access a wide range of tools, resources and services that support teaching and learning. Moreover, technological infrastructure necessary to usher the continent into the 4IR can only be built where basic infrastructure exists. The urban-rural divide threatens to grow if proactive efforts are not made to ensure that new infrastructure and policies are developed to bridge the gaps, which requires collaboration between all stakeholders, from governments to communities.

Major cities across the continent are also characterised by wide gaps between the spaces with top-rate infrastructures including well-equipped schools with qualified teachers and large urban peripheries with
inadequate social services or even lacking basic human and infrastructural resources for the schools. The youth in such peri-urban spaces tend to face exceptionally challenging living and learning conditions sometimes even more so in comparison to some rural areas. The fast-growing urban population with concentrations in these very impoverished peripheries is a source of legitimate concern.

South Africa offers a valuable case study of the educational landscape. Since the advent of democracy in 1994, South Africa has made headway in increasing access to education and reviewing and revising education policy and curriculum design. While the country can be proud that there has been an expansion of access to education services to the poor, the quality of education is still below standard and continues to be characterised by critical inequality along racial and socio-economic lines. The country still faces challenges in its low quality of education, even before accounting for the new challenges of preparing students for success in the global technology-driven world of the 4IR and the 21st century.

Across the Early Childhood Development (ECD), primary and secondary school levels, certain themes are recurring. At ECD level, many centres offering early childhood education lack basic infrastructure and are operating in poverty-stricken environments. Some of the ECD centres in disadvantaged areas still use pit latrines — posing substantial health risks for babies and toddlers who are more susceptible to illness than older children. To reconcile this, the importance of safe, clean and structurally sound ECD centres has to be emphasised in national discussions so that adequate resources can be allocated. The government should be tasked with creating a central ECD-focused agency that will co-ordinate and drive programmes tackling inter-related issues and challenges of nutrition, poverty and the provision of education. Creating a centralised ECD-focused agency will require collaborated efforts from different departments such as Department of Social Development, Education and Health.

At primary and secondary school level, many schools struggle with teacher quality and training. With teachers often choosing their profession due to not having other alternatives and subsequently undergo inadequate training, the country’s education system has produced learners with low knowledge content. Teaching, despite being highly challenging and core to the good functioning of a society, remains an unattractive and unrewarding profession, requiring that incentives are put in place to attract dedicated, relevantly qualified and skilled people to the profession. The situation is exacerbated by the new demands on teachers in the 21st century to make themselves digitally fluent and embody key skills, like critical thinking and creativity.

At the post-school level, institutions like universities are favoured over technical and vocational training (TVET) institutions, despite the importance of technical and vocational training for the 21st century workplace and efforts made to ensure that each district has a TVET college. TVETs have been perceived as second-rate institutions in comparison to universities, which is reflected in institutional challenges such as poor management. The issue is not in terms of either or in relative importance of the universities and TVETs but rather how to conceive and implement a balanced system institutional mix whereby the universities and TVET institutions complement each other and offer learning opportunities to all for whole spectrum of human resource need for the economy. Thus, the value and potential of technical and vocational training needs to be promoted to address the stigma associated with the quality of education provided.

Recent student protests, such as the #RhodesMustFall and Open Stellenbosch, at universities and TVETs across the country demonstrate the need for critical attention towards the kind of curricula that is being taught and the work that needs to go towards creating learning content that speaks to Africa’s development needs. All post-school institutions need to ensure that their graduates have the skills required for a 21st century workforce, but within the African contexts in which they operate. Critically locating education in Africa requires the decolonisation, reconstructing and redefining of knowledge and skills systems.

Many of the themes drawn from the South African case study recur across Africa. In many countries, basic infrastructure is found wanting. Underdevelopment, disparities in resource allocation and pervasive inequalities continue to persist. It is not easy to imagine a reality in which ICT prospers within this context. ICT infrastructure needs to be improved and expanded through partnerships between different stakeholders. Africa’s education system is also characterised by a shortage of teachers, in brute numbers, and within that a shortage of quality teachers who received basic training with the required certification and are themselves digitally fluent and adequately equipped to tackle the demands of the 21st century and the teaching and learning environment. Continuous professional development is fundamental for meeting the demands of the pedagogic and
technological advances in the 21st century classroom. With new modes of teaching and learning, there is a need to rethink how education is delivered. It is important for educators to move away from the rote learning towards problem solving and creativity.

Education needs to be aligned with the requirements of the economy and businesses but, at the same time, economic actors should be recruited to help fund and develop education programmes. The latter is particularly necessary, as many African governments struggle to fund education. Education takes place in an ecosystem of learning where harnessing its potential requires collaboration. It can no longer be seen as something that happens only in the classroom; rather, communities and parents must be involved in ecosystems of learning. However, socio-economic conditions challenge the capacity of such stakeholders to take on such a role. New technologies offer new promise at all levels of education, where capitalising on that promise requires digital fluency and the integration of technology into the learning environment. It is through inviting collaboration, knowledge sharing and mobilising resources from different stakeholders that the potentials of the 4IR can be realised.

In light of the current landscape and the key considerations for the evolution of education in Africa, a Pan-African approach to curriculum development and pedagogy needs to be explored - one which incorporates the insights and bodies of knowledge of indigenous knowledge systems into both curriculum content and teaching and learning methods. Indeed, indigenous knowledge can inform the very teaching and learning methods that form part of any curriculum, as indigenous knowledge methods of creation and sharing emphasise adaptability and interpersonal communication; important skills that are required for the 21st century. However, such indigenous knowledge systems are under threat and need to be preserved, something which the technologies of the 21st century can aid in.

Promoting Pan-Africanism, however, requires more than just promoting indigenous knowledge. It requires developing a range of 21st century skills, from basic literacies, like reading, writing and numeracy, through to digital fluencies, critical thinking, creativity, communication, collaboration and citizenship. These skills are interconnected, and global trends demand a learner-centred approach to education, requiring that teachers engage in continuous professional development to equip them with the relevant skills themselves, as well as the tools necessary to conduct learner-centred education. The development of these 21st century skills must be clearly defined and responsive to business needs, and incorporated into education policies and curricula, and qualification frameworks must be aligned with regional and global standards to ensure that people are able to move within and outside of Africa with qualifications that are recognised the world over.

Equipping people with the necessary 21st century skills is critical for the future of work. The digitisation of African economies is creating new jobs that will require new skills and competencies. Across all sectors, employees will be required to possess skills in new technologies such as big data and robotics. Amid the many opportunities that are currently being ushered in by the 4IR, it is important to think about the lack of employment that low-skilled and low-literate people will have. This cohort of people are at the greatest risk of losing jobs. Therefore, while it is clear that there is a great need to prepare the next generation for the changing world of work, a multifaceted strategy is needed.

The rapidly developing set of technological trends have the potential to drive growth in core sectors of economies across Africa, yet it is fundamental that the structural challenges that inhibit the reach of new technologies be addressed. While internet coverage remains low, bandwidth slow and data costs high, the benefits of automation and digital innovations will remain elusive. However, developing infrastructure must be done hand-in-hand with the development of legal and regulatory frameworks that support data-driven technologies and innovation-driven growth. Policies and laws need to govern data privacy and security, cybersecurity and intellectual property rights in ways that protect individuals but do not stifle growth or local innovation. As the world increasingly opens up with the use of digital technologies, such policies need to be in harmony with international rules and standards.

Technologies of the 4IR should also be harnessed for streamlining governance, such as through national digital strategies for storing information in the cloud. We must not forget, however, the human element. Local technologies and industries, especially those that draw on indigenous knowledge systems to offer African solutions to African problems, must be promoted, and cultural capital and national identities should not be lost in the onwards march towards global digitisation. Given the unique human capacities for creativity, rational
thinking and emotional intelligence, humans remain a valuable asset for businesses and government, requiring that humans remain our centre of attention.

The culmination of this report resides in the key priorities areas that should underpin the efforts of governments and other stakeholders in advancing 21st century education in Africa. These range from addressing the socio-economic inequality influencing the quality of education to strengthening systems of governance. The report further proposes pilot studies that need to be undertaken to create the foundation for a 21st century Africa. This research has also produced strategic recommendations that speak to the key priorities and a short-, medium- and long-term action plan. The recommended pilot studies work in tandem with the key priorities for growth, and it is through their completion and addressing of these key issues and tasks that Africa can initiate and further the transformation that will enable it to live and flourish during the 21st century, and beyond.
1. **STATE OF EDUCATION IN 21ST CENTURY AFRICA**

1.1. **Introduction**

Education is society’s way of teaching citizens useful concepts, information and skills, which allow all learners to prosper in society while also contributing to society’s needs. It is meant to empower individuals with knowledge and skills required to sustain and grow in their community, of the *gemeinschaft*\(^1\), and in the broader society, the *gesellschaft*.

The changing of the times necessitates a change in the very nature of education and the modalities through which it is delivered to citizens. During feudal times, for instance, individuals who knew mathematics and who were literate, were lowly accountants and scribes in the service of pharaohs and kings. In the age of enlightenment, education was restricted to the upper class, which required knowledge to rule over their societies. It was not until the 19th century’s Industrial Revolutions that universal education was seen as valuable across societies, because of the need for skilled factory workers, inventors and scientists to achieve practical advantages over competitors. In the 20th century, the value of the individual was further elevated, and education was seen as a way for people to live more fulfilled lives by being able to appreciate art and literature, even if they toiled in unrewarding office jobs. These were the practices that colonists brought with them to the continent of Africa. During colonial times, as Africa was faced with the definition as outlined by the Western countries, it formed a critique of this form of education that had Africans educated to take low-paying jobs in every field. In South Africa for instance, there are moves to gain access to the system and transform it at the same time.

This brings us to our own 21st century lives and an evolving education system that puts more emphasis on the individual than ever before. No longer is the learner meant to be recipient of school lesson content and processes; he or she is, ideally, meant to be the main participant and explorer of knowledge in those lessons. Using technologies to explore a subject at their own pace, the learners of today can work out solutions to problems for themselves. Problem solving is one of the four pillars (or “competencies” in the educationalist’s vocabulary) that support 21st century education, with the other three being critical thinking, collaboration and digital literacy.\(^6\) These core competencies are widely accepted by educationalists as necessary to produce educated citizens of innate personal worth and value to their 21st century communities and their societies. These four goals for moulding modern students’ minds are not achievable through any one system alone. Educationalists are experimenting with modes of instruction and pedagogic tools to carry these out. The upskilling and the broadening of knowledge of teachers is a recognised necessity, whatever the outcome of curriculum changes is, as new skills and new conceptual understandings are required to harness the technologies of today and for the shifting needs of tomorrow.

After the societal restrictions of earlier times, education changed as a means to accommodate the steam-powered First Industrial Revolution of the 19th century, which required a minimal understanding of factory processes and machinery. Classroom instruction changed again under the electricity-powered Second Industrial Revolution around the turn of the 20th century, when new technologies (the automobile, aeroplane, telephone, radio, motion pictures, etc.) both assisted educational systems and influenced what was taught. The computer-powered Third Industrial Revolution of the late 20th century brought the infinite knowledge of the digital age to the classroom as a means to access data. Throughout all of these incarnations of industrial revolutions, technology has acted as a way to increase access to information, the student was still a rather ‘passive’ recipient of knowledge, because of society’s prioritisation of ‘learn and then do what you’ve been taught’. While problem solving and critical thinking were applauded, only now have these qualities risen to the forefront as the goal of 21st century education. Prior to today’s Fourth Industrial Revolution (4IR), technology was a means to acquire information, and information acquisition was the ultimate goal of an educated individual. In the present day, all information can be downloaded much faster than human memory can process and store it, and the educated person today is no longer defined as someone who knows a lot but rather as someone who knows how to apply knowledge creatively and thus also imaginatively.

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\(^{1}\) The terms *gemeinschaft* and *gesellschaft* are used to emphasise the different interests that may be experienced by group in communities and society at large. Tönnies, F., *Community and Society*, 1957/1887. ISBN 0-88738-750-0. (Translated from, *Gemeinschaft und Gesellschaft*, Leipzig: Fues’s Verlag
The 4IR can be conceived of as “a range of new technologies that are fusing the physical, digital and biological worlds, and impacting all disciplines, economies and industries.” It is often understood to be solely premised on the use of technologies, such as artificial intelligence (AI), the internet of things (IoT) and quantum computing. However, these are tools, not end products. The end product of 21st century education is a society that, through technology, can adapt to change and also lead to change. Adaption for survival will ensure the human species can conquer climate change, overpopulation, disease and destructive human impulses that are responsible for wars, famine and human rights abuses. There is no smartphone capable of overthrowing a dictator. However, smartphones were the communication devices used by activists to oust half a dozen autocrats in Africa in the past two years. In other words, a 21st century education is not about new technology itself but about using that technology to achieve a goal.

1.2. Education in the African Context

With the highest youth population in the world - an approximated 50% of Africans under the age of 15 – the African continent is full of potential. It is projected that by 2055, the continent will be home to 1 billion children, and estimated to be 40% of the global total. In light of this potential, Africa’s education system is faced with a myriad of challenges. According to the Africa Learning Barometer, out of approximately 128 million school-aged children, only half will have the opportunity to attend school and learn basic skills. It is estimated that 17 million school-aged children will never go to school, of the 97 million entering school on time, 37 million will not learn basic skills. Furthermore, 14 million will enter school late from which 3.6 million will not learn. On average, children who are poor, disadvantaged and living in rural areas are at a far greater learning disadvantage in comparison to their wealthy, urban peers. Children in urban peripheries too lack basic learning opportunities to develop into knowledgeable and positive contributors to individual socio-economic attainment and societal development.
Although some have hailed the 4IR as Africa’s developmental solution, which allows the continent to leapfrog many steps into the future, respondents in this survey are less overtly optimistic about the effect that the 4IR will have on Africa’s development. However, the outcome is still predominantly positive, with exactly half of the respondents indicating their agreement, to varying extents, that the 4IR will help address Africa’s development needs. Moreover, there are few respondents that do not believe that the 4IR will assist as only 19% of the sample show disagreement with the statement. The significant proportion of respondents that could not take sides (31%) also shows the large degree of uncertainty about what the 4IR holds for African economies and education systems.

1.2.1. Socio-economic and system challenges

While Sub-Saharan Africa has seen gradual economic growth in recent years, the region still has a high rate of poverty. Even though governments have committed to pro-poor policies, access to education for children is still directly linked with household incomes. This means that children who come from rich families are more likely to be educated than those from poor families. Countless children in Sub-Saharan Africa are marginalised and deprived of education – both in terms of quality and even basic access.

While there are many facets of African society that encourage and develop both formal and informal education systems, there are also significant socio-economic challenges faced by the education sector. Survey respondents agree that poverty is a chief concern, as more than 80% of the sample ranked it as 1st or 2nd among the provided challenges. The lack of economic stimulation and abundance in many an African economy has a large impact on teaching, resulting in a lack of funds for remuneration, training, school facilities and new technologies.
Moreover, literacy levels (2.77) and languages of instruction (4.19) are intertwined socio-economic challenges. Learners are often alienated from their curricula because of language barriers, entering school either unprepared or fluent in languages that are not used in their tuition. Although neither of these challenges are often ranked 1st, low literacy levels are ranked 2nd more than any other factor, and language of instruction remains in the top 4 positions for more than 50% of the respondents. Racism and discrimination (4.87), diseases and illnesses (4.9), and conflict and war (5.08) may be popular topics for current affairs and world news, but respondents do not believe that they have as much of a socio-economic impact on education as factors directly related to teaching in Africa.
Sub-Saharan Africa also holds the lowest rate of adult literacy worldwide, with more than 60% of the population of 15 and over unable to read and write. According to the UNESCO Institute of Statistics (UIS), Sub-Saharan Africa has high rates of exclusion, with over a third of youth between the ages of 12 and 14 out of school, and youth between the ages of 15 and 17 are not enrolled in any form of post-primary education. Despite the sharp increase in the number of children enrolled in education systems in West and Central Africa, girls are still underrepresented. Girls on average still have lower levels of educational attainment than boys, which is in part due to many girls being married off while they are still children. Child marriage and underage pregnancies also contribute to girls dropping out of school. Girls who have completed 10 years of education are six times less likely to be pushed into marriage before turning 18 than those who are less educated. Research shows that the younger the girl is when she starts school, the lower her chances are of becoming a child bride.

Poverty has been a key driver of child labour in income-generating activities in farming and has also resulted in children being malnourished and unable to fight off diseases and illnesses. It is estimated that 29% of children in Sub-Saharan Africa between the ages of five and 17 are child labourers, resulting in many children being kept out of school.

African countries with the worst education development index are those that have been engulfed in lasting conflicts. Even conflicts that occur in relative short periods have immediately disruptive and destructive capacity. Almost three-quarters of countries in Sub-Saharan Africa have been affected by armed conflict in recent decades. Sudan, for example, has seen an increase in incidents of children being stopped from accessing education owing to conflict. Children have either been physically attacked for going to school or recruited by insurgent groups. Internal displacement and cross-border refugee situations have a particular impact on youth in relation to the disruption of education. Generally, children and adolescents who experience humanitarian emergencies are particularly vulnerable to missing out on schooling and dropping out of school permanently.

The education crisis in Africa is further exacerbated by low levels of teaching training. Research demonstrates that perspective teachers start their training with low levels of school education. In both English and French speaking African countries, over half of the prospective teachers would not have necessarily received a school-leaving qualification. With the significant reduction of wages in the teaching profession in most African countries, teachers have not been particularly motivated to work, impacting the quality of education that is being delivered. This outcome has prompted some teachers to engage in unfavourable practices, such as corruption, and encouraged the high rate of teacher absenteeism that is prevalent in Sub-Saharan Africa.

**1.2.2. Structural challenges**

Poor infrastructure continues to be a major hurdle towards achieving development in Africa. Physical infrastructure covering communication, power and transportation remains backward. The lack of education infrastructure limits access and quality of education in many African countries. Many children in Sub-Saharan countries are often learning in overcrowded and dilapidated classrooms. Malawi, for example, is estimated to have an average of 130 children per classroom in grade 1 and often lack basic facilities, such as toilets and running water. Research by Mwanza (2013) on the challenges of basic education in Zambia found that the hindrance to good quality education in the majority of schools in the country was the result of dilapidated and
inadequate infrastructure and poor learning environments, among others. In South Africa, the system is still in an infrastructure crisis: 269 schools do not have electricity; 7,816 schools have no piped water; 37 schools do not have any ablution facilities of any kind; 8,702 schools use pit latrine toilets; 70% of all schools do not have a library, while a majority do not even have space for a library; and 81% of schools do not have any laboratory facilities.

Although infrastructure development generally involves a public-private-donor participation in Africa, South Africa’s infrastructure development has been largely paid for by the state. The key consideration is that the 4IR is not static but evolving, and already students in underdeveloped African countries are missing out. The African Union’s (AU) Agenda 2063 has set its date for fulfilment of its target one that is decades in the future. Aimed at the year 2030, the United Nations’ (UN) Sustainable Development Goals (SDGs) present greater hope for education systems to become aligned with learners’ 21st century needs if the SDGs are accomplished. These needs do not merely involve technology. The danger posed by enthusiasm over the 4IR is that ordinary infrastructure needs are given less priority than shiny new technologies. In his 2019 State of the Nation address, President Cyril Ramaphosa said that South African citizens should image a country where bullet trains pass through Johannesburg as they travel from here to Musina, and they stop in Buffalo City on their way from eThekwini. While this is a laudable ambition, 21st century education requires roads and public transportation in the Eastern Cape and in other provinces where learners must walk 10 km to school. Rural parents must pay the unaffordable cost of private transport, and when they cannot, their children must endure cruelly long and sometimes perilous walks in all weather or sometimes withdraw from school. Eastern Cape schools in rural areas are closing because of a drop in enrolment due to poor attendance and absenteeism. Inability to access remotely located schools is a problem unfixable by a drone or better broadband but requires investment in basic infrastructure. Even if each rural homestead were outfitted with a home computer and solar electricity system for power, home-learning is still an unsatisfactory alternative to the communal and social learning experience with a physical teacher.

When asked to rank the most problematic structural challenges being faced by African education systems, survey respondents ranked infrastructural maintenance most consistently in 1st place. This challenge was followed by distance to schools (3.58) and electricity (3.62), although housing (4.6) was cited as the least important structural challenge by almost 30% of the respondents. Telecommunications was the only factor that was considered more frequently to be less important than housing, with 31% of the sample placing this challenge in 7th place. Interestingly, respondents believe that the distance to schools was a bigger challenge than the number of schools, inferring that accessibility has become a greater hindrance to education than the number of institutions.
Figure 7: Survey data on structural impacts on education by average ranking

“Please rank the following infrastructural challenges in order of their impact on education in Africa.”
1.2.3. **Implications of the urban and rural divide**

The myriad of challenges facing Africa demonstrates that there is still a lot of work to be done to prepare the continent’s children for the 4IR. The continent is still, in a number of ways, stuck in the First and Second Industrial Revolutions, with millions of children being without classrooms and access to electricity. Sub-Saharan Africa, with South Africa being no exception, finds a significant decline of infrastructure quality, income and education standards in rural areas compared to urban environments.

The same divide exists in urban areas between settled sections and informal settlements. The latter have the characteristics of neglected rural locations: no infrastructure, low education levels, joblessness and health problems – a reiteration that addressing societal inequity is not just a matter of geography but also of economics. Erasing the rural and urban divide is a goal as well as a process. Whether the 4IR can assist this erasure can be answered with an equivocal ‘yes and no’. The problem is primarily one of economics: resource allocation by the state’s and private companies’ need to seek profit on investment faces the challenge of low population density. It is easier and cheaper to meet the transportation needs of millions with a 10 km road in a city than thousands with a 100 km road in the countryside. Similarly, broadband expansion – so necessary for the 4IR – has been concentrated in areas where users are more densely congregated.

Yes, the 4IR has the means to erase the education and economic disparities between rural/informal settlement areas and formal urban areas. However, ICT and transportation infrastructure must be put into place. To finance this development – when state resources are limited and private investment is discouraged because of minimal return compared to urban areas – a common pool, open-access resource model has been proposed. Already, the 4IR era has brought broadband to rural areas, although this is constrained by community capacity to run ICT enterprises. The public ownership model harkens back to the Second Industrial Revolution when municipalities ensured electricity in towns through public ownership and the Third Industrial Revolution saw state ownership of services like telecommunications and broadcasting. Through these infrastructural developments were entire countries capable of obtaining power and radio and television signals.
“... Access to technology. Just the bandwidth is a challenge. If someone cannot get the right bandwidth in a classroom or on their mobile phones or whatever the case is, it is going to be a challenge to deliver that. So, we need to think of innovative ways of working with data providers, fibre providers ... in order to deliver learning because if you’re not connected these days, you’re honestly not getting access to the best learning that you can. It needs to be localised because [of] the context that we have here.”

Lindi Vundla, Focus Group Member, Uber

To meet 4IR needs, financing remains a challenge, necessitating public-private partnerships as one solution. Once infrastructure necessities are in place, education using ICT tools, which would also prepare students for the 4IR, can commence using online platforms supervised by teachers trained in ICT – with such training itself potentially done online. For South African educational specialist Professor Nosisi Feza, the 4IR in the education sector will be a substantial challenge. The rolling out of technology in rural schools will be difficult because of infrastructural challenges in tandem with teacher training that will be required. The lack of funding in rural schools makes it a challenge to develop basic infrastructure, not to mention technological infrastructure. The inequalities in the funding and provision of resources within African schools widens the learning gap between urban and rural schools, an inequality further exacerbated by the lack of attraction for teachers to teach in rural areas.

1.3. Decolonising education to meet Africa’s needs

Historically, the aims of a colonial education corresponded with the needs of African leadership in the 19th century and its authoritarian descendants in the 21st century. Both sought to discipline students intellectually and to channel knowledge to serve the masters, be it their colonial authorities, chiefs or kings. The intent of a colonial education was not to create enlightened individuals but rather to establish state subjects with enough basic knowledge to function but no creative intellect to challenge authority. It has, for the most part, disregarded an indigenous African education system that can provide learners with the knowledge and skills important for their own communities in their societies. Sifina (2001) notes that the failure of deconstructing colonial economies resulted in a discord between education output and economic growth. Although calls for decolonising education coincided with the independence movements, when countries achieved independence, the colonial education system, which emphasised rote memorisation for the purpose of passing standardised exams rather than creative thinking to imagine new solutions, was not fundamentally changed. Rather it was infused with curriculum additions like socialist propaganda in some countries and Pan-Africanism in others. The Socratic method of teaching, in which authority and established assumptions are constantly questioned, was abandoned, and corporal punishment was not questioned for a generation after independence.

1.3.1. Rethinking language of instructions

The colonial education system still characterises many African states today. The delivery of education is often content driven and marked by rote learning. More often than not, the ‘what’, ‘when’, ‘where’ and ‘how’ is memorised, but the ‘why’ that is raised as an exploration of an alternative reality is not taught. Children who ask: ‘But why?’ may be considered troublemakers, challenging their teachers. The classroom environment is one where discipline is prioritised and intellectually conflicting with a teacher is forbidden. Africa’s education system can only be decolonised if the intent of colonial education is replaced. Decolonisation will entail ridding education of a belief that there is a superior culture or superior beings who must be obeyed. This belief is instilled subliminally when instruction is only in a European language, or Western philosophies and religions are solely taught.

Educationalists have recognised the importance of reconstructing and redefining the colonial underpinnings of education in order to adequately prepare children in Africa for the 4IR – central to this is language.

There are a number of approaches to the role of language in learning, with the most explicit being the ‘straight to English’ approach and mother-tongue-based bilingual education approach. While the former has often been conceived of as the default position by many educators and educated people in South Africa, Ramadiro and Porteus (2017) theorise that successful education systems utilise a child’s mother tongue for instruction. Both scholars spent 18 months teaching in a rural Grade 3 classroom and found that teachers were attempting to teach in a language that the children had difficulty with and that they themselves were not comfortable with.
While learning was taking place, it was not sufficient to meet the demands on the curriculum. Ramadiro and Porteus (2017) hold that, where a language other than the mother tongue is used, the education system has to make certain that both the teachers and their learners are familiar enough with the language to teach in and learn through it. They do not advocate for a monolingual language of instruction – replacing English with isiXhosa, for example – but rather a bilingual approach to teaching.

Similarly, others argue that it is more efficient for non-English speaking children to become proficient and literate in their mother tongue before they begin learning a second or third language. The work of Catherine Snow, a Harvard University Distinguished Visiting Professor at the Centre for Education Practice at the University of Johannesburg, proposes a bilingual education model for the early grades, in which teachers teach a lesson succinctly in the home language and then repeats the gist of it in English. The psycho-linguistic and cognitive processes are thus blended systematically. At the University of Johannesburg, Elizabeth Henning and her team have studied foundation phase classrooms in Soweto, finding that there is a ‘multilingual maze’ in which young children have to navigate their learning.

The majority of Grade 4 learners in South Africa are unable to read well in their home language or any other language.

"There is definitely a space for mother-tongue instruction, but coming from a [multilingual] township in Gauteng, I question the idea of mother tongue and what that truly means because on paper it’s really one thing, but in [practice] and reality, it’s another. I don’t know where we get this idea of monolingual instruction and that when we speak of [introducing] or raising the status of our indigenous South African languages there is the perception that it will do away with English. [The abolishment of English] has never been proposed because there is no doubt that English is a global language. [However], the idea of monolingual instruction, [in our context], is problematic."

Tinhiko Nkuna
Deputy Headmistress, St Mary’s School – Waverley

Ramadiro and Porteus (2017) developed a framework for change comprising of three elements: the knowledge project; mother-tongue-based bilingual education; and changing teachers’ practices. Specific to the second element, both authors theorise that a mother-tongue-based bi- or multilingual education is important for building successful foundation phase classrooms in rural South Africa. It is premised on the belief that the promise of mother-tongue-based bilingual education is, at the moment, undermined by an educational knowledge project that is misaligned with the linguistic resources of the majority of children and their teachers and further skewed from the instructional contexts of their classrooms.
The above diagram summarizes Ramadiro and Porteus’ (2017) framework for change at a primary school level, with the centre of the diagram focusing on the classroom. While there are a number of external factors impacting the classroom, the two scholars emphasize two important factors: multilingual literacy, which places emphasis on the relationship between the children’s out-of-school and in-school literacies and their success; and the basic functionality of schools, districts and provinces. They (2017) contend that if these levels of the education system do not function sensibly, it would be difficult to make and sustain gains at the level of the classroom. The rest of the diagram denotes their hypothesis about primary relationships inside the classroom. On the left side of the diagram, they (2017) identify three conditions that, when taken together, can create a tipping point for teaching and learning in a classroom:

- Condition 1: the availability of high quality bilingual instructional tools (ideas, materials and practices) calibrated to the social and linguistic contexts of children and their teachers.
- Condition 2: a system of teacher development and support calibrated to the social contexts of teachers, one that is capable of generating communities of practice over time.
- Condition 3: a set of minimal classroom materials and physical resources.

The diagram proposes that the intermediary indicator between the generative conditions and learning outcomes is teaching and learning interactions. Ramadiro and Porteus’ (2017) framework places less emphasis on learner results and greater emphasis on the quantity and quality of teaching and learning interactions. The proposition is that, when there are ample learning interactions of a high enough quality, these will translate into learning performance.

1.3.2. Making technology accessible to all learners

Many African states have realized the potential of education to act as an instrument to achieve economic development and have invested in expanding the sector. While the continent still remains the least digitally advanced in the world, significant investment into broadband infrastructure has positioned Africa to benefit from digital education tools. Owing to these developments, there have been commendable efforts by both the public and private sectors to introduce smart educational technologies to pupils.

Countries such as Kenya, Nigeria and South Africa have been able to take instrumental steps in the digitisation of their education systems. Nigeria has collaborated with Chinese tech firm NetDragon to build smart classrooms in over 100 districts, while Rwanda’s collaboration with Google and Facebook has seen the introduction of a Master’s degree in Machine Intelligence. In South Africa, government policy is heavy on hardware but light on software, which makes ICT emphasised but not in education reforms that will change the curriculum and physical classroom to make 21st century learning possible.
On 5 July 2019 at the inaugural Digital Economy Summit, President Cyril Ramaphosa introduced a technology-focused curriculum for South African learners. The curriculum launch was a follow-up on the president’s State of the Nation Address before parliament a few weeks earlier in which he acknowledged the need to prepare the country’s learners as early as the primary school level for their participation in the 4IR. Through a partnership with the Netherlands, Kenya has been able to undertake transforming its education system. The partnership entails prototype smart classrooms used for vocational training but with applications for primary, secondary and tertiary studies. In addition to hosting computers and internet connectivity, these smart classrooms are designed as open spaces for project-oriented education and are physical plants crafted for inquiry-based learning, leading to the new educational goals of problem solving, team work, and personal growth.

As it has been demonstrated by the steps taken by some African countries, the introduction of ICT into schools is one important aspect of preparing African learners for the 4IR. There are two main categories that are important when thinking about the use of technology in schools: the first pertains to assisting and supplementing the teaching process through using technology; the second relates to introducing students to different aspects of technology, such as coding and computer literacy. Whether smart classrooms and curriculum reforms will become successful depends on educationalists’ embrace of not just technology but of the new education paradigm that these classrooms were designed to serve. This is the main question to be addressed by all African countries.

Educationalists are learning that common computer rooms used with teacher supervision are more effective pedagogic environments than when tablets are individually distributed to learners, who may lack the self-motivation to do assignments. They acknowledge that it is not enough to have children physically present at their school with a teacher to allow for a learning experience – not if the facility is substandard, if the teacher is not qualified and, if at graduation, the student does not know how to read for comprehension or do simple mathematics.
"I worked with governments that want to deploy One-to-One learning, say education [with] full ICT in the classroom, but when you go look at the teacher training policy, it only has policy on basic ICT literacy. The policy doesn’t refer to training teachers on integrating 21\textsuperscript{st} century skills in the classroom by utilizing ICT as an enabler. So, your teachers only get trained on A, B, and C, meanwhile you have a government that wants to also introduce X, W and Z to get its future workforce competitive in the global market place. The policies at all levels must align so that you are able to reach your countries vision … stakeholders tend to just focus on the ICT, so devices for all students, [but] that is just one of the components, in integrating ICT as an enabler of 21\textsuperscript{st} century skills.”

João C. Fidalgo,  
Business Consumption Lead, Intel Corporation South Africa, SADC Territory

At present, less than 1\% of children in Africa complete school with basic coding knowledge. While traditional education has been monodisciplinary, with one becoming more focused and narrowed in the progression of one’s studies, future education systems will be multidisciplinary. The 4IR is said to demand an interdisciplinary and T-shaped person – one with in-depth knowledge of a specific field in tandem with sufficient knowledge in other fields outside their specialisation.\textsuperscript{iii} Digital technology experts hold that a country’s youthful workforce needs to be equipped with 21\textsuperscript{st} century skills so that they can be able to participate in the digital economy. Regardless of chosen career paths, the skills that young people have to be equipped with are digital skills because the 4IR is set to cause disruption across all industries.

1.4. Meeting Agenda 2063 and SDGs

The AU’s Agenda 2063 – described by the AU as “a master plan for transforming Africa into the global powerhouse of the future”\textsuperscript{iv} – is a macrocosmic blueprint to expand development on a pan-African scale. It has been described as an ambitious and people-centred vision for Africa, encompassing a carefully drafted action plan aimed at positioning the continent for growth over the next 50 years.\textsuperscript{v} The UN’s SDGs, in contrast, are aimed at empowering the individual. African governments have committed to following both sets of development aims. Many African countries have their own national development plans, which are often inspired by the SDGs or are designed to meet the SDG targets that, once accomplished, will achieve nations’ own developmental desires.

Agenda 2063 has been designed to have markers along its 50-year development span to assess how effectively countries are meeting the Agenda’s goals. The SDGs are also regularly assessed to measure a nation’s progress.\textsuperscript{vi} When Agenda 2063 was developed in 2013, its target areas were largely devoted to economic and political matters and were designed to work in harmony with the 17 SDGs, recognising that the development of the individual is the foundation for larger national and pan-African development. For instance, Agenda 2063 Goal 2 – “Well educated citizens and skills revolution underpinned by science, technology and innovation” – references SDG 4: “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.”\textsuperscript{vii} The former cannot be achieved without the latter. This also ensures that countries need to try to fulfil two sets of development goals.

1.4.1. Education targets and SDGs

To realise a prosperous Africa that is founded on inclusive growth and sustainable development, it is important for education to be prioritised. It is an instrument through which Africa’s potential can be realised and is said to be the bedrock of sustainable development.\textsuperscript{viii} Agenda 2063 asserts that Africa has to invest in skills, science, technology, engineering and mathematics so that Africans can be able to drive the continent’s development through adhering to the vision and framework. The vision and framework include\textsuperscript{viii}:

- expanding universal access to quality early childhood, primary and secondary education;
- strengthening technical and vocational education and training through scaled up investments to establish high-quality TVET centres across Africa, foster greater links with industries and alignment to labour markets with a view to improve the skills profile, employability and entrepreneurship of youth and women, all in order to close the continental skills gap and;
building and expanding a knowledgeable African society through transformation and investments in universities, science, technology, research and innovation and through the harmonisation of education standards and mutual recognition of academic and professional qualifications.

Similar to the Agenda 2063, the SDGs targets and indicators for education encompass:

- ensuring that all girls and boys complete free, equitable and quality primary and secondary education, leading to relevant and effective learning outcomes by 2030;
- guaranteeing equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university, by 2030; and
- substantially increasing the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship by 2030.

Both developmental plans recognise that progress is holistic and that economic, political and societal issues are interlinked and must be approached collectively. To advance into the 4IR age, Africa must have an educated population. This is not possible without well-fed and healthy children and adults, gender equality to ensure all human capital is developed to maximise individual and collective achievement, or electrification and transportation links in all areas. Africa’s progress towards democracy is not linear but is forward moving, which is bringing the continent closer to the implied political goals of Agenda 2063 and the SDGs that advocate for inclusive and peaceful societies. Non-autocratic societies, where governments do not shut down the internet at will, are also a prerequisite for the 4IR. A review of the SDGs is a reminder that the 4IR can only take root in a society where a multiplicity of factors is met, beyond the business and communications environment, inclusive of societal needs and governance necessities.

The South African SDG Hub has been set up at the Albert Luthuli Centre for Responsible Leadership at the University of Pretoria to both track the country’s SDG achievement progress and to provide policy advice to inform laws and programmes promulgated to meet the SDGs. Although the realisation of the SDGs is not to be finalised until 2030, the clock has been running since January 2016 when they came into effect, and only 10 years remain. However, a uniformed score card seems to be lacking to tabulate how well countries are meeting requirements. Although the goals themselves are quantified in various sub-targets (Goal 1, which seeks to end poverty, calls for a halving of all people living in poverty by 2030), the obtainment of these also needs to be quantified. As things now stand, SDG progress is measured haphazardly by a variety of indicators, from unemployment figures to school attendance.
However, South Africa’s governmental data body, Statistics South Africa (StatsSA), in its work to collect data on government’s own National Development Goals, has correlated this data to correspond with SDG progress and has identified indicators to use going forward. For instance, Goal 1 – “End poverty in all its forms everywhere” – will be measured by such baseline indicators as “Percentage of the population covered by social protection systems,” which at the SDG launch in 2013 stood at 28.9% and in 2016 was 29.3%. More specific to the 4IR, SDG Target 7 – “Ensure access to affordable, reliable, sustainable and modern energy for all” – will be measured by StatsSA in part by the “Percentage of the population with access to electricity,” which stood at 93.3% in 2014 and rose to 94.2% in 2016. For Goal 9 – “Build resilient infrastructure, promote sustainable industrialisation and foster innovation” – a variety of baseline indicators include the number of passenger journeys and freight volumes moved monthly, the amount of GDP devoted to research and development (down from 0.8% in 2010 to 0.7% in 2014), and the proportion of South Africans covered by an LTE mobile network (53% in 2015 and 75% in 2016). All these factors will be correlated to come up with a single measure to track SDG progress going forward.
1.4.2. Using technology to make education accessible

More than any previous industrial revolution, the 4IR is linked to education. Learning institutions are important consumers of new technologies and, in turn, produce innovators and workers who advance societies. The most direct link between the 4IR and the SDGs is Target 4: “Ensure inclusive and equitable education and promote lifelong learning opportunities for all.” In South Africa, the government considers the achievement of this goal as something that is critical to the attainment of the goals of eradicating poverty, growing the economy in tandem with reducing inequality. However, measuring the achievement of this goal is not straightforward. Educationalists acknowledge that school time in substandard facilities with unqualified teachers who cannot impart basic skills like reading, writing, and mathematics is not enough. How technology can help is by making access to learning tools more democratic. Materials that once were available only in the fine libraries of affluent schools are now accessible online, often through e-learning platforms. However, the information accessed follows a learning curriculum that must also adapted.

While school was once designed to create industrialised workers, today’s world is driven by a knowledge economy that requires reasoning, problem solving and the ability to construct viable arguments. The lack of students’ reading comprehension is one sign of failing this requirement. Learning logic is obtained through the Socratic method of dialogue, of argument, and this is done best on a one-to-one basis and is difficult with a single teacher facing a room full of students with varying degrees of interest. A computer programme under teacher supervision, however, can engage a student through interactive programmes. Naseba is a firm that offers various 4IR methods to boost education systems – including mobile classrooms that roam remote rural areas called Smart Labs, which are low-cost solar-powered converted shipping containers, equipped with technology to make them classrooms dedicated to experimental learning – and online teachers’ aide programmes. The system, called Ed4.0 in homage to the 4IR, does manage to teach logic using “the first adaptive learning STEM [science, technology, engineering and mathematics] technology solution that engages each student in a pedagogical exchange powered via advanced AI algorithms.” When applied from preschool onwards, the logic system develops in a child conceptual mathematics understanding, which has proved a challenge to achieve for South African teachers.

New resources are catering to younger learners, ensuring solid platforms into a 4IR future

However, technological tools from primary to tertiary level need to be programmed with materials that encourage innovative thinking, which is the most valuable skill in the 4IR. University of Johannesburg Communications Professor, Ylva Rodny-Gumede, notes that South Africa has not had an education system that has fostered innovative and creative thinkers. One way to foster creative thinking at the tertiary level is to invest more public and private funds in research and development, which is currently under-funded in South
Africa. Research and development should not be targeted solely at making technologies and products, but also toward how these are applied and what society’s needs are for products and services. Because creativity premised on intellectual curiosity is the foundation for success in the 4IR, any pedagogic technologies would have to encourage creativity. Such an education system in the 4IR world must reward a student not for memorisation (in an age when all information is immediately accessible on-line anyway) but for innovation.

1.5. Reflections, Challenges and Recommendations

Reflection 1: Quality and nature of service

Challenge: Improving the performance levels of basic education - Baseline indicators show poor performance in reading and math, low levels of education advancement and poor intellectual quality leaving both individuals and society are ill-equipped for the challenges of the 21st century. Basic education is required to prepare students to adequately use ICT within the context of 21st century education. Current education systems in various African nations are not producing the skills and talent necessary for ensuring the development and success of the nation.

It is also important to redefine what the teacher should be doing in the 21st century so that it will enable teachers to act differently and seek different results from learners. Currently, teachers are expected to teach students to critically think, solve problems, communicate and collaborate. This is a challenge in South Africa because teachers are given, for example, specific pacesetters that must be followed rigidly, they are told when to test students and how those assessments should be conducted.

- **Recommendation:** Prioritising teachers through equipping teachers with resources and training programmes that they need to deliver quality education. Teacher education programmes should be able to address inclusive education in different subjects. There should also be perpetual training at all levels mirroring the ever-evolving technologies. Furthermore, the teaching profession has to be made competitive; teachers have to be better remunerated and provided with diverse career options to keep them motivated.

- **Recommendation:** Redefine what the classroom looks like through using formal and informal methods of learning. The 21st century classroom utilises technology to deliver lessons in ways that have not been used before, it is an enquiry-based and collaborative environment and enquiry based. Beyond the structured classroom, learning can be facilitated through community-based projects, sports event and academic competitions/contests (e.g. Olympiads).

- **Recommendation:** Use technology to enhance and support other literacies, such as gamification of maths problems and reading exercises. Technology-based skills can be acquired through use of ICT platforms and applications.

Reflection 2: Equality, inclusion and independence

Challenge: The rural and urban divide – Access and quality of education is often hindered by the rural and urban divide which is ever present in African states. This often leads to an exacerbation of inequality and exclusion, with rural schools lacking funding for the development of libraries, classrooms and new equipment. The majority of the rural schools also skills shortage as prospective teachers find it undesirable to teach in these schools. The rural and urban divide is also technological, with a greater proportion of people in Sub-Saharan Africa being excluded in comparison to other developing regions of the Global South.

- **Recommendation:** Governments, private companies, NGOs and other stakeholders should be incentivised to work collaboratively to meet costs of infrastructure development. It is also important for different stakeholders to collaborate on policies and programmes aimed at bridging the rural and urban divide. The development of an intentional and integrated plan for rural and urban schools is required. Government needs to develop well-structured and well-
articulated goals for both rural and urban schools. Some of these plans and goals will be the same and some will be different. Therefore, developing an index that will focus on measuring the quality of education within rural and urban areas is key.

- **Recommendation:** International development organisations and African governments should strengthen public-private partnerships investment in ICT-related infrastructure and services. There is also a need for the integration of technologies at all levels of schools.

**Challenge:** African education systems are still underpinned by the legacy of colonialism - Many African states are still characterised by a colonial education system that encourages dependence and trains students on how to memorise and reproduce ideas in order to pass exams. It does not encourage forward thinking, creativity and innovation; skills that are important for the 21st century.

- **Recommendation:** Reconstruct, redefine and decolonise current education systems. It will also be important to reintegrate of the traditional African knowledge systems through encouraging African indigenous knowledge systems, skills and cultural traditions.

**Reflection 3: Future-proofing the youth population through multi-pronged approaches**

- **Challenge:** An increasing percentage of youth - Because of the youth bulge that exists in Africa, all forward-thinking policies should be geared towards youth empowerment and inclusion. Education policies organically skew towards a youth focus because of the typical age group found in educational environments, however 4IR-related policy should be cross-cutting and should take into consideration the hindrances to youth fully participating in the economy.

- **Recommendation:** Develop an umbrella policy on 4IR in South Africa through consultation with multiple government departments. Particular attention should be paid to how technology infuses people’s lives and how interventions can be used in an efficient and resourceful way so as to maximise impact.

- **Recommendation:** Update existing youth-focused policies to reflect new thinking on 4IR. If the youth population is not given every chance of success in the 21st century, there will be negative consequences across standard of living indicators.
### 1.6. Example of African Excellence

**AFRICAN SUCCESS STORIES:**

*Changing how the developing world learns through innovative technology and skilled coaches*

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>Zambia and Namibia</th>
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<tbody>
<tr>
<td>INTERVENTION</td>
<td>Edulution</td>
</tr>
<tr>
<td>FOCUS AREA</td>
<td>Meeting SDG Requirements</td>
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<tr>
<td>DATE</td>
<td>2015 - present</td>
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<tr>
<td>DESCRIPTION</td>
<td>Digital learning company delivering numeracy and literacy content through platforms and coaches</td>
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#### THE PROBLEM

Many students and learners in Zambia and Namibia have historically taken English as a secondary or auxiliary subject (with only 14% of Grade 12 learners in Namibia achieving a ‘C’ or higher), meaning their literacy, on a global scale, is below par. Furthermore, both countries exhibit less than desirable results in terms of numeracy, especially Zambia, where 67% of Grade 6 learners are considered innumerate by SACMEQ III standards, and average student performance was only 40%.

#### THE SOLUTION

Edulution, an organisation that works in Zambia and Namibia, provides services that improve numeracy and literacy capabilities among schoolchildren. To achieve this, Edulution implements technology-, coaching- and analytics-based programmes that track student performance. The platform matches up students with mentors, who become responsible for each child’s practice, as well as an online portal for students to receive distance-learning tutorials. These measures have been implemented predominantly for learners with access to tablets.

#### RESULTS

Edulution, through their platform and mobile teaching centres, reaches close to 12,000 active learners a month from disadvantaged backgrounds in inner city townships in Lusaka and Windhoek. In terms of progress, Edulution’s “alpha” graduates have outperformed classmates by an average of 25% during the most recent Grade 7 national examination. These results are reinforced by Edulution’s adherence to SACMEQ and Cambridge education standards.

#### STAKEHOLDERS

Edulution has many stakeholders, including mentor partners and funding organisations, such as PestalozziWorld, who fund schoolchildren’s journey through the curriculum. Their transparency to funders deems them ‘zero risk’ as only hours completed by a learner are accounted for. As such, Edulution works in coordination with the governments of Zambia and Namibia, ensuring their courses are aligned with the respective curricula, and with communities and village elders, ensuring cooperation and encouragement from local beneficiaries.
2. STATE OF EDUCATION – A SOUTH AFRICAN CASE STUDY

2.1. Introduction

Education is not an island but rather a composite system that is rooted in political, economic and cultural contexts and linked to ideologies shaped by power and history. The advent of democracy in South Africa in 1994 brought significant reforms to all aspects of education policies and planning, with specific efforts made to introduce and extend pro-poor programmes.

Although the country can be proud that there has been an expansion of access to education services to the poor and increased enrolment at all levels of schooling, the quality of education remains below standard and continues to be characterised by critical inequality along racial and socio-economic lines. These political- and system-based changes are cause for a closer look at the education system in South Africa, and as such, this section uses the education environment in South Africa as a case study and evaluative benchmark for the African continent. Table 1 below gives an indication of the desperate education landscape that needs a serious overhaul towards quality education to have a fair balance of teacher/learner ratio. According to Table 1 in public schools the teacher/learner ratio was 1:31 whiles in private schools it was 1:11.

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Table 1: Comparison of South African learners in public and independent institutions (2018)

Data courtesy of the Department of Basic Education

On top of an already burdened system, education in South Africa is faced with a rapidly transforming, technology-driven and interconnected globalised knowledge economy, which requires competencies appropriate for dynamic and unpredictable models of economic and social development. Every country, including South Africa, is faced with the challenge of how best to implement a 21st century education system that will prepare today’s students for future needs. However, incorporating 21st century skills into the education system entails a fundamental re-orientation in pedagogical approaches.

Innovation by its very nature can exacerbate an already unstable system. The drive to innovate must, thus, be balanced with the drive to preserve what is already working. Therefore, leaders in education are obligated to do as much as possible to improve the current system while simultaneously building the conditions from which a new system can emerge. In order to align country development, with education at the centre, countries need to leverage on the opportunities that the 4IR brings to improve education systems. It is important to understand the state of readiness of the education sector in order to determine proper interventions.

“There are big challenges with the content … [and] the curriculum of the schooling system. We are not teaching children to get them ready for the world out there. We give them basic schooling in content but not in life skills to able to survive in the world. And also, the methods that we use in teaching are still very much outcomes based. … You learn something off by heart, you go off and write it in a test.”

Dr Adri Drostkie
Head of Research and Faculty Development, Henley Africa
When asked to indicate how ready the South African education system is for the 4IR, respondents were overwhelmingly negative in their responses as 77% believed the system is either not ready at all (56%) or only ready to a small extent (21%). However, almost a quarter (23%) thought that the South African system shows an average degree of readiness, although these are the most positive responses from the sample. South Africa’s role as an African education leader also sheds some light on the nature of the continent as a whole, implying that other African countries would not achieve the same level of confidence in their readiness for the new technologies that will shape education in the future.
The following section looks at the current state of South Africa’s education system across different stages of a learner’s educational journey from ECD through to tertiary and post-school activities. Within the different stages of education, this section will provide an overview of the successes and challenges faced, with a specific focus on how each level of education is responding to the changing nature of education in the 21st century, and it will offer recommendations for meeting these challenges. This section will also look at the governance of South Africa’s education system, paying particular attention to the alignment of policy with the demands placed on the system by global technological and digital advancements.

2.2. Early Childhood Education

2.2.1. Overview

The term ECD refers to the development of children from birth to four or five years of age across all spheres of development – physical, mental, emotional, moral and social. It motivates an inclusive approach to policies and programmes with the active participation from parents. The first one thousand days of a child’s life are the most crucial. Within these days, one is able to influence how well a child will perform in future and enhance their abilities to unlock their long-term potential. During these formative years, factors like nutrition, good quality learning, stimulation, childcare and nurturing will have an effect on how well a child transitions into adulthood. If these factors are not set in place, children are less likely to succeed in school and consequently lack opportunities in adulthood.

The primary location for ECD interventions is in the home. ECD plays a pivotal role in preparing learners to prosper in primary and secondary schooling and has been shown to impact development from childhood to adulthood. It is held that children who receive ECD interventions or education are less likely to repeat grades, drop out of school or be placed in special needs programmes. These children have higher achievement scores and are better positioned to study further. Research also shows a low correlation between adults who have received ECD and criminal activity.

Notwithstanding these encouraging reasons to promote ECD, the majority of children within Africa have not received adequate ECD education.

2.2.2. Key influencing factors and trends at the ECD level

2.2.2.1. Poverty

Many children in South Africa suffer from malnutrition. The development of children is understood to begin as early as pregnancy, so it is important that expecting mothers receive good nutrition and medical assistance, which is not always available. Approximately one-third of children in South Africa, especially in Gauteng and the Free State Provinces, have been stunted due to chronic malnutrition. South Africa has one of the highest rates of low-weight births, with 13.3% of new-borns under 2.5 kg nationally. There has also been a high prevalence of underweight-for-age instances at 21.3% nationally.

"Nutrition is an essential component, but here is the issue, ... these ladies establish these centres, they talk to parents, [but] parents can and cannot contribute. If they do, it is not consistent as well, ... so, what we [at the Hollard Foundation] found was not necessarily lack of food. First, it was that they don’t feed the children when they arrive because they assume [that the] children have eaten at home, and the parents assume that the child will eat at school, so you see the gap right there. ... Then, the second part was what they were feeding the children. Anybody was feeding whatever they can afford, whatever they can find in their immediate space of buying, ... and of course, what they buy was also informed by what parents contribute as a fee. There was another interesting factor attributed to the majority of the kids being malnourished. ... They were mostly children two-year-olds and under, and when you talk to the practitioners, they will say, ‘Well, these ones never finish their food;’ the issue here was that these children stopped eating when the hand gets tired.”

Ntjanja Ned
Ex-CEO and current Trustee, Hollard Foundation

The first one thousand days of a child’s life are the most crucial. Within these days, one is able to influence how well a child will perform in future and enhance their abilities to unlock their long-term potential. During these
formative years, factors like nutrition, good quality learning, stimulation, childcare and nurturing will have an effect on how well a child transitions into adulthood. If these factors are not set in place, children are less likely to succeed in school and consequently lack opportunities in adulthood. Nevertheless, the South African government has made major progress in addressing the provision of nutrition after pregnancy in the ECD phase through initiatives like breastfeeding campaigns, where as much as 73% of children were reported to have been breastfed in 2016 alone. Although breastfeeding remains one of the best food source for infants – given the good health of the mother, work still needs to be done to address the stigma around public breastfeeding.

In addition to affecting nutrition, poverty can also impact other aspects core to the early development of children. Children in disadvantaged households are often in environments that can negatively affect their psychosocial development. For instance, activities such as singing, playing and reading can stimulate a child’s mental capacity, while being exposed to stress and conflict at an early age can set the stage for a more tumultuous and difficult development.

2.2.2.2. Infrastructure

All ECD centres are required to undergo health and environment inspections by the Department of Social Development, yet many ECD centres operate without health and environment certificates. Infrastructure within ECD centres have been an issue for many centres in disadvantaged areas as some still use pit latrines, which pose major health risks for babies and toddlers who are typically more prone to infection than older children due to having weaker immune systems. In addition, ECD centres face overcrowding, which is a major safety hazard.

Quality infrastructure impacts more than just the learning and safety of the children as a lack of infrastructure is a contributing reason for why a majority of ECD centres within rural and township areas are not registered. The Department of Social Development stipulates high standards for infrastructure to achieve full or conditional registration as an ECD centre, thereby receiving government support, which many centres do not meet. Even among registered centres, only 57% have health and environment certificates. The locations of the ECD centres present patterns of infrastructural landscape that have an impact of this part of the education ecosystem and value chain. Figure 3 indicates the worrying percentage (%) level of ECD centres that meets legislative requirements or receiving state support across different locations.

![Types of ECD Centres in South Africa](image)

**Figure 12**: Type of area of audited ECD centres in South African (2014)

_Data courtesy of the Department of Social Development, RSA_
The inadequate access to ECD service centres is another key challenge in ECD. It limits access for disadvantaged children, as well as those living with disability. This is despite the commitment from the National Development Plan (NDP) to ensure that every child in South Africa has access to a full range of ECD services by 2030. These centres are largely publicly financed, being provided for by local non-profit organisations or microenterprises. While this is an appropriate and affordable format for localised service delivery that builds on and enhances social capital and local jobs, it cannot be scalable unless it is organised and supported. ECD centres within rural and township areas also dependent on the home structures. In most cases, there is no formal measure to ensure that the best ECD policies are practised in the homes, which affect the quality and cognitive development of children.

“... these [ECD] programmes are initiated by ordinary people, and they initiate them because of a need. ... Somebody says, ‘I need somewhere to leave my child.’ ... So, it starts like that. ... And the system does not say, ‘if you want to start looking at this, here is your door to knock on.’ It is a response to a need which, in fact, is validated by incidences of overcrowding because there are more children than the service, and there are no more alternatives. It shows there is a need. We need a better response, a much more comprehensive response.”

Ntjanja Ned
Ex-CEO and current Trustee, Hollard Foundation

2.2.2.3. Misaligned ECD curricula

There has been a plethora of discussions on the need for appropriate curricula and quality education within primary and secondary public schools in South Africa, and the ECD sector is no different. The South African government has taken note and has realised the importance of ECD for successful schooling, especially within poverty-stricken areas of the country. Over the past 12 years, there has been an increase in ECD development by means of the establishment of formal structures within relevant governmental departments. These focus on free healthcare for pregnant women and children from birth to six years, increased expenditure in the form of child grants, money reserved specifically as subsidies to ECD sites, the introduction of Grade R and the formal documentation of aspects of ECD, such as in the recently disseminated Children’s Act, No. 38 of 2005, as amended.

However, there is still a need for curricula that serves all the children of South Africa equally, especially those who are likely to perform poorly in their schooling careers. Generic ECD curricula that are insensitive to specific contextual needs will be misaligned with particular needs, requiring that effective ECD curricula should not place its focus on content alone but should be intricately bound to the contexts of the needs of all children.

2.2.2.4. Training ECD practitioners

The current number of practitioners and their qualifications do not match the skills needed in the ECD workforce in South Africa. For instance, over half of ECD practitioners in fully registered centres in South Africa do not have any ECD specialisation (51%). This is higher at unregistered ECD centres. Among assistant practitioners, 75% and 87% of assistant practitioners at fully registered and unregistered centres respectively have no formal ECD specialisation. Regarding registered centres, the province with the highest percentage of practitioners without specialisation is Gauteng (72%), followed by Mpumalanga (68%). This figure is dramatically lower in the Western Cape (9%). The only other provinces where less than half of the practitioners have no specialisations are the Northern Cape (41%) and Limpopo (49%).
“I have got my own views around [the] certificate of practice because, in the evidence of what we found, when you look at what is essential for children to learn, it is a social and emotional connection with a trusted adult. It’s the feeding and playfulness of the person that stays with them. Then, there [are] these tools and toys for stimulating [their minds], and there [are] the gross motor skills that the kids must have. … All those things require a rounded person to be able to do that … a certificate without these support tools and materials does not give us the outcomes, but rather indicates what the person knows as opposed to what they do on a daily basis. We need a mechanism to determine current competence on the development areas required for entry to Grade R.

Ntjantja Ned
Ex-CEO and current Trustee, Hollard Foundation

Several key factors have influenced the demand for skills in this sector, including the obligation to implement the Children’s Act, which requires suitably qualified staff, as well as an incremental increase in budget allocations to ECD since 2006. The Department of Social Developments and the Health and Welfare Sector Education and Training Authority (HSWETA) confirm this demand by identifying child and youth care workers as a scarce occupation. While these policy and programmatic innovations have been aimed at increasing the number and improving the qualifications of ECD practitioners, the quality of ECD services, especially in underserviced areas marked by poverty and inequality, remains poor.

Thus, there is a pressing need for change in the manner in which ECD practitioner training programmes are conceptualised, designed and provided in South Africa. Evidence gathered from developing countries and the experiences of organisations in South Africa indicates that the area of focus for addressing this challenge should be on the design of supportive teaching and learning environments and resources and methodology rather than on the curricula contents of ECD practitioner training programmes. A holistic, technically sound, integrated and interactive training model that combines theoretical and practical training, as well as ongoing mentoring designed to address common ECD practitioner educational challenges, is vital. Improving ECD practitioner training may assist in breaking the negative cycle of poor quality ECD provisioning by practitioners who are themselves the products of poor quality ECD in the impoverished centres where they are most likely to serve as practitioners.
2.2.2.5. Using technology to initiate early learning

Digital learning gives learners an opportunity to access content with no limitations to physical location. This means that learners can carry on learning despite absenteeism and could gain access to learning content that they would not otherwise be exposed to. Mobile technologies have been proposed specifically for the further development of the ECD sector, especially in the higher age bracket, with smartphones and tablets used as tools for learning. However, it is important for ECD practitioners and parents to carefully think about what kind of technology will be appropriate for the different development levels of young children. According to the Department of Education in the United States (US), the guidance on the use of educational technology for ECD practitioners and parents should reflect the kind of technologies that they have access to.

In developed countries, such as the US, ECD has utilised technology to teach children to great effect. For instance, children, even at the preschool level, can learn about animals through informational age-appropriate videos and applications, such as the Shine 2 tablet. With this tool, children learn about animal anatomy by painting over the animal with their fingers and watching the screen change to reveal an x-ray of the animal. Other uses of technology include applications like Move NG, which uses the human body as a game controller, thereby combining active play and learning in an immersive learning experience, or One Globe Kids, which creates an imagined contact experience with another person that aims to increase empathy and reduce prejudice and the anxiety of interacting with others. Children experience having friends across geographic, linguistic and cultural boundaries that may otherwise be difficult to cross.

In developing countries, technology has also been used effectively at the ECD level. For instance, in Ghana, Ghana Reads targets low income preschool and primary school children. Low-cost mobile basic e-learning libraries have been installed in 20 rural ECD and primary schools. These come with computer servers with two terabytes of open educational resources, which are connected to a projector, laser printer, speakers and monitors to cater to large group lesson delivery, as well as computer monitors for individual use. Additional resources can be added through flash drives or created locally, using a keyboard and video camera. The programme also seeks to provide students with technology, such as tablets and mobile devices, to enable children to practice reading independently or in small groups while teachers record and monitor their progress. Outside of Africa, another example is Broad Class – Listen to Learn in Pakistan, which uses standard technology, such as the radio, to help children gain numeracy and literacy knowledge and skills within marginalised or rural populations. English lessons are provided to students aged five and above that are culturally, linguistically and contextually relevant to these populations.
Nevertheless, implementing such initiatives in South Africa faces important drawbacks, especially in rural and township schools, namely that parents are unable to purchase mobile devices, afford the high cost of mobile data essential to access learning material, and keep the devices running as a result of lack of electricity at home. However, programmes like those in Ghana illustrate how drawbacks like these can be addressed and that improving the technological infrastructure of rural schools, through the provision of internet, laptops, smartphone or a tablet, remains an important aim. Crucially, by making use of technology from an early age, children can learn how to use technology appropriately and become digitally responsible citizens.

2.2.3. Reflections, challenges and recommendations

Reflection 1: Need for quality infrastructure for ECD centres

- **Challenge: Inadequate infrastructure and inequalities across the ECD sector** - Many ECD centres lack adequate infrastructure, especially in rural and impoverished urban areas. Tackling the provision of quality ECD education necessitates addressing the wider societal problems of poverty and inequality.
  
  o **Recommendation:** There needs to be promotion of ECD interests in national discussions so that adequate financial and non-financial resources can be allocated to this level of education. This will require the enhancement of multi-department and multi-stakeholder collaboration. There is also a need for the development of meaningful ECD policies, specifically addressing the needs of poor households and particularly those living within informal settlements.

  o **Recommendation:** Since an ECD centre is the first point of contact between children and local authorities, there needs to be a link between ECD centres and the nearest primary schools in the area to ensure that young children are automatically enrolled in school at an appropriate age. This will allow for continuity in the education process.

  o **Recommendation:** There is a need for the adoption of a hybrid model of ECD delivery, a model that recognises the realities of where children are born and raised and what communities have initiated as their response. The government must connect, engage, enable and develop a regulatory framework for these initiatives through a costed package of support for each model as opposed to “criminalising them”.

- **Challenge: Ineffective collaboration between key stakeholders** - As is the case with all levels of South Africa’s education sector, a lack of effective, strategic collaboration across stakeholder groups continues to hamper progress in the improvement of ECD. While the National Integrated Plan for ECD in South Africa holds that the three core departments to the provision of ECD services are the Departments of Social Development, Education and Health, the state of ECD in country suggests that the collaboration between these three departments has not been able to redress the key challenges hindering the successful preparation of young children for basic education.

  o **Recommendation:** As per the findings of the Worcester Polytechnic Institute (WPI) Cape Town Project Centre in 2013, there are three cornerstones of successful ECD. The effective collaboration between these cornerstones is critical in efforts to create an environment for children to reach their full potential.
Reflection 2: Creating an ECD-focused agency and increasing practitioner capacity

- **Challenge: South Africa lacks a central ECD-focused agency** - South Africa currently lacks a central agency to co-ordinate and drive programmes for young children that tackles the inter-related challenges of poverty, nutrition and the provision of education. The need for an agency is reiterated by Ntjantja Ned, ex-CEO and a trustee of the Hollard Foundation, who maintains that the country needs an agency to manage ECD because it requires focus, combination of skill sets that are currently not evident in the government departments responsible for ECD, it requires specific powers and accountabilities that the current provisions in the ECD policy cannot fulfil due to bureaucratic processes.

  - **Recommendation:** South Africa has to create a dedicated agency for ECD through learning from to other countries who have established agencies for this level of education. This agency should be independent and work to exclusively serve the needs of the children. An example of such a country who has created similar agencies is Mexico’s Oportunidades Programme (previously called Prospeera) that has made strides in addressing challenges surround nutrition, education, health and monetary poverty. The programme has especially been able to reduce income poverty in rural areas of Mexico.

- **Challenge: Developing ECD practitioner capacity** - There is a need for qualified ECD educators as the majority operating in centres across South Africa are underskilled.

  - **Recommendation:** There should be measures to track unqualified ECD practitioners so that they can be trained and developed to the necessary level. The quality training of practitioners is one of the most important interventions to raise the quality of interactions with children in ECD centres. One way of increasing the quality of practitioners is through making the sector more attractive for talented youth and graduates. Ntjantja Ned asserts that with the high rate of youth and graduate unemployment, government needs to tap into this pool of potential and harness it into the ECD space. These should be young people who are passionate about working with children and have an appreciation for developing their social and emotional skills competencies.
Reflection 3: Integrating technology at the ECD level

- **Challenge: Introducing and using technology in ECD centres** - The careful use of technology by ECD practitioners, parents and young children can initiate the development of critical skills, such as self-expressions, play and logic. Through thoughtful identification of what is developmentally appropriate for children in terms of technology, children are able to use technology to explore new worlds and engage in challenging and fun activities. Introducing good quality and affordable technology at the ECD level in South Africa remains a key challenge, especially in light of a misaligned curricula, insufficient infrastructure and inadequate training of practitioners.

  o **Recommendation:** Research into how other countries with similar developmental challenges to South Africa improved their ECD sector in tandem with using technology to initiate early learning is necessary. There is also a need for research existing technological tools built for education and how they can be tailored for the South African context. It is important for the technological tools to be used in tandem with learning resources such as LEGO blocks, for example, because children learn through exploration. A lack of resources, technological or otherwise, will limit their ability to learn.

  o **Recommendation:** ECD practitioners have to be trained on how to use technological tools to promote different ways of learning. It is important for these practitioners to keep in mind the varying development levels of children, carefully considering what will necessitate healthy childhood development and how using technology can aid young children in achieving learning outcomes.

The Department of Education in the USA is utilising the following guiding principles for using technology in the early learning environment:
Guiding principle 1: Technology when used properly can be a learning tool

Guiding principle 2: Technology should be used to increase access to learning opportunities for all children

Guiding principle 3: Technology may be used to strengthen relationships among parents, families, early educators and young children

Guiding principle 4: Technology is more effective for learning when adults and peers interact or co-view with young children

- Technology that is developmentally appropriate can help young children grow and learn – particularly when ECD practitioners and parents play an active role. Young children can use technology tools to play, solve problems and create make believe worlds.

- Technology is able to complement and extend learning in ways that would not have been easily achieved – only when used appropriately by young children with guidance and modelling from ECD practitioners and parents.

- Research on children’s media usage has demonstrated that children learn more from content when ECD practitioners and parents watch and interact with children – encouraging them to make real-world connections. Although technology such as tablets and smartphones have been designed to be handheld and individualised instead of shared experiences, children can benefit greatly when parents are actively involved when children use these devices.

- Relationships can be enhanced and strengthened between children, adults and practitioners when distance or other barriers, such as health issues, prevent in-person interaction.

Recommendation: Integrating technology at ECD level should not be at the expense of 21st century soft skills that are critical for young children to develop. ECD practitioners and parents should develop technological skills of young children simultaneously with developing emotional and relationship building skills.
2.3. Primary and Secondary Education

2.3.1. Overview

Since the birth of democracy, education in South Africa has seen fundamental reforms to the administration, governance and funding thereof, and a united national Department of Education was established with considerable responsibility entrusted at provincial levels.\textsuperscript{xcvii} The sector underwent a reorientation that encompassed a transformation from knowledge accumulation to an increased focus on creative thinking and problem solving, as well as a redirection of public spending to disadvantaged children. The South African government allocates a large budget to education, with US$ 17.3 billion (R262.4 billion) pledged to basic (primary and secondary) education alone for the next financial term.\textsuperscript{xcviii}

Despite these efforts, South Africa is considered to be a country with one of the worst education systems in the world, where it is estimated that children lag behind in comparison to those in poorer parts of the continent. Approximately 27\% of South African learners who have attended school for at least six years cannot read, contrasted to 19\% in Zimbabwe and 4\% in Tanzania.\textsuperscript{xcix} The education system in South Africa is said to be in a state of crisis, with high rates of enrolment each year yet progressively poor Grade 12 outputs.\textsuperscript{ci} Even when learners do reach their final year of formal schooling, they are less likely to qualify for a tertiary education than in other countries. The high levels of inequality in education is plagued by poor quality teaching, leaving learners disadvantaged and unprepared for life after school.\textsuperscript{ci}

![Education Enrolment at Varying Ages](image)

Figure 16: Rates and types of education enrolment in South Africa (2018)

Data courtesy of the General Household Survey

The lack of an adequately educated workforce impacts the stagnant economic growth in the country, where education serves as a robust predictor of labour market outcomes in terms of employment and earning potentials. Furthermore, educational specialists are finding that the skills learners acquire within school are mismatched with the skills needed in the workplace. Learners entering the 21\textsuperscript{st} century workplace are increasingly expected to have versatile and varied understanding of contents from different disciplines, be able to work collaboratively with partners and, above all, be able to work meaningfully with digital tools.

Notwithstanding the National Curriculum and Assessment and Policy Statement (CAPS) adhered to by government schools, which is said to be premised on promoting higher order thinking in learners,\textsuperscript{cii} research demonstrates that the CAPS curricula have not been able to remedy poor academic performance and lack of
preparation for the workplace. Education was thought to be the solution that keeps the youth away from the poverty trap, however, under the current educational system in South Africa, this seems less likely to happen.

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<td>NC</td>
<td>86%</td>
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<tr>
<td>FS</td>
<td>80.3%</td>
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<tr>
<td>KZN</td>
<td>80.5%</td>
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<tr>
<td>NW</td>
<td>80.5%</td>
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<tr>
<td>GP</td>
<td>54.8%</td>
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<tr>
<td>MP</td>
<td>87.7%</td>
</tr>
<tr>
<td>LP</td>
<td>92.2%</td>
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<td>77.3%</td>
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</tr>
<tr>
<td>EC</td>
<td>12.7%</td>
</tr>
<tr>
<td>NC</td>
<td>8.6%</td>
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<tr>
<td>FS</td>
<td>12.6%</td>
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<tr>
<td>KZN</td>
<td>7.4%</td>
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<tr>
<td>NW</td>
<td>1.3%</td>
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<tr>
<td>GP</td>
<td>6.7%</td>
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<tr>
<td>MP</td>
<td>4.5%</td>
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<tr>
<td>LP</td>
<td>6.8%</td>
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<tr>
<td>EC</td>
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<td>15.3%</td>
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<tr>
<td>KZN</td>
<td>15.3%</td>
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<tr>
<td>NW</td>
<td>17.5%</td>
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<tr>
<td>GP</td>
<td>7.4%</td>
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<tr>
<td>MP</td>
<td>17.2%</td>
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<tr>
<td>LP</td>
<td>19.7%</td>
</tr>
<tr>
<td>RSA</td>
<td>13.8%</td>
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</tbody>
</table>

Table 2: Provincial comparison of educational indicators in South Africa (2018)
Data courtesy of the General Household Survey

2.3.2. Key influencing factors and trends at primary and secondary levels

2.3.2.1. Teacher quality and training

Despite South Africa having trained more new teachers over the past decade than ever before, the country still experiences shortages of relevantly skilled teachers. It is estimated that the country needs between 20,000 and 30,000 newly qualified teachers to replace those that are leaving the system in tandem with those who can keep the current teacher-learner ratio steady. The low quality teacher training is also a key challenge hindering the improvement of the country’s education sector. Other research found that approximately 79% of South African Grade 6 mathematics teachers were classified as having content knowledge below the level at which they were teaching. The low content knowledge could account for the fact that half of South African learners who have attended school for five years cannot do basic calculations. Simultaneously, it has been estimated that 10% of the country’s teachers are absent from school each day.

Robinson (2019) posits that if more is to be expected from teachers, they should not be allowed into the classroom until they have met a basic set of criteria. She writes that teachers should be held to account when they fall short. It is the only way to improve the quality of teachers, the author suggests. There are two contributing factors to this occurrence: firstly, teachers often choose their profession due to a lack of any other options; secondly, teachers undergo inadequate training, with little to no practical engagement in classrooms or lecture rooms, in turn creating an unstable teaching and learning environment. Teachers are also misallocated, with some being allocated to subjects that they are not qualified in.

Teacher education and training is highly variable but generally insufficient. Robinson (2019) references a study that found that three out of five higher education institutions that were sampled provided no English language, literature or linguistic education for teacher trainees who were not specialising in the subject. This is despite the poor English language proficiency amid teacher trainees being a concern. It is, therefore, unsurprising that research on newly qualified teachers demonstrates that learners enter their studies with substantially poor skills.
Resultantly, their learners do poorly and resort to teaching because they perceive the profession as a low status career, exacerbating the problem. Teachers in South Africa are also not properly trained to use technology, although it is imperative that the educator knows exactly how to integrate technology with the curriculum objectives.

Focusing on teacher development aimed at technological enhancement within rural developing context has been especially challenging. There is also a lack of teacher development programmes specifically designed to enrich rural teachers’ classroom practices.

### 2.3.2.2. Inadequate infrastructure and resources

Infrastructure and resource constraints continue to hinder the delivery of quality of education at many schools, especially those in rural areas. Notwithstanding the significant strides that have been made in the availability of textbooks and workbooks, the issue of access to resources is still far from being resolved. In 2018, a general household survey published by the Department of Education reports that close to half a million learners complained about not having textbooks, a problem that is more pronounced in some provinces than others.

In May 2013, a Google search on conditions and infrastructure in South African schools showed results of banner headlines from newspapers, such as: “forgotten schools of the Eastern Cape left to rot,” “schools to be fixed,” and “technology in rural school is not a magic bullet, but it is a good start.” These news headlines epitomised the dire conditions in rural schools. Despite the changes that South Africa has seen since the new dispensation in 1994, there are still major problems confronting rural schools, with poor classroom infrastructure being a perpetual problem. Khumalo and Mji (2014) assert that problems related to infrastructural development were inherited from the apartheid era. People who lived and attended schools in rural areas were more neglected by the system.

Veriava (2012) postulates that the juxtaposition of schools without classrooms or basic services (dubbed ‘tree schools’) and the historically white former model C schools with their multiple sports fields, well-equipped libraries and laboratories highlights the persistent infrastructure inequality in public schools. Amid these extremes exists a broad spectrum of schools, from traditional mud structures and township schools to urban and suburban schools. Veriava (2012) argues that the latter also function in varying states of disrepair, but they receive lower state allocations than they should because they are perceived as serving middle-class communities. This has occurred because of an assumption that neglects the reality that urban and suburban
schools accommodate poor pupils who periodically have to commute from the township to the suburb. The limited access to quality teaching-learning resources, resulting from the merging of schools, also adds to the crisis. Though implemented to promote effective use of resources, the merging of schools only saves the costs of maintenance of buildings, while putting pressure on other learning and related resources, like libraries, teaching-learning technology and transport to schools.

The importance of infrastructure in the learning and teaching context cannot be underestimated. Good infrastructure enables students and teachers to access a wide range of tools, resources and services that support teaching and learning. In the context of technology, technological infrastructure affords teachers the ability to use technological tools for teaching and administrative tools. However, this can only be enabled where basic infrastructure exists. The lack of electricity in a school will render virtues of technology useless. The realities of rural life related to infrastructure and the lack of basic facilities also play a negative role in attracting suitably qualified teachers to teach in rural schools.

Notwithstanding the need for good infrastructure, it is important for different stakeholders in education to innovate ways in which to deliver a 21st century education for learners in disadvantaged areas. This has been exemplified by the Molo Mhlaba low-fee private school located in the township of Khayelitsha. In the midst of escalating crime rates, inequality and poverty, the school is responding to the township’s greatest challenge; the lack of availability of schools with quality teaching and learning. Molo Mhlaba offers quality education to young girls in Khayelitsha in collaboration with the Thope Foundation. The school not only prioritises a mother-tongue based bilingual approach – Xhosa and English – but also focuses on teaching iSTEAM (innovation, Science, Technology, Engineering, Arts and Mathematics) to young girls. In addition, the school curriculum is founded on exploratory learning, using CAPS as a starting point. Through utilising the Montessori approach to learning and teaching, learners at Molo Mhlaba school are encouraged to self-direct learning and collaborate – making it an engaging and creative learning environment. The school recognises the environment in which it operates, and as such, provides learners with two nutritious meals a day.

2.3.2.3. Pass rates are significantly low

The current grading system in South Africa makes the barrier between success and failure one of the lowest in the world. With a reputation for having a poor education system, especially in mathematics and science, the country’s low pass marks are often cited as one of the biggest problems as it sets the bar considerably low in assessment – a fail at 29% average and an elementary pass mark at 30% average. However, conditions are somewhat more complicated than sustaining a 30% average as a bare minimum. More precisely, learners have to get the following marks in order to pass:
South Africa’s grading system is markedly different in comparison to the rest of the world. Standard pass barriers around the world can be divided into three main levels: 40% in countries like Ireland, the UK and Japan; 50% is the barrier between a pass and a fail in countries like Canada, Australia and many European countries; 60% in countries like China, the Netherlands and US.\textsuperscript{cxxviii} South Africa’s pass mark is on the lower side of the exceptions, alongside countries like India, where a fail can be anything below 33%, and Myanmar where the failure mark is set at 29%.\textsuperscript{cxxx}

To provide some additional context, with the country’s pass mark of 30%, the 2017 matric class passed with a rate of 75.1%. However, if the pass mark was 40%, this rate would have been reduced to 54%. Just a third (33%) of matric students accomplished a 50% average.\textsuperscript{cxxi} The pass levels across 11 matric subjects written in 2017 is demonstrated in the graph below.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure17.png}
\caption{Matric pass requirements in South Africa across three pass levels}
\end{figure}

\textit{Data courtesy of Parent24}\textsuperscript{cxxviii}
Similar stark differences can be seen across accounting, economics and mathematics pass rates, drawing from 2018 results:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Proportion of learners passing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30% pass requirement</td>
</tr>
<tr>
<td>Accounting</td>
<td>72.5%</td>
</tr>
<tr>
<td>Economics</td>
<td>73.3%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>58%</td>
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The low pass mark does not adequately prepare learners for tertiary education, which is one of the purposes of the National Senior Certificate (NSC). Although tertiary education is not for everyone, it is important that the education system produced talented matriculants that can be trained to provide the high level skills that the country needs for its broader society and economy. In its current state, South Africa’s education system is not able to produce the skills and competencies necessary to bring the country out of its economic stagnation. The education system has resulted in inequalities in the return of skills, unemployment and low labour income and productivity in the self-employed informal sector. Ngozo and Mtantato (2018) further theorise that the education in South Africa can be characterised by two schooling systems: one is for the minority wealthy segment of the population, which is functional and equips pupils with necessary skills; the other is for the majority poor population that is dysfunctional and ill-equipped to provide pupils with the knowledge they should be acquiring at school. For the latter schooling system, learners’ talents and abilities remain undeveloped, limiting their access to economic opportunities.

2.3.2.4. Integrating technology into the curriculum

The role of technology in improving teaching and learning has been well documented. Although technology is not a remedy for all educational problems, it is able to offer the potential of advancing students’ knowledge and skills, encouraging autonomous and co-operative learning. Technology can help learners to engage in
independent learning to solve their own problems through learner-centred hands-on facilitation and diversified continuous assessment. The use of technology in education has the ability of adding value to the curricula and to transform learners into knowledge instructors. Integrating technology into education can also encourage learners to construct their own ways of learning while generating knowledge and skills that come with utilising new technologies. Despite these opportunities brought about by technology in education, many South African schools are still without access to adequate technological infrastructure and tools. In addition, schools that do have computers and other technological infrastructures tend to limit the use of technology, focusing on acquiring computer skills rather than integrating technology into the classroom.

Amid the many inhibitors when it comes to executing technology education in South Africa, a lack of access to and the availability of technological tools like the internet, computers and curriculum materials are at the top of the list. Additional factors found to inhibit implementation are educators’ lack of clarity about these innovations and their lack of skills and knowledge needed to be technological role models; the incompatibility of organisational arrangements with these innovations; and a general lack of motivation among educators and support staff. Another common hindering factor, as noted by the World Bank, is that:

“... many models, expertise, and research related to ICT [used] in education come from high-income contexts and environments (typically urban, or at least peri-urban). One consequence is that technology-enabled ‘solutions’ are imported and ‘made to fit’ into more challenging environments. When they don’t work, this is taken as ‘evidence’ that ICT use in education in such places is irrelevant – and possibly irresponsible.”

Even with the many challenges hindering the implementation of technology in education, companies who are working to introduce technology into the curricula have managed to positively impact the quality of education in rural schools. An example is Inspireware, who has been able to successfully integrate technology in the curricula of over 350 suburban, rural and township schools in South Africa through the use of a smartboard called InspireBoard. The smartboard is a fully interactive touchscreen whiteboard that has all the functionality and versatility of a computer. The syllabus is easily observed in a pragmatic way through the use of predesigned PowerPoint presentations, computer applications and learning games, thereby captivating and retaining students’ attentions. InspireBoard is able to bring static diagrams and books to life, with learners becoming active participants as they are encouraged to come up to the smartboard and engage with it. The interactive InspireBoard does require broadband to function and has its own built-in software that can be used to enhance teaching in the classroom.

Inspireware uses interactive, engaging content with animations, games, simulations and assessments via interactive digital content. Multimedia content is a teaching tool assisting teachers to expound difficult concepts in mathematics and science in a way that is exciting. The interactive content is developed in line with the South African National Curriculum Statement (NCS) in tandem with CAPS and covers all the Learning Outcomes and Assessment Standards. Inspireware believes that teacher development is important, and as such, offers SETA accredited courses and tailor-made packages. The training ranges from refresher and advanced courses, to monitoring and reporting related uses, and sustained use of curriculum supporting methods. Teachers who attend the training also receive a certificate of attendance.
“When I went to these schools, all of them had 25 PCs, but you’re sitting with realistically over 100 kids in the class. I mean, where we were at one of these schools, the desks were 74 desks with two children per desk, so that’s 148 kids in a Grade 12 maths and science class. Now, it was deep Limpopo, there was no doors and windows, and we had goats walking in and out of the classrooms. ... This was the reality of most of the schools that I have been to. ... Let’s not waste money on computer labs, let’s rather take that money, put it in a laptop, one interactive board in that classroom and a projector that you can pull down. ... [It’s about] having the content so that the child has to come up and touch, double click and see a simulation and answer and do a little game. ... It is very much the way that kids now get up off their chair, they’re now moving, they’re now doing, and they are moving as they are doing, and so they are not switching off.”

Linda McGhee
Managing Director and Founder, Inspireware

In a poorly resourced school in rural Kenya, 2019 Global Teacher Prize Winner Peter Tabichi uses technology in 80% of his lessons. Though the learner-teacher ratio in the school is 58:1, with the majority of students coming from poor families, Tabichi believes that technology can facilitate good pedagogy and provide learners with a window to the world. He uses technology in a myriad of ways, from recording videos of their science projects with his smartphone to downloading teaching content from the internet. Through innovating how his lessons are delivered, Tabichi’s learners’ achievements in school and attendance in lessons have improved.

There is a need for governments to work in building the capacity of teachers around educational technology and ICT. This is done through understanding the limitation of their educations systems’ infrastructure and their teachers’ capacity to utilise technology. The following has been recommended by the Varkey Foundation, a foundation dedicated to improving the education standards for underprivileged children:
The successful integration of technology into curricula requires engagement between a range of stakeholders, including the relevant departments of education, curricula developers, innovators in developmentally appropriate technological tools and teachers. All stakeholders need to have a common understanding of what the various curricula aim to achieve in tandem with the kind of technological interventions required to achieve them. To avoid the undesirable consequences of delayed or failed implementation, it is important that curricula incorporate technology and be examined in the classroom that often takes many contrasting contexts in South Africa.

2.3.2.5. Government’s recent introduction of new subjects

In its efforts to respond to the growing workplace skills gaps and poor state of basic and tertiary education, the South African government has recently made a move to help align the curriculum with the skills requirements of the 21st century — a critical part of governance in the context of education. Minister of Basic Education, Angie Motshekga, announced during her 2019/2020 Basic Education Budget Vote Speech that the department has developed a Grade R-3 and Grade 7 Coding and Robotics curriculum; and that these would be piloted at 1,000 schools across five provinces from the start of the 2020 school year.

Minister Motshekga noted that:

"Curriculum developments in the basic education sector are advancing at a rapid pace as we move swiftly to meet the global trends in digital and ICT education to prepare and skill our learners for the demands of the current and future economy. ... We have also begun the process of transforming our curriculum by introducing new and existing skills-based subjects."

In addition to coding and robotics, other new technology subjects and specialisations will be introduced, including:

- Technical mathematics
- Technical sciences
- Maritime sciences
- Aviation studies
- Mining sciences
- Aquaponics
Although the introduction of these new subjects and the plan to do so in a staggered, strategic way through pilot implementation is encouraging, teachers have raised concerns, such as these expressed through the website www.parent24.com:

“I teach. I find grade 4s who can’t read properly and don’t understand what they are reading. I find grade 12s who can’t add fractions. How on earth are they going to learn programming and coding without these basic basic skills.”
(Teacher Celeste)

“I am pretty sure us as rural school teachers will be exposed to such after 5yrs because when implementing such transformations a child is never prioritised. They are the ones making big in life regardless of obstacles and teachers will be trained and workshoped for 2 days. That is the story of us rural teachers.”
(Teacher Phindy)

“I am a teacher and this is the first I hear about this? When are they going to start training us? Where are we going to find the extra teachers and the extra money to pay them? Get the basics right before launching into this head-on!”
(Teacher Carin)

There are indeed various key considerations that Government need to take into account during the rollout of these new subjects, and more generally, in future changes to the curricula. According to University of Western Cape Senior Lecturer Dr Mmaki Jantjie, there are five core elements that need to be in place for effective rollout:

1. Infrastructure
2. Teacher training and support
3. Localised learning content
4. Technical support
5. Safety and security

Although indicating a negative-leaning response, survey respondents were relatively non-committal when asked if new 4IR-focused subjects would be effective in South African schools, as only 14% opted for the extremes of “Not at all effective” (10%) and “Extremely effective” (4%). Almost 40% of respondents thought that these new subjects would be moderately effective, however, an almost equal proportion of the sample (37%) believed the new subjects to be only slightly effective in addressing education gaps relating to the 4IR.
Figure 22: Survey data on the effectiveness of new 4IR subjects in RSA curriculum

“The South African government plans on introducing technology-focused subjects (e.g. robotics, artificial intelligence) into the school curriculum. How effective do you think this plan will be in preparing students for 4IR?”

2.3.3. Reflections, challenges and recommendations

Reflection 1: There is a need to improve teacher quality and training

- **Challenge: Practical ways for improving teacher training** - As it has been demonstrated, teacher quality and training in South Africa remain poor. The quantity and quality of teachers is considerably low. Many school children are being taught by teachers who are not qualified. Teachers have insufficient knowledge on the subject they are teaching, with learners bearing the brunt of this reality.

  - **Recommendation:** The teaching sector has to be made attractive in so far as increasing the teachers’ remuneration and creating a myriad of opportunities for growth and development. Government should also consider reopening teacher training colleges that were closed following the country’s transition into democracy. There needs to be collaboration with different stakeholders on how to improve teacher training. The colleges should be operated in collaboration with universities that have demonstrated commitment and successful implementation of educational technology and innovation.

  - **Recommendation:** Government has to increase the skills, knowledge and competencies of teachers through continuously training and retraining. Implementation of in-service training and re-skilling to enable teachers to “keep up” with digitisation and related technological trends will help to improve the quality of teaching.

  - **Recommendation:** A peer-mentoring system should be implemented in all provinces to support teachers who have been in the system for several years. Teachers that show commitment in the training should be recognised, appointed as mentors and incentivised.

  - **Recommendation:** Learning from and expanding upon successful piloted programmes/interventions on improving teacher quality and basic infrastructure, particularly in rural schools, such as the Kagiso Trust Beyers Naude School Development Programme

Reflection 2: Low pass mark is inadequately preparing learners for post school study and work

- **Challenge: South Africa’s grading system is reproducing socio-economic inequalities as it fails to prepare the majority of learners for post school education and work** - At the current pass mark of 30% and 40%, depending on the subject, learners are not being prepared for post school learning and work. The education system is failing the economy, with learners leaving school with poor skills and work-related competencies.

  - **Recommendation:** Improvement in the quality of education, especially its delivery and assessment approaches, is one way to improve the pass mark. Another is to simply raise the pass mark to 50% so that learners are motivated to work harder in order to pass.

  - **Recommendation:** Improving the performance of learners should not rest solely on the shoulders of government and teachers, parents need to play a more active role in their children’s education through encouraging and motivating their children to focus and work hard to achieve good marks.
Reflection 3: Using technology to improve teaching and learning

- **Challenge: Ways of integrating technology into the curriculum** - Given the widely discussed advantages of instructional technologies in the classroom and the need for a technologically skilled workforce, a challenge is to find ways to promote the use of those instructional technologies while taking into account contextual challenges, such as the available infrastructure. Further, technology needs to be fully integrated into the curriculum, not just through the use of instructional technologies but also by ensuring that learners and educators are competent technology-users.

  - **Recommendation:** There needs to be research and development into instructional material specific to how technology can be integrated into the classroom. This should be complemented by research aimed at deciphering the technological needs that are specific to urban and rural schools. South Africa should learn from other African nations who have successfully integrated technologies in their education system.

  - **Recommendation:** The government needs to allow development of strategies and adoption approaches enhancing critical skills in our schools. Most of these approaches centre around inquiry-based science education (IBSE).
CASE STUDY:
Kagiso Trust’s Beyers Naude School Development Programme

Kagiso Trust is a development agency that collaborates with government and partner organisations to address important problems in education. The agency’s commitment in education programmes is to strengthen and replicate education programmes from ECD through to tertiary opportunities. Kagiso Trust has developed proven education models over the past 30 years that have delivered long-lasting results for learners – one such model is the Beyers Naude School Development Programme. 

Piloted in 2004, the Beyers Naude School Development Programme (BNSDP) was a school development programme first implemented in the Vhembe district of Limpopo. 

The goal of the programme was to establish good governance and management principles that would form the foundation for the long-term success of schools. The programme was also aimed at restoring the culture of teaching and learning in schools in tandem with developing functional and sustainable relationships amid key stakeholders within school communities. It provides basic infrastructure to rural schools and ensures quality education by providing expertise to empower teachers and learners, and develops leadership capacity in teachers, learners and parents. The programme was extended to 10 schools in the Free State’s Thabo Mofutsanyana district in partnership with the Free State Department of Education in 2007.

Kagiso Trust’s interventions through the BNSDP in rural and township schools in the Free State has resulted in several schools achieving a more than 90% matric pass rate. The Free State’s performance has been consistent since the inception of the BNSDP. While the national pass rate stood at 78.2%, Free State received 87.5%. The Trust’s partnership with the Free State’s Department of Education has also resulted in an improvement in matric results in a number of districts such as The Fezile Dabi, Xhariep and Maluti-A-Phofung districts which scored more than 92%. There were also recorded improvements in the Motheo district and Thabo Mofutsanyana, where 25 of the 56 Free State schools scored a 100% pass rate. The province achieved more than 70% in all gateway subjects, including mathematics, accounting, and physical science.

The DWSD education model is now replicated in Limpopo Province at Sekhukhune focusing on Riba Cross education district. This education model has also been implemented in Motheo and Fezile Dabi by Kagiso Shanduka Trust – a partnership of the Free State’s Department of Education, Kagiso Trust and Cyril Ramaphosa Foundation.
2.4. Tertiary and Post-School Education

2.4.1. Overview

Post School Education and Training (PSET) in South Africa is “located at the nexus between the formal education system and the workplace”, and refers to all learning and teaching that happens after school, which includes a variety of institutions such as public universities, Technical and Vocational Education and Training (TVET) colleges, private institutions, apprenticeship programmes, Sector Education and Training Authority (SETA), and the National Skills Fund (NSF).

A common mandate for the various institutions and entities that make up PSET is to “ensure that those entering the labour market are qualified and competent to take up employment and income generating opportunities that exist and that will exist as the economy grows and changes in the future”. Research over recent decades has shown decisively that countries without successful post-secondary institutions will fall behind in the global knowledge economies of the 21st century. Because young people with a college or university qualification are significantly more likely to be employed than those without, a successful tertiary and post-school education sector is essential for thriving societies and well-functioning economies. Post-school education attainment directly affects the labour market as young people without work-relevant skills will struggle to find employment, reinforcing social and income inequality.

Improving tertiary education enrolment and graduation rates is essential if the country is to address its increasing skills gap and increasing unemployment levels. Millions of young people in South Africa are unemployed or underemployed, whilst employers have jobs that they cannot fill. Stats SA has recently published unemployment figures for the second quarter of 2019. The number of young people (aged between 15 and 34) not in employment, education or training, has risen from 39% to over 40%. Overall unemployment rose from 29% in the first quarter of 2019 to over 30% in the second quarter. Compared to the same time the previous year, unemployment rose by 9.4%. Owing to rising unemployment rates, the workplace in South Africa continues to be characterised by low productivity, a slowly transforming labour market and the lack of mobility of the workforce.

After 1994, the post-school education sector needed to restructure and consolidate the highly fragmented and unequal system that apartheid left in its wake. One of the key difficulties facing the higher education sector today is the enduring inequality among formerly racially segregated schools, and the interdependence of tertiary, secondary and primary education; dysfunction in one area ripples outward to affect the others. The White Paper on Higher Education, titled ‘Building an Expanded, Effective and Integrated Post-school System’, stresses the importance of the integration of various forms of higher education into a more co-operative body of learning. Its main policy objectives include the development of a fairer and more equitable education system,
improvement of quality, and a stronger relationship between education and training institutions and the workplace.\textsuperscript{237}

The overall goal of higher education today should be to foster deeper engagement between educational institutions, the market, industry and society in order to move forward in a more equal and socially just way. As the South African Department of Higher Education and Training (DHET) states:

"The true meaning of transformation [is] when all students entering the system have a reasonable chance of success and access to powerful forms of knowledge and practices that will enable them to enter the productive economy and improve their life chances and that of their families."\textsuperscript{238}

More young people are becoming discouraged because they are unable to find job.

2.4.2. Key influencing factors and trends at the tertiary and post-school level

2.4.2.1. Expanding access to further education

South Africa is experiencing growing pressure to expand the post-school education and training system, and to enrol prospective students in higher institutions of learning, including at TVET colleges and sector community colleges.\textsuperscript{239} Despite the obvious benefits of studying after school, and many young South African aspiring to do so, only 8% of youth aged 15 to 24 are in any type of post-school education.\textsuperscript{240} DHET has mandated to increase access to post-school opportunities, both for learners who have successfully matriculated from high school, as well as for those who have not achieved their grade 12 certificate. DHET has stated that it plans to increase higher education enrolment numbers in public and private institutions to 1.62 million by 2030.\textsuperscript{241} Although gains have been made in the provision of greater access to higher education, growth in enrolment numbers has not translated into equity, and the system remains fragmented.

Increasing access to higher education is also constrained by financing. The majority of students in South Africa cannot afford student fees as they are beyond the reach of the average South African household income.\textsuperscript{242} Even with the National Student Financial Aid Scheme (NSFAS) in place, the majority of students with household incomes between R120,000 and R600,000 – dubbed the “missing middle” – are excluded. The financial impact of accessing higher education was reiterated through the #FeesMustFall movement in 2016/2016 where student
protesters put pressure on the state to expand access to public universities through ‘fee-free’ education. Since then, South Africa’s post-school sector has remained caught up in debates on fair and equitable access to education, which is heavily premised on access to finances. Post-schooling tuition costs are substantial and are out of reach for many without the NSFAS. Although NSFAS is well established, the demand far exceeds the funding available.\textsuperscript{clxvii} Following a presidential Fees Commission of Inquiry to explore the feasibility of fee-free higher education and training, the government announced substantial additional funding to support poor and working-class students from families with a combined income of lower than R350,000 per annum. New funding was introduced for first-time entry students in 2018 and continued for first-time entry students in 2019.\textsuperscript{clxviii} South Africa remains at a critical crossroads while the sustainability and viability of The Treasury’s funding of a phased-in approach to fee-free higher education is still to be determined.

Furthermore, access to higher education is disproportionately affected by a range of other factors such as prior schooling, socio-economic status, geographical location (e.g. urban/rural), language, and other features that constitute the social and cultural capital that students bring with them to university.\textsuperscript{clxx} Many learners from rural areas continue to be excluded from participating equally in higher education on these grounds. The effects of rural areas being deprived of resources under apartheid’s sub-division of the country are still being felt today, both in terms of development and education. Learners from rural areas remain disadvantaged in terms of access to higher education as gaps in students’ skills and knowledge prevent them from entering and succeeding in higher education. Notwithstanding the increase in enrolment into higher education institutions, rural students remain underrepresented in these enrolment rates.\textsuperscript{clxxi}

Figure 12 indicates the extent to which barriers to entry into tertiary education hampers access, with the over 45% of students across all age groups affected by financial constrains to attend tertiary education. This will mean these group will miss out on the introduction of 4IR oriented curriculum for future skills, subsequently exacerbating the digital divide.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{reasons-not-attending.png}
\caption{Reasons for not attending educational institutions, Ages 18-24 (2017)}
\end{figure}
2.4.2.2. Calls for decolonisation

The call for a decolonised education has been a cornerstone of student protests over the past few years. Students across universities mobilised on the basis of their demand for free education in tandem with a demand for drastic changes to university course material and curricula. With the dubbing of the university knowledge systems as “Eurocentric”, sexist and racist; students argued for a decolonised education system that would provide them with the kind of educational access necessary for addressing an “African-centred humanness”.

Calls for decolonisation are embedded within the idea of an “African Renaissance”. Whilst there is growing consensus amongst academics, administrators and students about the importance of transformation and decolonisation of the curriculum, questions as to how these notions are to be conceptualised and ultimately implemented, remain contested. Mgqwashu (2016) contends that decolonising curricula is not about replacing the work of European and Northern thinkers with local theorists and African authors; but instead, it is far more nuanced than that. To encompass a broader and more relevant educational experience, universities should first define their approach to development and dissemination of curricula. Mgqwashu (2016) postulates that it is only once this has been done that we can proceed with the process of decolonisation.

In November 2016, the university council of Stellenbosch commissioned its management to investigate the meaning of decolonising the curriculum and make recommendations on how the university should respond. Stellenbosch University defines decolonisation as ‘removing the notion that content or knowledge of colonising countries (especially European/Western countries) is superior to that of colonised countries and communities’. Professor Arnold Schoonwinkel, the vice-rector for learning and teaching at Stellenbosch University, contends that decolonisation does not mean that the university is entirely changing the curricula, or rather “not chucking out everything that has been working well and replacing it with something else”. In speaking about the approach Stellenbosch University has taken, Professor Schoonwinkel relates that the university has decided to supplement the knowledge, research and perspectives from Western countries with those from South Africa and Africa – utilising African content alongside transnational and international content.
2.4.2.3. Overlooking TVET pathways

The current decade has seen a significant return of interest in workplace training and TVET institutions as overburdened higher education systems are no longer adequate in preparing young people for the workforce. According to the United Nations Agenda for Sustainable Development, equal access to affordable and high quality TVET is a target of the Sustainable Development Goals (SDGs) agenda, together with a commitment to substantially increase the number of youths and adults with the relevant skills for employment, decent jobs and entrepreneurship by 2030. Focusing on day-to-day duties involved with a specific trade, craft or profession, TVETs offer an important alternative to university for improving education and skills development. The goal of vocational education and training is to fill existing skills gaps, boost productivity and enhance industry employment.

Successful TVET institutions could help a country like South Africa to reach its national development goal of decent employment, while supporting inclusive growth by creating a capable workforce through skills development. South Africa’s Department of Basic Education, aligned with the National Development Plan, has proposed the introduction of a ‘Three Stream Model’. This model offers learners three distinct pathways towards further education or training; namely: academic, vocational and occupational, recognising that learners have distinct talents and thus aligning this with society’s range of needs.

On the ground however, the current configuration of the schooling curriculum caters for learners who are academically inclined, leaving learners who are vocationally or occupationally talented with few options. Currently, 40% to 50% of learners leave the education system before reaching matric; as a result, the cohort matric pass rate is around 40%, which means that about 60% of learners are currently not completing their ‘academic’ education. Whilst the Three Stream Model tackles this challenge, work still needs to be done. Despite a government target of seeing 2.5 million young South Africans enrolled at TVET colleges, less than 800,000 students are currently registered. Compared with the country’s nearly 1 million university students, and a significant percentage of youth not attending any tertiary institutions, it is clear that much work is needed in this area.

2.4.2.4. The 4IR and transforming education

Changes driven by the 4IR have heightened the need for innovation to ensure that education remains relevant. South Africa struggles with an ever-widening mismatch between the skills acquired through school training and the needs of an employer, which threatens to become even wider as technology transforms business and jobs faster than employees can adapt. The problem of slow economic growth will only be exacerbated as South Africa stands to lose 41% of its jobs to automation and increased use of information and communications technology (ICT). Whilst it is likely that relatively low labour costs and new job creation will offset this loss, the country’s capacity to adapt to further job disruption is still a top priority. In South Africa alone, it is estimated that 39% of core skills required across many occupations will be entirely different by the year 2020 and two thirds of children today will be working in jobs that have not been invented yet. According to a survey conducted by the World Economic Forum in South Africa, these are the top drivers of change for 2015-2020 in the context of the future world of work.

<table>
<thead>
<tr>
<th>Drivers of change, 2015–2020</th>
<th>Rank</th>
</tr>
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<tbody>
<tr>
<td>Processing power, Big Data</td>
<td>1</td>
</tr>
<tr>
<td>Changing nature of work, flexible work</td>
<td>2</td>
</tr>
<tr>
<td>Middle class in emerging markets</td>
<td>3</td>
</tr>
<tr>
<td>Mobile Internet, cloud technology</td>
<td>4</td>
</tr>
<tr>
<td>Geopolitical volatility</td>
<td>5</td>
</tr>
<tr>
<td>Climate change, natural resources</td>
<td>6</td>
</tr>
<tr>
<td>Sharing economy, crowdsourcing</td>
<td>7</td>
</tr>
<tr>
<td>New energy supplies and technologies</td>
<td>8</td>
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<tr>
<td>Young demographics in emerging markets</td>
<td>9</td>
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<tr>
<td>Rapid urbanisation</td>
<td>10</td>
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<tr>
<td>Women’s economic power, aspirations</td>
<td>11</td>
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<tr>
<td>Internet of Things</td>
<td>12</td>
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<tr>
<td>Adv. Manufacturing, 3D printing</td>
<td>13</td>
</tr>
<tr>
<td>Artificial Intelligence</td>
<td>14</td>
</tr>
</tbody>
</table>
The blend of digital literacy and universal human traits necessary for the 21st century and the 4IR will require much more interdisciplinary training. In addition to previously valued abilities to collect, organise, and evaluate information, the 21st century workplace also requires interpersonal skills such as teamwork, communication, and leadership, in tandem with intrapersonal competencies such as resilience, mindfulness, empathy and curiosity. Successful members of our future labour force will also need to engage innovatively and productively with technology. It has been projected that the 4IR will create a wide range of new jobs in fields such as science, technology, engineering, and mathematics (STEM), data analysis, computer science and engineering. As such, there is a strong demand for tertiary education and other vocational programmes to incorporate learning that taps into these skills.

At present, there are only 11 universities in South Africa offering programmes and modules in the 4IR and related fields of artificial intelligence and robotics. As examples, The University of Johannesburg offers a set of in-depth digital literacy training sessions to first-year students and, The University of Pretoria’s ‘Ready for Work’ programmes help students increase their employability chances. The University of Johannesburg reached a three-year collaboration agreement with the City of Johannesburg Metropolitan Government to create the ‘Digital Ambassadors’ program, under which approximately 3,000 entrepreneurial youths from across the City of Johannesburg will receive dedicated training at UJ via an open-sourced, cloud-based learning management system. However, in a working paper written on ‘4IR and education’, Athambile Masola poses an important question about the compatibility of transformation and 4IR. If ‘4IR is intricately linked to the question of industrialisation, and industrialisation is intricately linked to the history of conquest’, then can we ensure institutes of higher learning keep pace with technological innovations without compromising on questions of justice and redistribution? The paper concludes that until the future is seen as a space for multiplicity and pluralism, innovation will continue to benefit the few, not the many.

The teaching landscape may be changing, especially in terms of where students obtain their content and their ability to self-learn, however, more than half of the survey respondents (54%) indicated that formalised universities will remain as important as they are today. Despite this positive outlook for universities, the shift away from formalised learning is evident in this survey response, where 29% indicated that universities would only be moderately important in the future, and 17% questioned the need for their existence in the education system at all. Many universities are already adapting to this trend, ensuring that their content is available in both
physical and digital formats, however, it remains important that they are able to offer students services and benefits that are not freely available online.

2.4.2.5. Workplace training

Unequal educational attainment directly affects the labour market, as young people without matric and work-relevant skills struggle to join the workforce - reinforcing social and income inequality. South Africa struggles with an ever-widening mismatch between the skills and knowledge acquired by young people through formal education and the needs of employers. This gap threatens to become even wider as technology transforms business and jobs faster than employees can adapt. Millions of young people in South Africa are unemployed or underemployed, whilst employers have jobs they cannot fill. While it is likely that relatively low labour costs and new job creation will offset this loss, the country’s capacity to adapt to further job disruption is still a top priority.

It is within this context that workplace training has become increasingly important and must continue to be prioritised by government (particularly through SETAs) and also the private sector. South Africa’s Sector Education and Training Authority (SETA) consists of organisations across sectors that were established in 2005 to assist in the implementation of the National Skills Development Strategy and to increase the skills of people in their respective sectors. Skills development has been recognised as a key priority under the Amended Broad-Based Black Economic Empowerment (B-BBEE) Codes of Good Practice, and thus businesses must emphasise skills development to meet the sub-minimum requirement for the B-BBEE scorecard. As part of this process, businesses are to develop and submit their Workplace Skills Plan (WSP) to the relevant SETA. This WSP relates to the training and development initiatives that they intend to complete in the following year.

A good WSP is strategically developed around the skills that are needed in an organisation, taking into consideration the current as well as future needs. The plan aims to fill skills gaps that are identified through one or more of the following: a skills audit, the performance management system, succession planning initiatives and/or any new process or technology changes planned for the coming year.

South African companies spend billions of Rands each year on workplace training, but often do not experience benefits that are perceived to correlate with the substantial investment. Factors such as the clarity of the purpose of the training, engagement of employees and comprehensive career pathing are all critical in maximising value and impact. Regardless of whether it is for B-BBEE compliance or purely for the purpose of upskilling their workforce, organisations need to establish training solutions that effectively invest in their employees’ careers while also aligning with their own skills development strategies and priorities. Staying abreast of industry trends is critical in closing the gaps between skills shortages and current and future skills development needs.

2.4.2.6. Schneider Electric’s Contribution to Workplace Training

Schneider Electric South Africa - a leader in digital transformation of energy management and automation systems - has observed a huge need for practical skills development in the field of energy in tandem with the persisting skills gap in the country’s labour market. The organisation has introduced advanced teaching methods and training in line with the Department of Higher Education and Training’s vision of accelerating artisans through the use of state of the art equipment. Schneider Electric South Africa and Schneider South Africa has invested close to R17 million into various F’SASEC partners including:

▪ F’SASEC Vaal University of Technology
▪ F’SASEC University of Johannesburg
▪ F’SASEC Sedibeng TVET College
▪ F’SASEC Cape Peninsula University of Technology (CPUT)
▪ F’SASEC College of Cape Town for TVET
▪ F’SASEC Don Bosco Mozambique

Schneider’s investment demonstrates the organisation’s commitment to creating access to education and their focus on vocational training to equip students with the necessary skills required for the industry. Through this initiative, Schneider Electric South Africa has established a network of vocational training centres in partnership with the Schneider Electric Foundation, French Ministry of Education, Higher Education and Research and
Schneider Electric France. This network boasts partnerships with five South African tertiary education institutions, as well as one in Mozambique and is called French Southern African Schneider Electric Education Centre (F’SASEC).

Schneider is also passionate about social impact in within communities. It has been committed to creating access to education for youth from disadvantaged communities, with a particular focus on women has been at the forefront since the inception of this initiative. The organisation also provides training in entrepreneurship for students who would like to explore the option of creating their own business field of energy. An example of a former student who works as a technician at Green Wave Automation and also runs his own site.

“I was surprised to find that F’SASEC VUT offered the full package, with everything from free internet for research to the N courses we studied. The practical training we received while doing domestic wiring was also very beneficial. I learned a lot from Prof Sebastiani. He is punctual, precise and accurate in everything he does. I am a lot more disciplined now than I was before I met him. I come to work an hour earlier and strive to reach my targets before they are even set for me.”

Lafras Magabe
Schneider Beneficiary

2.4.3. Reflections, challenges and recommendations

Reflection 1: Limited access to post-school education and training (PSET)

- Challenge: Increasing access to institutions offering post-school education and training - Notwithstanding the gains that have been made in education, many young people are excluded from accessing post-school education and training due to a number of reasons such as language, funding and geographic location.
  
  o Recommendation: There should be multiple funding options available for students across different education and social backgrounds. While government cannot presently fund the majority of capable learners leaving school, different industry and education stakeholders should collaborate on creating various funding options for prospective students.

- Challenge: Tackling the urban-rural divide - One of the key hurdles for children from rural backgrounds is lack of knowledge and guidance necessary for a successful application process to an institution of higher learning. Learners require assistance to make their way through the plethora of academic forms, financial aid forms, handbooks and course prospects. Students from rural schools are often deprived of both the formal and informal resources that are required to apply at institutions of higher education. This is in contrast to what learners in urban schools are able to access: career and academic guidance counsellors, pre-college and university training and university open days.
  
  o Recommendation: Government should work with civil society to promote and develop programmes to assist students from rural areas in applying to higher education institutions. Government should also encourage and incentivise higher education institutions to expand outreach to rural areas. There is also a great need for the deployment of career and academic guidance counsellors to schools located in rural areas.

Reflection 2: Reprioritising TVETs as a critical component of higher education

- Challenge: Increasing enrolment in TVET institutions - While much of our attention has been focused on the inaccessible costs of tertiary education, the importance of TVETs job-related skills production has been neglected. TVETs are often perceived as second-rate institutions compared to universities. This may reflect institutional challenges, including poor management. Related to the question of stigma is the perception that technical colleges do not equip students with necessary skills and that there is an underlying disconnect between course content of the colleges and the actual skills needed in the labour market.
o **Recommendation:** There is a need for national drive to promote TVETs, explicating the importance of these institutions to growing a skilled labour force that can contribute to developing the national economy. The drive will also help reduce the stigma surrounding TVETs and the students who attend these institutions. Furthermore, this challenge represents an opportunity to include the private sector, whose input and investment can be obtained through incentivised programmes.

o **Recommendation:** Government has to put actionable plans in place to realise the initiative of the Department of Higher Education, Science and Technology to have a post school training institution in every district municipality over the next ten years. Government should also ensure that current TVET development, such as the nine new TVET campus sites under construction and scheduled for completion in 2020, are in fact completed.

**Reflection 3: Meaningfully decolonising the colonial-apartheid systems of higher education**

- **Challenge: Decolonising, reconstructing and redefining knowledge systems appropriate for the country’s development** – As past student protests at universities and TVETs across South Africa have demonstrated, there is a need for critical attention towards what kind of knowledge systems are taught and reproduced in South African institutions and whether they are in fact relevant for the particular context and educational needs at hand.

  o **Recommendation:** There needs to be an agreement on what decolonisation means for South Africa, and on what the implications will be for the curricula. This will require developing a framework for a decolonising pedagogy and curricula that will not only promote Africa-centred knowledge systems but also develop skills important for the 21st century.

**Reflection 4: PSET institutions need to adequately prepare students for the workplace**

- **Challenge: Training students for the future workplace** – The future workplace will require workers who are able to engage innovatively and productively with technology. In addition to previously valued abilities to collect, organise, and evaluate information, 21st century skills that will be required such as creativity, adaptability, teamwork, leadership skills and empathy. Workplace training should aim to co-ordinate the efforts of the education, employment and business sector. Understandably, there needs to be greater emphasis placed on training students for the workplace.

  o **Recommendation:** Curricula offered by PSET institutions needs to encourage 21st century skills such as those that have been mentioned above. It should also be developed around the needs of the employer in particular, and the needs of the economy more broadly. This can happen when different stakeholders (business, labour, education institutions, government) in education work together in better-understanding and meeting the diverse socio-economic needs of the country.

  o **Recommendation:** Improving the potential employment outcomes for South Africa’s youth requires business, government and other key players to co-operate to align workforce-development programmes with educational initiatives and public policy.

  o **Recommendation:** Preparing the youth to be job-creators, and not just job seekers would require entrepreneurial skills to be incorporated into the curriculum for all PSET programmes.
2.5. Governance

2.5.1. Overview

Debates on how education systems should be governed remain contentious. Owing to South Africa’s complex, controversial and painful past, it is improbable that any model chosen for the management and control of the country’s public schools would satisfy all role-players in education. A model placing substantial decision-making power over issues such as admissions, school fees and nomination of staff outside the control of state education departments, will always be contested. Notwithstanding this, it is important for school governance to be understood as part of the democratic process that began in 1994. The Preamble to the South African Schools’ Act of 1996 (SASA) denotes a partnership model that sees the state, educators, parents and learners accepting joint responsibility for the funding, organisation and governance of schools.

Various role players that have been assigned by the government to govern the basic education sector are provincial departments of education which work concurrently with the Department of Basic Education (DBE), the South African Council for Educators (SACE) whose core functions include the registration, promotion and personal development of educators, and Umalusi which is responsible for developing and maintaining a sub-framework of qualifications for the General and Further Education and Training Qualifications sub-framework (NQF Level 1-4). Other role players include Provincial Education Departments (PEDs), Council of Education Ministers (CEM), district offices, and SGBs who are responsible for the following:

- **Provincial Education Departments (PEDs)** – works closely with the DBE to ensure that provincial budgets and strategies are in line with and support national policies. The PEDs are responsible for financing and managing schools directly.
- **Council of Education Ministers (CEM)** – comprises the Ministers of Basic Education, Higher Education and Training and nine provincial members of the executive councils for education. The CEM meets regularly to discuss the promotion of national education policy; share information and views on all aspects of education in South Africa in tandem with coordinating action on matters of mutual interest.
- **District offices** – these offices are the PEDs main interface with schools and are not only central to the process surrounding information gathering and diagnosing problems in schools, but also play a critical support and intervention function.
- **Student Governing Bodies (SGBs)** - comprises parents and educator representatives, including learner representatives in secondary schools, and principals become the unelected members of SGBs. The SASA of ‘96 demarcates powers and duties in relation to the SGBs and makes it clear, for example, that the SGB has to act in the best interest of the school and stand in the position of trust towards the school.

The White Paper on Education and Training (1995) provides the following framework for governance in South Africa’s education sector:

The new system of education will be a single national system, which is largely organised and managed on the basis of nine provincial sub-systems. The Constitution has vested substantial powers in the provincial legislatures and governments to run educational affairs (other than universities and technikons) subject to a national policy framework. The essence of the relationship between the national and provincial governments is co-operative (White Paper on Education and Training, 1995).

Notwithstanding the decentralisation of governance in the country’s education system, the governance system relies on mutual cooperation. Ngoma (2019) writes that the actors in multi-level systems of governance are not limited to state employees, however, encompass non-state actors and non-governmental organisations. Decentralisation of governance also means that social actors in the education sector need to be more involved – particularly SGBs.

2.5.2. Key influencing factors and trends at governance level

2.5.2.1. Hierarchical versus Horizontal Governance

Leadership skills and training are important aspects for the effective running/management of a school. In South Africa, many principals are appointed without following a process which includes having any professional
training or proper qualifications. There is a lack of rigorous criteria when appointing a principal. While other countries like the United Kingdom (UK) have set criteria for becoming a principal which requires one to first become a senior teacher or a deputy head and thereafter work with the principal as a member of the senior management team, South Africa does not require a compulsory and specific qualification for principalship. The Employment for Educators Act (No. 76 of 1998) stipulates that any applicant wishing to apply for the post of principalship should at least hold a three-year teacher’s diploma and seven years teaching experience. Furthermore, on the recommendation of the SGB, a post-level one teacher may be appointed as principal without having any leadership and management qualifications or experience. There have been several attempts made by Ministry of Education to increase the professional standards and competencies of principals in the country through formulating the South African National Professional Qualification for Principalship. Notwithstanding, there has not been sufficient training for principals. The majority of the workshops facilitated by education districts are largely premised on policy matters relating to curriculum changes and administrative issues, with only a small portion given to address the lack of leadership skills and training of principals in South Africa. In its current state, leadership at the level of principalship remains unstructured and inefficient.

Another challenge facing the public school system is the tension between ‘hierarchical’, top-down, bureaucratic, governance, and the more ‘horizontal’ approaches, in which resources and responsibility are assigned closer to the schools and school participants. Xaba (2011) theorises that the capacity to govern is a basic challenge at school governance level. He contends that whole provincial departments of education have engaged in the training of SGBs, through functional units at head offices and district levels, however, the actual enactment of these roles is often less than ideal. He further postulates that the effectiveness of the training that school governors receive is often questionable. Referencing other reports, Xaba (2011) relates that SGBs are not trained before they assume their positions, which manifests into problems such as difficulties in managing large volumes of papers, lack of knowledge on how to make a contribution, and insufficient knowledge on appropriate legislation. There has been little effort to support school governing bodies in this role, and the nature in which governance functions are prescribed is problematic. Xaba’s (2014) research on principals views on challenges in their school governance roles, found that most functions required knowledgeable people to execute them, which was not possible because of the low literacy levels of the parents. This was particularly challenging when it came to completing tasks such as the developing and drawing up of school policies, financial management and accounting processes, maintenance of school infrastructure and shortlisting and interview processes. The parent-governors’ low education levels also seemed to project frustration over the composition of the governing bodies.

Horizontal governance is strengthened by empowering parents and the broader community to build networks with one another as a way of sharing lessons and providing mutual support. An inclusive culture fosters active citizenship and a shared commitment to upholding the vision and mission of the school. Case studies of schools in the Western Cape have shown that without good horizontal governance, a strong bureaucracy is insufficient. Kenya also provides a strong case for the impact of horizontal governance and citizenship on educational outcomes. Despite spending significantly less on education per pupil than South Africa, Kenya has historically over-performed on education metrics, both relative to South Africa and more broadly. Instead of a top-down approach to governance, Jomo Kenyatta, Kenya’s first president of the independence era, championed a strong focus on active citizenry as the pathway to development. Kenya’s strength is the shared motivation among stakeholders throughout the system to achieve good learning outcomes. This approach involves proactive engagement and accountability at all levels: public officials, principals, teachers and their unions, and parents and communities.

2.5.2.2. Strengthening governance at school level

Governance in education comprises multiple layers from the central down to the community level with various actors and stakeholders holding varying degrees of power, authority, influence and accountability. Whilst governments still play the most significant role in co-ordinating education, the distribution of responsibilities is continuously changing in response to calls for greater efficiency, effectiveness, accountability and democracy; with new actors such as communities, the private sector and the household becoming increasingly involved in many different aspects of education governance.

Multiple factors are important in ensuring good governance in South Africa’s education sector. Many models can be utilised to ensure effective governance and management in schools, one being a governance system that
collects school data for informed analysis, policy making and implementation. Mastercard Foundation (2019) proposes three main ways in which technology can be used to foster effective education:

1) Through increasing accountability, transparency and reducing corruption
2) Enhancing accurate decision making based on data collection
3) Using technology to improve school management and greater efficiency in managing information

The Mastercard Foundation (2019) holds that accountability is key for good governance and denotes an integral part of an effective education system. It is held that accountability should be enhanced at all levels of the system. The use of technology can support and facilitate initiatives aimed at improving accountability from the level of the Department of Education through to teachers.

An example of how the South African government is using technology to improve the state of education is the formation of a partnership between the Department of Basic Education (DBE) and the Michael and Susan Dell Foundation. This partnership launched the Data Driven Districts (DDD) programme in 2013 which aims to support improved learner outcomes through the increased quality, availability, analysis and use of education data. As per the DDD website:

“The DDD Dashboard provides data and information down to an individual learner level; giving School Management Teams, as well as district and provincial officials, essential information to give learners the support they need. The DDD Programme is active in 8 provinces, with accredited DDD trainers building capability through training and support to education officials to ensure data collection and use.”

The DDD Programme now reaches more than 11.5 million learners across the country and although the DBE owns the intellectual property and code for the DDD Programme system, provincial education departments are granted a perpetual licence at no cost, which has tremendous potential going forward.

2.5.3. Reflections, challenges and recommendations

Reflection 1: Inadequate training of role-players at school-level governance

- **Challenge: When failures at the bureaucratic level are persistent, participatory school-level governance can make a significant difference** – This difference cannot be made when there is inadequate training and support of members responsible for school governance such as those of the
SGB. There is also concern that national public and private education systems require greater accountability, especially in terms of teacher performance and learner results. The schools, teachers and principals that regularly exhibit poor results are regularly not addressed, improved or replaced.

- **Recommendation:** Government needs to prioritise the training of different role players at school governance level. This can be informed by what Xaba (2011) refers to as a capacity assessment. It is important to access the skills and competencies of perspective role-players in school-level governance in order to avoid a “one-size-fits-all” approach to training and development. That way, for instance, governing bodies would benefit from customised training programmes.

- **Recommendation:** An opportunity for the private sector exists. Much like the partnerships being established by *Partners for Possibility*, the African education environment can benefit from formal and informal partnerships between school leaders and those qualified in the commercial and business landscape. The experience and knowledge gained from operating successful commercial ventures can be adapted by school principals and department heads in the running of their specific operations.

- **Challenge:** *Increase the use of technology to strengthen school governance* – while technology has been used to improve the state of education (such as the DDD Dashboard), government needs to fully explore the ways in which digital tools can be used to strengthen systems of governance to reduce corruption, redundancies and poor decision making.

- **Recommendation:** Learning from other African countries who have used technology to improve governance. For example, there are numerous mobile phone platforms that have emerged around sub-Saharan Africa, with the aim of addressing problems within school management and administration. These include the following:

  - **Democratic Republic of Congo (DRC):** the accountability platform, Allô, Ecole (translated Hello School!), was launched in the DRC in 2016, with the purpose of addressing the gap in communication amid education beneficiaries, school management and decentralised administrative structure of the Ministry at the provincial and district level. With the use of the mobile phone, the platform enables teachers and parents to provide feedback in the availability and use of textbooks, absent teachers and state of school construction through the use of interactive voice response (IVR) and SMS.

  - **Uganda:** EduTrac, a mobile phone data collection system, crowdsources data from parent, school leaders and teachers to allow the government education administrators to see and respond to challenges at the school level. It allows education administrators to collect data on teacher attendance, school infrastructure, enrolment, and delivery of textbooks through the use of 18 indicators including school maintenance and school receipts of government grants.

2.6. **Gap Analysis of South Africa’s Education Sector**

The South African education system continues to be characterised by overwhelming inequality along socio-economic and racial lines. The vast majority of school children are served by public schools with massive deficits in infrastructure and where the quality of teaching is severely lacking. The reasons for the difficulty in improving the education system are varied and complex. They include the socio-economic context in which many children live, the lack of available human, financial and physical resources and poor governance, to name a few. One of the key difficulties in South African education is the interdependence of primary, secondary and tertiary education. Dysfunction in one area ripples outward to affect the others.
In our survey, each respondent that did not believe South Africa’s education system to be completely ready for 4IR was asked which factors they thought were the biggest hindrances. Although a lack of organisational support (33) and low skilled teachers (32) were factors that worried respondents most, all listed barriers received significant consideration, with poverty and financial issues (the lowest rated barriers) gaining 18 mentions each. With the changes inherent in the 4IR, it is important to note that outdated and irrelevant curricula were rated highly (28), underlining the need to adapt future curricula to the trends being seen in economies dominated by technology.

Similar challenges have been highlighted in South Africa’s latest General Household Survey, as detailed across provinces in the following table:

<table>
<thead>
<tr>
<th>School problems</th>
<th>WC</th>
<th>EC</th>
<th>NC</th>
<th>FS</th>
<th>KZN</th>
<th>NW</th>
<th>GP</th>
<th>MP</th>
<th>LP</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of books</td>
<td>3.2%</td>
<td>1.8%</td>
<td>2.1%</td>
<td>3%</td>
<td>3.7%</td>
<td>2.3%</td>
<td>2.9%</td>
<td>4.1%</td>
<td>1.4%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Classes too large</td>
<td>6.7%</td>
<td>1.2%</td>
<td>1.2%</td>
<td>1.8%</td>
<td>3.1%</td>
<td>5.6%</td>
<td>3.6%</td>
<td>4.3%</td>
<td>2.2%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Fees too high</td>
<td>5.5%</td>
<td>2.2%</td>
<td>1.2%</td>
<td>1.9%</td>
<td>1.7%</td>
<td>2.4%</td>
<td>4.5%</td>
<td>2.4%</td>
<td>0.5%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Poor facilities</td>
<td>3.8%</td>
<td>1.6%</td>
<td>1%</td>
<td>2.4%</td>
<td>1.9%</td>
<td>2.8%</td>
<td>2.1%</td>
<td>2.5%</td>
<td>0.9%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Lack of teachers</td>
<td>3.2%</td>
<td>3.5%</td>
<td>1.4%</td>
<td>0.6%</td>
<td>0.8%</td>
<td>1.5%</td>
<td>1.5%</td>
<td>1.1%</td>
<td>0.5%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Teacher absenteeism</td>
<td>2.2%</td>
<td>0.7%</td>
<td>1.3%</td>
<td>0.6%</td>
<td>0.6%</td>
<td>1.7%</td>
<td>2.3%</td>
<td>0.5%</td>
<td>0.7%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Poor quality teaching</td>
<td>2.8%</td>
<td>0.4%</td>
<td>1.2%</td>
<td>0.5%</td>
<td>0.9%</td>
<td>1.2%</td>
<td>1.9%</td>
<td>1.6%</td>
<td>0.6%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Teachers on strike</td>
<td>1.9%</td>
<td>0.1%</td>
<td>0.5%</td>
<td>0.3%</td>
<td>0.5%</td>
<td>0.9%</td>
<td>1.2%</td>
<td>0.5%</td>
<td>0.4%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

Table 5: Common problems faced by learners in South Africa (2018)  
*Data courtesy of the General Household Survey*

Each of the above challenges can be understood on its own, but also as one part of a complex whole. The unequal development of South Africa’s education system has left deeply seated dysfunction at all levels. The challenges identified above should be seen as an accumulative set of hurdles that need to be conquered strategically and concomitantly. Major unresolved challenges at the ECD level, for example, will inevitably continue to have prominent ripple effects at primary, secondary and tertiary levels, affecting the course of a learner’s schooling career.

Based on the reflections, challenges and recommendations outlined above, what follows is a gap analysis for South Africa’s education sector, which aims to help inform next steps.
There is no central agency for ECD that solely advocates for all issues regarding children and education.

A large number of unregistered ECD centres.

Ineffective collaboration between relevant stakeholders.

Many ECD centres do not have a health and environment certificate.

Early Childhood Development

Lack of teaching quality and professionalism.

Learners, especially in disadvantaged areas do not have the skills necessary for making a contribution to the economy (e.g. entrepreneurial skills).

Lack of instructional technologies being used in the classroom.

There is a strong need to bridge the digital divide between suburban, urban and rural schools.

Teacher training curriculums need to provide prospective teachers with proper training and practical teaching experience for the 21st century.

Limited access to post-school education and training (PSET).

Colonial-apartheid systems still characterise higher education in South Africa.

Mismatch between the skills acquired by the youth through school training and the needs of employers.

Governance at school level has not been effective because of a myriad of issue – especially because role-players are inadequately trained.

Poor top down governance and slow-moving change at bureaucratic level.

Technology is not being sufficiently used to strengthen systems of governance.

GAP ANALYSIS

School Governance and Policy

Primary and Secondary

Tertiary and Post-School

Figure 28: Summary of SA Education Gap Analysis
## 2.6.1. Gap Analysis for Early Childhood Development

<table>
<thead>
<tr>
<th>Current Gap</th>
<th>Desired Future</th>
<th>Steps Needed</th>
<th>Key Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is no central agency for ECD that solely advocates for all issues regarding children and education</td>
<td>The establishment of a central agency for ECD that single-mindedly deals with issues relating to children and education that is independent and autonomous from government</td>
<td>Government needs to create a policy that provides for a central agency that has the power to control all ECD related issues in South Africa. The proposed agency should be created based on its ability to meet this need or one should be established.</td>
<td>Department of Basic Education, ECD Centres and Practitioners, Researchers and Academics in ECD, Private Sector and Social Partners.</td>
</tr>
<tr>
<td>The current lack of properly trained ECD practitioners</td>
<td>Effectively trained ECD practitioners that can meet the needs of the 21st century learner</td>
<td>A re-evaluation of all ECD academic training institutions and their programmes curriculum. Establishing a universal mandatory curriculum for different levels of ECD training. Closing or improving all ECD centres that do not meet minimum requirements. Involving relevant stakeholders in the creation of a new or revised ECD training curriculum that is publicly informed.</td>
<td>Department of Basic Education, Department of Higher Education, ECD Practitioners, Parents, Child caregivers, Non-government training organisations.</td>
</tr>
<tr>
<td>A large number of unregistered ECD centres</td>
<td>All ECD centres across all socio-economic contexts need to be registered</td>
<td>Department of Basic Education needs to allocate a budget that is specifically aimed at ECD, focused on tackling the infrastructure issues that hinder majority of ECD centres from being fully registered. ECD interventions need to include infrastructure challenges of unregistered ECD centres and help them become compliant.</td>
<td>Department of Basic Education, Department of Social Development, Private sector investors and social partners.</td>
</tr>
<tr>
<td>Ineffective collaboration between relevant stakeholders</td>
<td>Working partnerships among key stakeholders within ECD that make collective decisions together</td>
<td>Informed decisions regarding all matters pertaining to ECD should be informed collectively by government family and the school.</td>
<td>Department of Basic Education, Department of Social Development, Parents and ECD Practitioners.</td>
</tr>
<tr>
<td>No use of technology within the ECD for teaching and learning</td>
<td>Specific developmentally-appropriate technology to be implemented within ECD to promote learning and critical</td>
<td>Identifying the best form of technology for a South African context. Training ECD practitioners on how to use these technologies.</td>
<td>Department of Basic Education, ECD practitioners.</td>
</tr>
</tbody>
</table>
### Current Gap

- **Skills such as self-expression, play and logic**
- **Desired Future**: All ECD centres operating around SA comply and get the health and environment certificate
- **Steps Needed**: All ECD centres in SA should be placed on a national database regardless of their registration status so that officials are aware of all the centres in SA. An incentive system that provides a pathway and incentives for full compliance be developed and funded
- **Key Players**: Department of Basic Education, Department of Social Development and COGTA (local government)

<table>
<thead>
<tr>
<th>Current Gap</th>
<th>Desired Future</th>
<th>Steps Needed</th>
<th>Key Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many ECD centres do not have a health and environment certificate</td>
<td>All ECD centres operating around SA comply and get the health and environment certificate</td>
<td>Training ECD practitioners on what kind of digital pedagogy to use for young children. Providing the basic tools and technologies for practitioners to use. Providing coaches/mentors for practitioners.</td>
<td>Developers of Instructional Technologies, Government.</td>
</tr>
</tbody>
</table>

| **2.6.2. Gap Analysis for Primary and Secondary Sector** |

<table>
<thead>
<tr>
<th>Current Gap</th>
<th>Desired Future</th>
<th>Steps Needed</th>
<th>Key Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of teaching quality and professionalism</td>
<td>Improved teaching quality and professionalism</td>
<td>Competitive entry requirements for teaching qualifications, making teaching a desirable and competitive profession with rigorous training to maintain quality and professionalism. Involving the necessary stakeholders in the development of a new or revised curriculum. Involving current teachers in the development of new training curriculums will provide invaluable insight on what the programme needs to incorporate as well as training components.</td>
<td>Department of Higher Education, Training institutions, Teachers, School Governing Bodies (SGBs).</td>
</tr>
<tr>
<td>Learners, especially in disadvantaged areas do not have the skills necessary for making a contribution to the economy (e.g. entrepreneurial skills)</td>
<td>Addition of 21&lt;sup&gt;st&lt;/sup&gt; century skills into the curriculum for basic education such as problem solving, innovation and ‘thinking outside the box’ mind-set.</td>
<td>In addition to introducing technology-related subjects into the curriculum, the government should add subjects that further encourage creative thinking and problem solving such as entrepreneurship.</td>
<td>Department of Basic Education, Curriculum developers, Teachers, Entrepreneurs.</td>
</tr>
</tbody>
</table>
## Education in the Age of the 21st Century

**Current Gap**
Teacher training curriculums need to provide prospective teachers with proper training and practical teaching experience for the 21st century

**Desired Future**
Teachers properly trained in order to meet the needs of the 21st century learner and displaying competency in understanding subject content and the ability to use and understand technological instruments that can enhance learning and teaching

**Steps Needed**
Development of a new curriculum that will improve the provision of education for all learners in South Africa that is based on inclusivity and equality.
The new curriculum should embody the principles of 4IR and will propel learners to think creatively and critically, and be able to work across many disciplines collaborating effectively and communicating efficiently.

**Key Players**
- Department of Basic Education
- Curriculum Developers
- Teachers

## There is a strong need to bridge the digital divide between suburban, urban and rural schools

**Current Gap**
Policies that ensure equality and inclusivity with respect to digital access

**Desired Future**
The current curriculum should incorporate instructional technologies in the curriculum exposing teachers and learners to technology and 4IR principles

**Steps Needed**
Examining current policies and identify which knowing and unknowingly contributes to exclusion
Amend or create policies that is centred on inclusion and support to all students regardless of their backgrounds.

**Key Players**
- Department of Higher Education
- Academic Institutions
- Community

## Lack of instructional technologies being used in the classroom

**Current Gap**
An increase in the number of young people who are able so access PSET institutions regardless of their socio-economic backgrounds

**Desired Future**
Creating multiple ways in which young people can receive funding
Government working with civil society to reach learners in the rural areas

**Steps Needed**
Establishing a school curriculum that incorporates instructional technologies that better prepares students for the 4IR
Collaboration between government, the private sector, NGOs that will see most, if not all, school in the country utilising instructional technologies

**Key Players**
- Department of Basic Education
- Teachers
- Instructional Technologists
- Technology companies

---

**2.6.3. Gap Analysis for the Tertiary and Post-School Sector**

<table>
<thead>
<tr>
<th>Current Gap</th>
<th>Desired Future</th>
<th>Steps Needed</th>
<th>Key Players</th>
</tr>
</thead>
</table>
| Limited access to post-school education and training (PSET) | An increase in the number of young people who are able so access PSET institutions regardless of their socio-economic backgrounds | Creating multiple ways in which young people can receive funding | Department of Higher Education and Training
| | | Government working with civil society to reach learners in the rural areas | Civil Society
| | | | National Treasury
| Colonial-apartheid systems still characterise higher education in South Africa | A decolonised and redefined curriculum that speaks to African bodies of knowledge and concerns | There is a need to define what decolonisation will look like in South Africa’s higher institutions of learning | Department of Higher Education and Training
| | | Universities and science councils must set up platforms for governance in knowledge systems where dialogue between Western and Indigenous | Department of Science and Technology and across all other

---

Table 7: Gaps Analysis for Primary and Secondary Sector
### 2.6.4. Gap Analysis for School Governance and Policy

<table>
<thead>
<tr>
<th>Current Gap</th>
<th>Desired Future</th>
<th>Steps Needed</th>
<th>Key Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance at school level has not been effective because of a myriad of issues especially because role-players are inadequately trained</td>
<td>Efficient and effective governance at school levels so that the basic education system can produce better outcomes</td>
<td>Clearly defining the roles and responsibilities of school governors (e.g. parents, principals, and education representatives) Setting a threshold for the kind of skills and competencies required for admission into a school governance position Designing and carrying out appropriate training programmes for elected school governors (members of the SGBs)</td>
<td>The Department of Basic Education Provincial Departments of Education District Directors SGBs Teachers and Unions SGBs Broader Community</td>
</tr>
<tr>
<td>Poor top down governance and slow-moving change at bureaucratic level</td>
<td>Participatory, school-level governance where all stakeholders feel included</td>
<td>Empowering parents and the broader community to build networks with one another and share knowledge</td>
<td>Teachers and Unions SGBs Broader Community</td>
</tr>
</tbody>
</table>

Table 8: Gaps Analysis for Tertiary and Post-School Sector
<table>
<thead>
<tr>
<th>Current Gap</th>
<th>Desired Future</th>
<th>Steps Needed</th>
<th>Key Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology is not being sufficiently used to strengthen systems of governance</td>
<td>Integrated application of technology to support school governance at different levels to improve management systems, increase accountability and reduce corruption</td>
<td>There needs to be research done of the kind of technologies that can be used to improve and strengthen school governance, one way of doing this is learning from what other African countries have to done</td>
<td>Department of Basic Education Educators Instructional Technologists SGBs Technology companies</td>
</tr>
</tbody>
</table>

Table 9: Gaps Analysis for School Governance and Policy
### 2.7. Example of African Excellence

**AFRICAN SUCCESS STORIES:**

*Changing how the developing world learns through innovative technology and skilled coaches*

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>Ghana</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERVENTION</td>
<td>iREAD</td>
</tr>
<tr>
<td>FOCUS AREA</td>
<td>Primary School Education</td>
</tr>
<tr>
<td>DATE</td>
<td>2012 - 2014</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>Improving literacy levels of early grade learners through e-reading technology</td>
</tr>
</tbody>
</table>

#### THE PROBLEM

Within Sub-Saharan Africa, Ghana’s literacy levels have historically performed amongst the worst. When the Ghana 2013 Early Grade Reading Assessment (EGRA) conducted its research, almost half of all grade 2 students in 815 primary schools throughout Ghana either could not read at all or could not read with comprehension. Moreover, primary schools across the country faced a dire shortage of reading material available in either English or in the local language, Akuapem Twi.

#### THE SOLUTION

As a means to tackle illiteracy and lack of reading material, the iREAD (Impact on Reading of E-Readers and Digital Content) Study was implemented. To avoid the costs of transportation, printing and storage, the iREAD programme was based on the provision of e-readers, or portable electronic devices that can store thousands of textbooks and resources. The intervention consisted of the provision of relevant (culturally and age appropriate) reading materials, the implementation of effective teaching practices, and activity-based learning opportunities.

#### RESULTS

Overall, the majority of students and teachers from the iREAD Ghana Study had positive experiences with the e-reader. Learners who participated demonstrated significant improvements in reading and comprehension, in both English and Akuapem Twi. Reports from Amazon accounts also indicated that learners in Ghana, who previously held 3-10 books, now had 107 books each on average. Teachers also indicated that the utility of the e-readers was highlighted in class, where time spent on the devices constituted 34% of total teaching time.

#### STAKEHOLDERS

The iREAD programme is a culmination of the joint efforts between the United States Agency for International Development (USAID) and Worldreader. This initiative, which was classified as a Global Development Alliance Program, was monitored and evaluated by ILC Africa – a local African organisation that specialises in advisory services. With the assistance of the Ghana Education Service and Olinga Foundation for Human Development (a local Ghanaian NGO), students were selected and teachers were trained to use the e-readers.
3. KEY CONSIDERATIONS IN THE EVOLUTION OF EDUCATION IN AFRICA

3.1. Introduction

Africa’s journey into the 4IR will be inundated with opportunities and challenges. The need to adapt the learning environment to that of the economy, in a technologically advanced state, is a significant endeavour and key decision-makers will need to be cognisant of factors that will impact this journey. Chief among them are the development of teachers, the impacts of education on the economy (and vice versa), the required innovation for transformation, policy needs and the irreplaceable input of community engagement.

These impacts, across the board, will be subject to technological changes. The increased degree of connectivity will affect the skills required of a teacher as much as it will affect the revenue generation of an economy. The link between education and the economy is inextricable and an efficient economic model will encourage harmony between the two, ensuring teachers are adequately trained to develop learners who are able to boost the economy and develop new innovations, while bettering their communities.

The following sections consider each of the chief impacts and input of the education environment, how they can be bettered, what challenges are being faced and how they are unique to the African education landscape.

3.2. Teacher Education and Continuous Development

Ensuring that teachers in Africa are well-positioned to facilitate learning in the context of the 4IR is a critical component of a harmonious ecosystem. The processes involved in teacher training and development include enabling policies, infrastructure, curriculum and procedures – all of which play a key role in boosting teacher knowledge, skills, attitudes and behaviours. In SSA, an insufficiency of research into system-wide implementation under challenging conditions means that much of the literature comes from the Global North and does not necessarily take into consideration nuances of African countries. A study by Hassler, Hennessy and Hofmann argues that the following are necessary conditions for advancing teacher professional development:

- Programmes must centre student and teacher learning
- Efforts should be largely school-based and ongoing
- Time constraints and programme scheduling should be taken into consideration
- There should be tangible opportunities for advancement (for example, promotions)
- Teachers should be motivated and incentivised
- Programmes should promote fidelity without being too rigid or prescriptive
- Resources should be managed through strategies such as open access
- Technology should be used to enhance programme delivery

The logic behind continuous professional development of teachers is that, in a constantly shifting world, teachers are regularly given the opportunity to evolve their skills and knowledge. As teachers develop themselves, they have a better chance at successful learner interaction and engagement. Versatility in teaching styles, pedagogic methods and materials translates into teachers keeping pace with the 4IR and giving students the best possible opportunities to benefit from the classroom experience.
“If the teacher has insight into what she is doing, able to decipher what type of assistance she can give to each one of the children... if you have that teacher, an independent teacher, somebody, who is also very much reflective, somebody, who can read the classroom and say, this child is very strong in an auditory way, this one is a visual child, somebody, who is in that position, you have solved all your problems. I think basically it is all about the training of the teachers. If the teachers, really are well trained, not only just knowing their subject matter they are able even to assess their classroom, they are able to evaluate, what is it that is good for this child then I think you have solved all your problems.”

Professor Nkidi C. Phatudi
COD: Department of Early Childhood Education, UNISA

There is a considerable need for schools to reinvent themselves and persevere in the pursuit of innovation through forward-thinking professional training. The dynamic and permeating nature of education means that all future renditions of teacher training and development must take into consideration school-level, community-level and country-level socio-economic factors. Considering the success factors of past and existing programmes in a developing country context is a useful way of extracting insights that could be applied to education policy. For example, a study of a Kenyan maths and reading literacy programme yielded the following results: teachers who are invested in through professional development, coaching and instructional support foster better learning outcomes. Undeniably, these types of interventions do not take place in a vacuum; hence, factors such as physical school infrastructure, provisions for out-of-school learning and student curriculum are of critical importance. This section delves into further details, using a lens of the SDGs, the 4IR and socio-economic needs. The intention is to position teacher training and development as the bedrock of the learning system and thus the key to society’s development.

3.2.1. New roles for teachers

From pre-school to university level, the teaching profession is being disrupted to the benefit of teachers’ careers, the learners they educate and national education goals. While evolution of education in the 21st century is often seen as linked to the 4IR, advances in teachers’ roles address not only new ICT adaptations, but also old challenges like erasing the divide between urban and rural education, and other forms of inequality. The role of teachers is evolving as nations re-align their education systems to meet SDGs, national development goals and constitutional mandates, as seen with Lesotho’s push to enrol all children in pre-schools and South Africa’s need for education to be taught in the eleven official languages. Governments have awakened to the reality that today’s teachers are more than pedagogues and, whether this is ideal or not, teachers are also social welfare workers. Each day African teachers must confront poverty, violence, drug and alcohol abuse, teenage pregnancy, classroom overcrowding and other forms of poor educational infrastructure. These problems, if not addressed, deteriorate students’ ability to learn. In addition to becoming ever more proficient as educators, particularly as curriculums evolve, teachers must become skilled in identifying signs of difficulties in individual students, such as malnutrition and physical or sexual abuse.

To some extent, teachers must also be behavioural therapists, moving from punishing violent behaviour to understanding the root causes that require psycho-social support. Teachers are not therapists or social workers but must be grounded in these fields because they are on the frontlines of the child-society interface and are in the most immediate position to connect children with professional assistance. South Africa’s Ministry of Basic Education seeks to introduce social workers and psychologists in school districts, increasing the numbers of those experts in populous districts where they already exist, and ramping up interventionist programmes, such as School Nutrition Feeding Schemes.

In terms of the 4IR, 21st century education does not just require teachers to become digitally literate, but also to understand wider societal intricacies and use the tools they are equipped with through professional development to empower students to lead lives of success.

“Digital age pedagogy is very different [to pedagogy in other ages]. I am not a computer guru, but my mindset is geared towards learning [new] skills...that entrepreneurial mindset pushes you and I would say that teacher development needs that [mindset] and teacher training needs that [too]. There is very little of that to be seen, and there is a great opportunity, [for a mindset shift], in that regard.”
An Eton Institute study identifies seven roles the 21st century teacher must assume:

The controller
The authority figure of the classroom whose example defines for a child what a good authority figure must be.

The prompter
The teacher brings out the best in each student, beginning with urging every child to participate in class.

The resource
The teacher with his or her knowledge of a curriculum subject is the go-to person for a student with a question.

The assessor
The teacher is the observer of a student’s academic performance both as the one who grades assignments but also one who spots problems that will lead to assistance.

The participant
Classroom assignments are enhanced with a teacher plays a role, without however dominating the activity.

The organiser
Considered one of a teacher’s most important roles, the ability to organise a class so all students know what to do and when also provides children with a valuable lesson on organisational skills.

The tutor
A teacher must be available to provide one-on-one assistance to a student with a question or special need.

The link between these roles and the 4IR is that teachers in developing countries are more likely to be able to wear many different hats, due to having more resources and support at their disposal. Technologies such as ClassDojo, a gamified classroom management application, make it possible for teachers to control, prompt, assess, organise and tutor students through a computer or mobile device.

Educationalists also recognise the value of recreational programmes, from sports to the arts. These activities, once deemed luxuries, have long been absent from most African schools because of affordability issues and resource prioritisation into core subjects. Many schools do not have the facilities for basic classroom activities and therefore cannot afford to develop more niche infrastructures, such as gymnasiums. A solution is to hold governments accountable to their obligations as UN treaty signatories, where they pledged to boost education spending, as well as to encourage further collaborations between public, private and non-profit sectors to make these dreams a reality. In terms of teachers, they will have dual roles in the 4IR – in class and outside class – that are standard for teachers in the developed world, where a social science teacher may coach soccer after school.

Through developing technologies such as mobile applications and VR which overcome certain infrastructural obstacles, teachers without formal sports or arts training will have toolkits at their disposal to offer extracurricular activities to students. The goal to develop well-rounded, healthy and creative students can be realised with the help of technology.
Notwithstanding the new roles for teachers, there are universal qualities that good teachers will always need to have in order to teach effectively. A good teacher is one that has good communication skills, is attentive to learners, and has deep knowledge and passion for their subject matter. It is one that collaborates with colleagues and learners and is able to build a sense of belonging and community in the classroom. These are but a few important qualities that make a good teacher, and subsequently encourage good teaching.

3.2.2. Upskilling and re-skilling teachers

Teachers in Africa are in need of being upskilled in order to meet the needs of the 21st century student. In order for this to be achieved, the reality is that schools need to allot time for teachers to attend training courses, either physically or virtually. Each country, province and school district will have particular skills that are required to meet area-specific needs (speaking to data found in Integrated Development Plans), however, there should also be some standardisation. What is clear is that all teachers need to have a basic set of digital skills, grounded by linguistic and mathematical literacies and proficiency in their teaching subjects. This has historically been an area of weakness in African education systems – where teachers are not at all properly equipped to teach.

In Kenya, in 2016, the Ministry of Education surveyed the nation’s teachers and was alarmed to find that 15,000 English teachers were insufficiently prepared to teach the subject. A Stellenbosch University study found that 80% of South Africa’s teachers lack the knowledge and teaching skills to teach the subjects they are currently teaching. Among Grade 6 mathematics teachers, four out of five could not themselves achieve a 60% grade on a Grade 6-level maths test. These worrying statistics underscore a problem that cannot be solved by technology alone – African countries must address elementary skills discrepancies in parallel with developing 4IR-ready teachers.

“I worked with governments that want to deploy One-to-One learning, say education [with] full ICT in the classroom, but then when you go look at the teacher training policy, it only has policy on basic ICT literacy. The policy doesn’t refer to training teachers on integrating 21st century skills in the classroom by utilising ICT as an enabler... the policies must be aligned.”

Joao C. Fidalgo
Business Consumption Lead, Intel Corporation South Africa, SADC Territory

Science teachers in particular require upskilling to keep abreast of the rapid advances in the sciences. ICT has allowed discoveries to be studied and mainstreamed into the science and technology industries swiftly, vastly expanding knowledge at an accelerated pace. ICT also allows science teachers to use telecommunications programmes, such as Skype, to participate in seminars, professional discussions and upskilling instructions a continent away in real-time. Namibia’s programme using ICT to improve teacher training quality, supported by UNESCO’s China Funds in Trust (CFIT), provides teaching and learning material to use in online chat forums, and has 5000 teachers enrolled. In 10 Sub-Saharan countries, 45,000 teachers have been, or are being, upskilled through the UNESCO initiative which began in 2012.

The world’s education systems have long been supplied by private industry publishers, and more recently ICT firms, who produce learning materials from textbooks and tapes to chalkboards. Apple Computers has entered the teacher continuous education space with Apple Teacher, a free professional learning programme. South Africa is to become Africa’s first country to use the tutorial, where the aim is to upskill knowledge of ICT so that teachers can better utilise ICT tools in the classroom. There has also been a Nigerian-based programme focused on building teacher ICT capacity: UNESCO, in collaboration with Nokia, the British Council, and the Nigeria Teachers’ Institute (NTI) provided teacher training for selected teachers centred on mobile technologies and how they can be harnessed for teacher professional development and educational offerings.

These initiatives exemplify what continuous training means in the teaching profession: it is not only the improvement of skills in the subject in which a teacher has specialised (such as languages or social sciences), but also the upskilling of teachers to become proficient in entirely new subjects. The 4IR will require a new crop of specialised teachers, while changes in school curriculums will require other skills. Clearly, continuous education programming must be well-managed if it is going to be effective.
In line with respondents’ views on the biggest 4IR education barriers in South Africa, the readiness and skills of the African teaching workforce is viewed extremely pessimistically. An astounding 84% expressed disagreement with the statement that teachers and educators were ready for the 4IR — a result that almost conclusively highlights the facet of education that needs the most attention. However, this does not portray the capabilities of teachers alone, as these educators can be under-supported by governments, underpaid in terms of national income averages and without any continuous development, thus contributing to the perception that current teachers and educators do not have the tools with which to educate in the 4IR.

3.2.3. **Adapting to new modes of teaching**

Education in the 21st century is seeing a move away from information memorisation as the primary means of passing on knowledge, and towards problem-solving and creativity. In other words, modern modes of education encourage a student to be able to retrieve the necessary information to solve problems, and not necessarily be able to recall it. This trend is becoming more important as the 4IR intensifies.

New modes of teaching will concentrate on training minds to think for themselves rather than receive and repeat lessons without applying critical thinking. The goal for the 4IR is simply for students to be able to say how a computer works, but also, for instance, why a computer doesn’t work better and asks them to problem-solve improvements. Traditional teaching has not been sufficient to encourage critical thinking skills.

To remedy this, South Africa has instituted the Outcomes-Based Education school curriculum. Aimed at developing creative problem-solving skills at all levels of education, the curriculum focuses on critical thinking and effective communications as components of problem-solving; because the system combines both “minds on” (critical thinking) and “hands on” (practical activities), the teacher must adapt to the combined pedagogic approach, which is project-based. This is a more involved process for the teacher than the lecture-and-repeat mode of teaching, where students memorise textbook lessons, repeat them in exams, and are then graded on how well they have retained information. For the teacher, assessing critical thinking is more complex than marking exams, and involves constant monitoring of student involvement.

“I think the case study method of teaching and learning through experience is also an interesting combination. And I think business schools are quite effective [in teaching using] case studies because it makes a theoretical concept quite tangible and more relatable and easier to remember.”

*Alon Lits
Focus Group Member, Uber*

Instead of having education constricted by curriculum texts, problem-solving requires an enabling environment. One way this is accomplished is by simply allowing students to browse the internet to discover relevant material.
of interest, moving beyond curriculum texts to all kinds of information. Another way of creating an environment conducive to problem-solving and collaboration is by educational institutions offering online courses. The University of Ghana, the Kwame Nkrumah University of Science and Technology, and the Cape Coast University target the working class through distance learning courses.\textsuperscript{ccxxxix} In this environment, teacher-student interaction is mostly virtual, a distinctly 21st century mode of teaching.

In terms of monitoring student performance, a Teaching and Learning International Study (TALIS) survey of South African teachers already reports good performance in the application of continuous assessment: 86% of the country’s teachers routinely observe and assess student work and provide the student with immediate feedback. The percentage is higher than the average of all TALIS countries surveyed.\textsuperscript{ccxl} 4IR technologies such as e-assessment tools make it easier for teachers to assess students on a continual basis without some of the obstacles associated with paper assessment, such as manual grading, storage constraints and misplacement of paperwork.

Electronic modes of teaching and learning are the most obvious innovations associated with education in the 21st century. These modes are also essential to implementing the South African Ministry of Basic Education’s Early Grade Reading Programme. Aimed at establishing literacy and comprehension at the formative stages of early education, the programme offers teachers professional support to implement curriculum. Critical thinking, the foundation for problem-solving, is required for reading comprehension. The lack of reading comprehension in young South African students is to be addressed by the Early Grade Reading Programme.\textsuperscript{ccxli}

Various pedagogic institutions have proposed, or are experimenting in, a search for ideal modes of education. While the standard educational mode has been time-based, in which a curriculum is studied within a particular time frame and measured by exams at intervals; a new mode is goal-based learning, whereby students are assessed by their achievements on a project basis in a way that is similar to how the world works. The US-based company 21st Century Schools advocates for this type of learning through Small Learning Communities, where students are grouped into communities of 150 individuals, and work within flexible study environments with 6 to 8 designated teachers.\textsuperscript{ccxlii} In an African context, where there are not enough teachers to engage with students in a traditional classroom set-up, there are innovative, alternative teaching models being tested such as Spark Schools in South Africa: a combination of group instruction, small groups, targeted intervention and online learning allows for scarce teaching resources to be deployed strategically and for students to take an active role in the learning process.\textsuperscript{ccxlii} All these new modes will require upskilling by teachers as part of their continuous pedagogic development.
### 3.2.4. Case Study – Kagiso Trust Teacher Development Intervention

<table>
<thead>
<tr>
<th>Understanding teacher development</th>
<th>Kagiso Trust teacher development</th>
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<tr>
<td><strong>Definition</strong></td>
<td>The framework within which Kagiso Trust implements its education programme, as a contribution to teacher development, involves many facets.</td>
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<tr>
<td>Teacher development, in the context of education interventions, often deals mainly with competency, which relates to conduct in school, ability to effectively and/or efficiently address both personal and education environment challenges, understanding of subject matter, and best methods to impart subject matter to learners. Although teacher development includes obtaining or upgrading academic qualifications, it has not been a priority or focus of development interventions by non-government entities.</td>
<td>Kagiso Trust’s key focus is on transformation and empowerment, and curriculum support. The other elements of the Framework are additional activities that are provided as support to schools, based on needs’ analyses.</td>
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<tr>
<td><strong>OECD view</strong></td>
<td><strong>Transformation and empowerment</strong></td>
</tr>
<tr>
<td>The OECD’s <em>Comparative Review on Teachers</em> (2005) indicates “effective professional development is ongoing. This includes training, practice, feedback, adequate timing and follow-up support”. It refers to teacher development as “professional development”, which as “a lifelong learning approach” that is based on created “opportunities and incentives to enable staff to refresh, develop and broaden their knowledge and understanding of teaching and to improve their skills and practices.”</td>
<td>This component of teacher development by Kagiso Trust involves conversation amongst school stakeholders. The Schools’ Retreat is the first stage for teacher development and a key driver of the success of Kagiso Trust’s Education Programme.</td>
</tr>
<tr>
<td><strong>Policy framework</strong></td>
<td>Retreats entails profiling schools of schools based on enrolment and Grade 12 results performance analysed over three year and is aimed at aligning the outcomes from the Retreat as part of an Action Plan.</td>
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<td>At a South African level, the <em>Norms and Standards for Educators</em> 2000 espoused in the <em>National Policy Framework for Teacher Education and Development in SA: 2006</em> requires a teacher to be a: ✓ specialist ✓ curriculum developer ✓ leader, administrator and manager ✓ scholar and lifelong learner ✓ professional who plays a community, citizenship and pastoral role</td>
<td>A retreat is a deep conversation facilitated outside the school premises where participants reflect on themselves and understand their role as individual in a school setting and as part of a school team. At the Retreat a school is asked to make own choices regarding where it wants and need to be as an organisation. The purpose of the Retreat workshop is to develop and create an environment in a school for team members to: • hold each other accountable for the effective functioning of the school; • create an environment where each stakeholder does not feel they are intimidated to speak out • create an environment for the effective functioning of the school; • introduce the whole school development programme; and • More schools for professional development of teachers, management and leadership, as well as the overall functionality of the school.</td>
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<td>Thus, development of teachers should address a combination of the above roles and responsibilities of a teacher.</td>
<td>The outcomes of the Retreat is a development of an Action Plan informed by nine (9) Areas of Whole School Development.</td>
</tr>
<tr>
<td><strong>Enablers</strong></td>
<td><strong>Curriculum support</strong></td>
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<tr>
<td>Enabling environment and factors play an important role in teacher development. Government can provide rewards to teachers in recognition of the development they expose themselves to. For example, the South African Council for Education (SACE) and the Department of Basic Education (DBE) has introduced the Continuing Professional Teacher Development (CPTD) management</td>
<td>An essential component of Kagiso Trust’s teacher development is curriculum support and the organisation is focused on gateway subjects, namely mathematics, science and accounting.</td>
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<tr>
<td><strong>Curriculum support entails:</strong></td>
<td><strong>Curriculum support entails:</strong></td>
</tr>
<tr>
<td>• Baseline survey to identify topics, methodology and pedagogy challenges</td>
<td>• Baseline survey to identify topics, methodology and pedagogy challenges</td>
</tr>
<tr>
<td>• Profiling individual subjects’ performance by learners</td>
<td>• Profiling individual subjects’ performance by learners</td>
</tr>
<tr>
<td>• Development of differentiated support approaches to challenge areas identified by teachers</td>
<td>• Development of differentiated support approaches to challenge areas identified by teachers</td>
</tr>
<tr>
<td>• Alignment of intervention plan with the District’s Plan</td>
<td>• Alignment of intervention plan with the District’s Plan</td>
</tr>
<tr>
<td>• Quarterly results or error analysis to develop remedial options</td>
<td>• Quarterly results or error analysis to develop remedial options</td>
</tr>
<tr>
<td>• Incentivising of teacher performance based on learner or subject achievements</td>
<td>• Incentivising of teacher performance based on learner or subject achievements</td>
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</table>
system to promote continuous development of teachers by allocating them points for participating or enrolling in certain endorsed activities or programmes. This serves as an incentive for teachers to continuously use development opportunities to improve themselves and enhance their work performance.

<table>
<thead>
<tr>
<th>Development outcomes</th>
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<tr>
<td>• Improved attitude, morale and confidence in the profession</td>
</tr>
<tr>
<td>• Improved content knowledge and methodology</td>
</tr>
<tr>
<td>• Improved curriculum coverage</td>
</tr>
<tr>
<td>• Improved teamwork and leverage of skills at the disposal of a school through, among others, development of lead teachers</td>
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</table>

**Teacher development space and role-players**

Teacher development is not a single-sector responsibility, as multi-stakeholder contributions have proven to leverage offerings from various quarters. This means that teacher development is not solely reliant on the teacher, but on enabling environments that provide opportunities and support.

The marginal impact of teacher development is not just localised to the teacher but is beneficial to the overall academic institution - the learners’ academic performances and relationships with other colleagues and leadership. Ultimately, education is key to national socio-economic development.

**Kagiso Trust’s value add in the 4IR**

Access and exposure to ICT – Kagiso Trust has supported schools by providing computers and, where there was a need, computer science laboratories. They have also provided computer literacy training to educators, to ensure incorporation of ICT into lesson planning and efficient teaching and learning processes.

This will begin to bridge the digital divide and bring rural and township schools closer to the world of technology. Currently, Kagiso Trust has interest and is engaging on possible practical introductions of disruptive technologies in schools as tools for learning required skills for the future.

**Recommendations**

Any intervention geared towards teacher development should be comprehensive and, thus, should be based on teacher needs analyses. To increase the levels of access to technology, the basics should be in place to ensure exposure and bridge the digital divide (in skills and use of technology in schools).

Introduction of complex disruptive technologies, to leap from the current teacher community of practice into the fast moving 4IR era, should be gradual and not imposed. As such, there should be deliberate and dedicated technology knowledge and skills development programmes, aligned to schools’ plans.

**Table 10: Kagiso Trust teacher development intervention**

### 3.3. Education as an Economic Driver

The economic value of education can be calculated on a national/societal level and on an individual level. On a personal level, someone may not be able to avoid a life of unskilled labour with just basic literacy and maths skills obtained at primary school – as a high school diploma is required for many jobs. An undergraduate degree allows entry into professional fields, with salaries rising in line with academic achievement. In South Africa, the average salary of an MBA holder is US$ 50,500 per annum. This is more than double the average salary for the holder of a bachelor’s degree and triple the average salary for the holder of a high school diploma.\(^{\text{ccxliv}}\) Earning potential in South Africa therefore has a direct, positive correlation with education levels.

The value of the particular type of degree held by a scholar does, however, depend on the job market. A survey of the South African economy found that the most valuable degree in 2018 was Bachelor of Engineering, with the second most valuable degree being Bachelor of Science, followed by Bachelor of Commerce, Bachelor of Education, Bachelor of Accounting and Bachelor of Technology respectively.\(^{\text{ccxlv}}\) As the 4IR accelerates, a
Bachelor of Technology degree will likely increase in value, although every degree listed shows its bearer possesses knowledge vital to 4IR.

![Value of Degrees in South Africa](image)

Figure 33: Comparative starting salaries of degrees in South Africa

Data courtesy of Business Tech

Clearly, the simple monetary value of education can be established, and while the non-monetary value of education is less tangible, it is nonetheless recognisable. Educated people are provided opportunities that non-educated people are not, exacerbating inequality. As for society as a whole, the value of an educated citizen is similarly both tangible and intangible. Economies prosper with skilled and knowledgeable workers. Research and Development (R&D) is an essential component of industrial, medical and technological advancement, and is made possible through trained scientists and technicians. Economies function best under democratic systems, and educated voters have more tools at their disposal to participate in democratic processes.

In Africa, the societal value of education varies from country to country. A ground-breaking public opinion poll by Gallop in 2013 assessed the value African populations place on education and found significant differences. The question asked what qualities were required for success in life. In Botswana, 73% of people said education, versus only 13% in Cote d'Ivoire. Ghana (72%) and Zambia (64%) were second and third on the list, and South Africa (51%) was ninth. Only nine countries had more than 50% of people ranking education as the most valuable quality to achieve success in life, although education was still more valued than any other quality. The family/friend connections were valued by more than 50% of the people in seven countries. The other values – hard work and intelligence – were ranked of lesser value. Because of the demonstrable worth of an education, it may be surprising that this quality is not valued more. However, the reason is clear: education is an asset that is still denied to many in Africa due to lack of access, poor quality of courses and high attrition levels. Despite the fact that across all Sub-Saharan Africa, primary school enrolment rose from 23% in 2000 to 41% in 2015, and the number of children out of school dropped from 43.5 million to 17.2 million (according to a survey by the Commonwealth Education Hub), attendance does not equate to a successful educational experience. The value of education is also disparaged by parents who require that their children work on their farms or in their family businesses out of necessity. Gender discrimination keeps girls out of classrooms by societies that see little need for educated women because women’s roles are viewed as “in the house” and not in the commercial or political arenas. These issues are complex to navigate, particularly because traditional African methods of learning are not given much credence in a Euro-centric educational discourse.

Population growth will compel expansion of the education sector. By the end of the 21st century, Africa’s workforce will surpass in number the workforce of Asia or any other continent, although at present, Africa’s workers aged 15 to 64 are a quarter in number of Asia’s. However, Asia is aging demographically, unlike Africa, which currently contains 15% of the world’s workforce (projected to rise to a third by 2100). Nigeria’s current labour force will rise by 350% to 375 million by 2100. Therefore, Africa has the potential to industrialise and become more self-sufficient, but this can only happen if education systems grow to ensure skilled, critically
thinking individuals whose intellectual talents are trained to constantly adapt to ever-changing workplace demands.

### 3.3.1. Aligning needs of the economy with education

The debate on the need to make education subservient to economic needs, or even for educationalists to be cognisant of the requirements of the economy, is controversial. Teachers have argued that their role is to make learners knowledgeable, and not to act as an employment agent with an aim of filling jobs. At the same time, teachers are telling students to study because an educated person can find work. Meanwhile, politicians bemoan any curriculum that is not aimed at producing workers, and schools are fighting losing funding battles against governments set on cutting non-core subjects like the arts and some sciences.

Education in the 21st century may have seen that debate finally put to rest with the arrival of 4IR. Since skills are constantly changing, occupations become redundant and new ones are created, it is impossible to do job training with lifelong careers in mind. The World Bank predicts that, within decades, 41% of today’s jobs will be rendered obsolete because they will be taken over by automation, while 35% of the remaining jobs will change so radically that workers doing them today, if not upskilled, will be unable to do them. Meanwhile, ICT jobs in South Africa have risen 20%. Two-thirds of South African children entering school today will be working jobs that, at present, do not exist.83

Thus, the debate over what schools must teach is put to rest by the reality that education systems cannot predict which jobs to “train” their students for, as even in the short term, the job market is shifting too quickly. What schools must teach to adequately fill a country’s economic needs is, ideally, what they should always teach: critical thinking, problem-solving, and the ability to process knowledge and not just memorise facts and procedures. Creativity is the most valuable resource a worker can possess and, given the 4IR trends that dominate economic progress in the 21st century, aligning education to meet the needs of the economy requires recognising the conditions of the 4IR workplace.

Today’s African economies need technicians trained in workshops to fix older models of computers that can be refurbished, as well as technicians with the ability to invent and maintain the next generation of computers. At the very least, new technicians must understand where technological trends are going. That skill is only acquired through analysis and information processing — solving a problem and finding a solution. What Kenneth Baker, Chairman of the London-based Edge Foundation, said about his country applies to all African countries in the 21st Century: “The U.K.’s future workforce will need technical expertise in areas such as design and computing, plus skills which robots cannot replace – flexibility, empathy, creativity and enterprise.”
There are some concrete curriculum adjustments that can be effected to best target the learning experience with likely fields of employment. The Edge Foundation recommends eight programmes encompassing a learning career from primary to tertiary level:

- Bring in external experts to teach primary school students how to code.
- Equip primary schools with technology such as 3D printers and design software.
- Enable secondary school students to study computer science, design, technology, or other technical subjects.
- At least half of all 14 to 16-year-olds should take computer science courses.
- Offer apprenticeships from age 14 by blending the core academic curriculum with hands-on learning.
- Equip all students with basic business skills and foster relationships between schools and local employers.
- Encourage schools to develop career and technical trajectories covering enterprise, health, design and hands-on skills for 14 to 18-year-olds.
- Offer part-time university courses or apprentices to so that students can obtain a Foundation Degree – equivalent to an Associate’s Degree.

As is evident from this list, investment in education will be required by governments to ensure schools are equipped with necessary teaching tools, from hardware to teacher upskilling through continuous education.

3.3.2. Utilising the education sector to address development needs

Boosting the education sector is in itself a primary development goal, targeted in SDG 4 to: “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.” Agenda 2063 elevates improved education as its second stated goal: “Well-educated citizens and skills revolution underpinned by science, technology and innovation.”

South Africa is Africa’s only member of the Organisation of Economic Co-operation and Development (OECD), and as an OECD member country South Africa was surveyed and its achievements toward educational development goal attainment were quantified. In quantitative respects, achievements were promising, such as three-quarters (76%) of young adults aged 25-34 having secondary school diplomas. However, one out of five (21%) secondary school students are over age, early childhood education services (ECES) are rare, and tertiary graduates are low. Of relevance to adapting the workforce to 4IR, only 12% of upper secondary school students attend vocational programmes. Among children aged 5 to 14, 16% were not enrolled in school – a surprisingly high figure for Africa’s most economically-advanced country. The survey also showed that a national push to bring tertiary education to all pays off highly for the individual. South Africa’s employment rate of 83% for university graduates is nearly identical to the average university graduate employment rate in all OECD countries (84%).

By improving education systems and ensuring, not only education for all, but the right type of education, (which produces critical, independent thinking and problem-solving) the education sector can also be utilised to achieve all other development goals. There are no national development plans, Agenda 2063 targets or SDGs, that can be achieved without educated Africans who can innovate solutions and carry these out. As the Commonwealth Education Hub commented after UN member states unanimously adopted the Sustainable Development Goals in September 2015: “Education is a cornerstone of the post-2015 agenda, as a goal in itself as well as a catalyst for broader change.”

Since 2004, the UN education and cultural organization, UNESCO, has mounted a global effort to advance Education for Sustainable Development (ESD). The initiative promotes the kinds of education, teaching and learning policies, and practices that advance social, economic and ecological developmental goals. As the effort progressed, UNESCO came to realise that just as SDGs were holistic in nature, each one requiring the success of others to advance, so too must all stakeholders participate in developing national education systems – legislators and national executives, the business community, NGOs, civil society, and the media. Without such broad and hands-on participation dedicated to education, the SDGs as a whole will not be obtained.
An educated populace will produce individuals who innovate answers to climate change mitigation in their communities, while the educated community will be able to understand and carry out these solutions. An educated population will be more ideally suited to achieve SDGs on a national level because they will own the process, rather than have SDG-work be a top-down affair where programmes may appear to be imposed upon communities. In order to be fully capable of meeting SDGs and national development goal needs, the Commonwealth Education Hub’s recommendations suggest that by 2030 education systems:

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<tr>
<th>Recommendation</th>
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<tr>
<td>Ensure that all children complete free, equitable and quality primary and secondary education, leading to relevant and effective learning outcomes</td>
</tr>
<tr>
<td>Ensure that all children have access to quality early childhood development, care and pre-primary education so that they are ready for primary education</td>
</tr>
<tr>
<td>Substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship</td>
</tr>
<tr>
<td>Ensure that all youth and a substantial proportion of adults achieve literacy and numeracy</td>
</tr>
<tr>
<td>Ensure that all learners acquire the knowledge and skills needed to promote sustainable development</td>
</tr>
<tr>
<td>Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all</td>
</tr>
<tr>
<td>Substantially expand the number of globally-available scholarships to developing countries, in particular least developed countries, small island developing states and African countries</td>
</tr>
<tr>
<td>Facilitate increased enrolment in higher education, including TVET and ICT, technical, engineering and scientific programmes, in developed countries and other developing countries</td>
</tr>
<tr>
<td>Substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing states</td>
</tr>
</tbody>
</table>

Figure 34: Commonwealth Education Hub’s recommended education reforms

How such goals are to be financed is examined in the next section.

### 3.3.3. Financial implications of education in the 4IR

Financing African education in the 21st century is part and parcel with financing the entire social welfare matrix of which education is a component, as exemplified by the SDGs. Education is the essential ingredient of these developmental agendas. It should be noted that, although the initial financial outlay for improving education systems is significant, there will also be positive financial implications of a 4IR-ready education system, for example: medium and long-term savings on printing textbooks and future revenue streams made possible through 4IR technologies such as Business Process Outsourcing (BPO).

UNESCO notes three means for governments to raise money for education: internal resources, external aid and innovative funding. The latter includes public-private partnerships to provide vocational training of students who would then serve the industries that sponsor education. The achievement of SDGs, including education growth that exceeds short-term developmental goals, requires the participation of the private sector, NGOs, and global bodies like the UN. A high-level event held by the UN in September 2018, titled “Financing for SDGs”, addressed ways to pay for education and other developmental goals. It was noted at the conference that such financing “represents tremendous investment opportunities, in the order of trillions of dollars. Yet, despite growing momentum for investments in sustainable development, the financing gap is significant.” The process has four components:
Successful implementation of point 4 is necessary to show that investment in SDG, which can be risky, produces sustainable results. This is essential if additional investment is to come.

Identifying investors who would be interested in financing SDG-directed projects, while also enticing other investors to put money in such projects, financial houses have created portfolios dedicated to this work. While established as an NGO with a vision to end poverty by 2030, Business for the Planet (B4P) is an investment management firm that designs financial impact investments that help to end poverty. B4P has identified a segment of US institutional investors who are interested in projects that have both a social impact and generate a financial return; or they represent clients interested in this type of investment. B4P estimates that “the largest pool of cash on the planet is the US$ 63 trillion global asset management industry. If 1% of these funds were shifted to development, you could fund 11 United Nations in the first year and 50 United Nations over five years. That means refugee camps in Syria and Darfur are helped, HIV/AIDS medicine gets to those who need it, and Africa becomes food sustainable in a generation. All of these projects could be funded.”

Education funding is an important component of foreign investment toward African development. Private firms such Microsoft and Apple have shown an interest in ICT-related investment through programmes geared towards boosting ICT in classrooms and upskilling teachers to meet the demands of 4IR. It is possible to draw corporate interest in African development if mutual benefits are highlighted.
Despite dedicating a greater % of GDP to education than the world average, African governments are not providing sufficient financing for education in the right formats. As a consequence, one-third of education costs are paid by households. Given widespread poverty, this is one reason for low enrolment, high drop-out levels and grade skipping which ensures that, even in relatively advanced countries like South Africa, many students are older than they should be in the grades they study. External aid would go a long way to lift the education payment burden of families. International assistance for African countries was halved from 0.86% of GDP of contributing countries in 2002 to 0.45% in 2015, following the global economic crisis. The Global Partnership for Education funding conference held in Dakar, Senegal in 2018 found world economic conditions better and the international community ready to commit more funding to African education going forward.

3.4. Innovation in Education Delivery

Education is said to operate on two levels. The micro-level is between teacher-and-learner and focuses on the student’s cognitive growth. The second is the macro-level, where education is part of a social system and meets the needs of society. Innovations in education begin with curriculum but are executed through technological and non-technological teaching methods, such as new approaches and methods of transferring information. 21st century education is tied to the 4IR in a circular manner: education is improved through 4IR enhancements in education delivery (technologies) and the education systems reciprocate by producing skilled workers required by the 4IR, who will then improve educational technologies too. These technologies are founded on 4IR needs, as well as the requirements of evolving educational systems. A look at these 4IR needs finds that, in Africa, over half (52%) of Kenya’s work activities today will be done through automation in the next decade, compared to 46% in Nigeria, 44% in Ethiopia and 41% in South Africa. New job creation will result, but employers in Sub-Saharan Africa are already reporting a scarcity of skilled workers. In Tanzania, 41% of firms report this problem, 30% in Kenya, 9% in South Africa, and 6% in Nigeria. As the 4IR accelerates, the gap between available skilled workers and employers’ needs will widen. Between 2007 and 2017, the average “ICT intensity” of jobs in South Africa, which is one of Africa’s most advanced economies, increased by 26% in all formal sector employment, versus 18.4% in Kenya and 6.7% in Ghana. As the World Economic Forum (WEF) notes, “Often this skills instability stems from the fact that many jobs in the region are becoming more intense in their use of digital technologies.”
Noting that in the long term the beneficiaries of the 4IR will be highly skilled ICT workers in digital design, creation and engineering, the WEF recommends that Africa’s educators build “a pipeline of future skills” by designing a “future-ready” curriculum that encourages creativity, critical thinking and emotional intelligence. Specific vocational training at present should target occupations with strong job creation potential: hard and soft infrastructure, green jobs and “new work formats.” One of the innovations in education delivery recommended by the WEF’s Africa’s Skills Initiative is public/private partnerships that extend learning beyond the classroom through mentoring, apprenticeships and other skills-learning means. The initiative touches upon a uniquely African means to deliver education, by recognising the culture of education as practised outside of formal education systems. “Sub-Saharan Africa has among the lowest number of years of formal education amid its older generations, although this data does not account for alternative modes of learning such as informal apprenticeships, learning on-the-job and traditional knowledge systems that have provided learning and training opportunities for millions of working-age Africans with little formal, curriculum-based qualifications.”

One of the boldest educational innovations would be to tap into this time-honoured system of learning and update with ICT to educate both the learner and the teacher through online forums, challenge-based exercises and smart technologies. This will also narrow the education deficit between generations.

21\textsuperscript{st} century problems, such as global warming, poverty eradication and unemployment, require solutions that are systemic – that is, having one specialty alone cannot address these problems, but rather an entire system, crossing several disciplines, and “multiple ways of knowing” are needed to find a solution. Students, workers and citizens must all be involved in a system that allows for flexibility of thought and adaptability toward new skills. Teaching environments will need to be equally flexible. One innovation that allows this to occur is a “studio-based model” that replicates the way architects are trained. Rather than be seated, lined in rows, and listening to a teacher, students work in open spaces on their own projects, and can see and interact with other students working on projects. Students and teachers then critique the projects. Students learn from the struggles and successes of their fellow students and absorb the creative process as they themselves become creative within a supportive environment. When students are tasked with projects that collectively provide the solution to a problem, they learn how society also works through togetherness. This is activities-based learning versus simple lecturing, and thus requires teachers to learn and experiment with new teaching practices. Innovative tools such as artificial intelligence, real-time simulations, big data analysis, interactive robotics, holograms and emotion recognition systems\textsuperscript{civ} can be strategically integrated into studio-based learning to bring educational experiences into the 21\textsuperscript{st} century.

The principal innovation in 21\textsuperscript{st} Century can be described as “learning to be”, as opposed to the 20\textsuperscript{th} century model “learning about.” The goal of education today is not to mould a 20\textsuperscript{th} century mind that memorises facts.
and absorbs information, but to mould a creative individual who is capable of discovering, thereby creating new information. In this new model, learners are often put in an environment, usually a work environment, where they are apprentices in the new sense. In the old sense, an apprentice duplicated the particular skills of his or her master, whereas today’s student apprentice would not learn a specialty, but rather the process of a working environment through technical and social engagement by doing real work. Here a public/private partnership arrangement would be necessary, and the arrangement would be designed to include a portion of a student’s regular academic year. The process is for the student “to engage in productive enquiry” and is one of several ways 21st education is approaching the need to make today’s students creative and critical thinkers – not merely receptacles of knowledge, but knowledge generators themselves.

3.4.1. Toward learner-driven education

Learner-centred education places the student as an individual at the centre of the education system. The philosophy behind and the design of the practical application of this system is based on three principals:

- Each learner is considered a unique individual, from differing backgrounds and circumstances, and possessed of unique strengths, weaknesses, interests and aspirations.
- Each learner is believed to possess unlimited potential which matures in different ways and times per the individual.
- Each learner is believed to possess a basic human need to learn and the task of educators is to satisfy that need.

The tension such an approach to education can cause in more conservative African countries is apparent. As discussed in Section 1, African society has traditionally been founded on the collective and not the individual, with individuals disciplined to follow and not challenge authority figures. For this reason, colonial education that taught servility to authority was perpetuated into the post-independence era. Only now, when that system of education has been shown to jeopardise the welfare and future of nations by producing graduates ill-equipped to cope with a 21st century world, has this old mode come into question. Adapting will not be easy. This is evident by the persistence of corporal punishment; whereby overburdened teachers beat children for not learning lessons out of fear that if the teacher’s class does not do well on exams then the teacher’s livelihood is in jeopardy. Learner-centred education that stresses a child’s development, rather than a child’s marks, will ease such pressure on a teacher. Learners themselves become part of their education process, by designing and executing projects. They become instilled with an excitement about education that has been demonstrated when this mode of learning is tried. New methods of assessing student’s academic accomplishment are being devised whereby measurements are made in terms of individual growth rather than test percentages.

The new model considers the work of education as done by and with the learner; and there is no average learner. The pedagogic vocabulary is being adapted to describe a system where learners follow individualised syllabuses on computers that are programmed with the child’s strengths and weaknesses to produce a programme designed to navigate the child through the class curriculum. “Competency-based” now means the student paces himself or herself with regards to what he or she is capable of learning. “Learner agency” means a student chooses which format he presents to his class what he has been learning – a written report, a video or even a play. “Socially embedded” means a time period when students discuss what they are learning in terms of their own lives, their communities around them and what they hope from their lives ahead. In the old system, education is something imposed on children. In the new system, children have a major role in educating themselves, buttressed by a professional support infrastructure of teachers and technology.
All of this requires a shift from standardised learning to specialised learning. Standardisation used to be prized for its efficiency at moving a maximum number of students through the education system, from pre-school to 12th grade. Worse, graduates are not equipped to meet the 21st century world’s need for adaptable, creative thinkers. The standardised system may seem necessary because of a lack of funds required to support learner-centred education, however, changing economic and societal circumstances are hastening its retirement, whether cash-strapped governments welcome the change or not.

3.4.2. Outside-the-classroom learning (i.e. eLearning)

e-Learning is a formalised teaching and learning system specifically designed to be carried out remotely by using electronic communication, usually the internet. With the rising increase of technological advancements, it is expected that the way people choose to learn will change from the traditional routine to stepping outside of the classroom into the digital sphere. This makes learning more accessible to both students and employees. Online learning allows students to access course material, take and submit assignments, and attend classes offered by higher institutions based all over the world, virtually.

e-Learning has the potential to create the desired impact in efforts to widen access to higher education with success. For instance, the DHET noted that while distance education is well-known for increasing the educational reach of institutions and for providing learning opportunities to many who would otherwise be deprived of formal learning, open learning (such as that offered by UNISA, EdX and Coursera), may use the benefits of online and e-learning to achieve this end. The following advantages of e-learning include:

- Online learning platforms place a strong emphasis on higher order thinking as students have to analyse or create something to prove they have integrated their new knowledge.
- Students can demonstrate their adaptability and acceptance of change by being open to learning new skills.
- The integration of different students from different backgrounds working together on a common goal fosters collaboration.
- Learning becomes more active and dynamic when compared to traditional in-class learning, allowing it to be centred on the students and their learning, instead of focusing on the classroom activities.
- Access to a vast quantity of resources is possible at lower cost.
- Learning can be differentiated pedagogically – it can accommodate different learning styles, allowing students to work at their own pace and facilitate learning through a variety of activities.
- New tools and social media encourage collaboration between students and the community, without barriers of space and time.
- Those same tools allow for the development of virtual communities that can persist after the program/course is completed.
- IT and the Internet can transform processes and institutions, thereby innovating ways of teaching and learning and opening the door to new pedagogies.
UNISA is viewed as being ideally placed to play a leading role in increasing access to higher education for marginalized communities and to support high-level capacity development beyond the borders of South Africa, especially on the African continent. As Africa’s largest and the only dedicated distance learning institution, UNISA has the necessary capabilities to support structured and sustainable e-learning. Government views e-learning as a new knowledge-based industry, able to leverage the advantage of advanced educational systems to create educational products and services that can be marketed internationally, which is similar to the DHET approach.

E-learning is vitally important in the fight against poverty, underdevelopment and marginalisation.

Ghana makes use of a programme called Wolo, which is an e-Learning initiative designed to offer high school education as well as skills training to Africans. Through the power of technology, students in high schools will be able to access quality teaching from some of the best educators from the elite schools in Ghana, regardless of where they are situated. Wolo delivers a learning experience through multiple online platforms, including web, mobile applications, and digital television.

Through live video and on-demand feeds, students have flexible options to study at their own pace, anywhere and at any time. The platform also offers opportunities for hands-on tests with a large library and bookstore providing the needed literary materials. Wolo also offers a skills training program that is designed to empower and enhance human capital by offering practical knowledge. This is an out-of-classroom experience that has the potential to engage the entire African nation.

3.4.3. Learning with Augmented Reality (AR) and Virtual Reality (VR)

Hyped as one of the tech trends in education to watch, Augmented Reality (AR) is a relatively new media tool. AR adds information, or otherwise enhances, a real-world environment. For instance, a student with an AR application could aim the camera of a smartphone at a map of a town and data is superimposed over the picture – such as landmarks, types of trees, distances and the types of clouds in the sky. Virtual reality (VR) takes this process a step further by creating an artificial reality that is viewed through headgear and heard through headphones. Both tools have applications for learning, however, VR requires an investment in expensive equipment. VR is rapidly changing and is in the experimental stages, hardware is in danger of quick obsolescence. AR is also new, but the advantage is that most students today possess smart phones, and many schools have already invested in tablets that can be used for AR purposes.
AR requires a processor, display, sensor and inputting device – all of which are contained in a smart phone or tablet. Of course, more sophisticated and costly AR technology is available, such as a head-mounted display (HMD). Some of these are as small as eyeglasses, although such devices are, for now, outside the affordability of school systems. AR, like VR, can be a total sensory-immersive experience, including audio, but then arguably removes the student from reality, like VR. AR can be used for gaming, which is an update on in-class games used for education purposes and ties in with today’s youth’s fascination with gaming.

Promoted by its advocates as a way to chase the boring out of the classroom learning experience, AR has proved to engage students and is a physical example of the intersection of 4IR and education. AR allows instant visualisation of a situation, which aids problem-solving. The lessons taught are interactive. Nothing gets done without a student’s involvement, which is an advancement from the student being a passive receptacle for information heard from the teacher or read on a blackboard or in a textbook. AR advocates argue that the use of AR will save schools money because lessons can be taught on devices like smartphones. However, at this stage in their development, smartphones cannot substitute for a textbook and are costly. Some of the impediments associated with AR are:

Figure 40: Difficulties encountered with AR learning methods

Costs of mobile devices are a barrier for many African students, unless they are sponsored or subsidised

AR quality varies depending on devices, so some standardisation would be necessary

Hardware is not indestructible and needs to be replaced every few years, increasing AR operating costs

AR programmes require extensive memory and bandwidth to be functional, both of which require good internet infrastructure

Teachers need to be trained in how to use this technology

However, AR is an innovation whose advancement is inevitable in 21st century education. Educators utilise what has proved to work, and AR has proved to be a good way to engage students, making them more interested in subjects and able to visualise and better understand difficult subjects, like maths and the sciences. Students can manipulate 3D models to comprehend complex problems, giving them a visual and tangible representation of what is being asked.

A look at AR applications at each level of learning shows why the advocates of this mode of teaching are enthusiastic:

- For pre-school and primary school, AR makes effective flash cards, allowing items and concepts to come to life with sound and movement. AR video can demonstrate any process or identify any object, from insects to planets. AR flashcards and programmes also allow children to improve their counting and number identification skills.

- At high school level, AR explains core topics with 3D illustrations, such as allowing exploration of the inside of the human body for science class. The AR app Arloon Plants teaches botany through illustrations of all plants and animation of plant growth.
- For self-learning, a number of applications are available, such as Google Translate, Starwalk (which teaches astronomy) and Aurasma (which teaches creativity in technology by allowing the user to create their own AR experiences). The latter is a preview of where AR teaching will ultimately lead – teachers and students creating their own programmes, based on their personal needs and interests, in which they can study and understand a subject and work through a curriculum.

3.4.4. Gamification in learning

Games as a method of teaching are as old as education itself. Field trips where students are given assignments to identify trees and animals are adventure games. Flash cards are some of the many ways that card games are employed in education. Today, gaming is used in reference to video games, and gamification in learning refers to the integration of video games into teaching. All games designed for educational purposes are aimed at teaching about specific subjects, but also to expand the learning of concepts and to reinforce a learner’s development as a type of educational supplement. Educationalists realise the value games have on learning, and gaming had become a part of the education process long before video games. Games are a form of interactive play that teach goals, rules, adaptation, problem-solving and interaction with others; as well as narrative, because games are often devised in the form of a story.

Games have an advantage as a teaching tool because of their ability to get the player passionately involved in a process. While teaching necessary concepts like structure, games involve their players by providing rewards, which inspire motivation and lead to ego gratification with the reward of winning or accomplishing a goal. However, losing is also taught as acceptable if the player learns from the experience. With goal attainment, a process analogous to a series of battles in a war, no one is ever truly a loser as long as the process continues. Meanwhile, the player enhances their creativity, finds emotional release and engages in social interaction. One concern about gaming is that it leads to isolation and reduces learner-teacher interface time. This need not be the case because the choice of game can ensure group participation and teacher involvement.

Figure 41: Benefits of gamification in learning
Educators have had success in transferring the popularity of video games among today’s youth to the classroom. Game designers have turned their efforts toward classroom instructions, and in some cases have adapted popular games like Minecraft to teach lessons. As a result, hundreds of apps and online programmes exist for every curriculum need imaginable, at all levels of learning. Everything from maths to reading, languages and sciences, music and art, history and culture all have associated educational video games. Video games also fulfill the 21st Century education imperative of having the learner become an active participant in his or her own learning.

For African schools, cost is a factor, particularly measured against such basic competing needs as simple blackboards and other infrastructure. Several organisations provide grants or assist with financing video and computer technology. Some advocates of educational gaming are shunning the name video game in favour of “digital play”, which they feel more accurately describes how a learner participates in this mode of education. A refined concept is Game-Based Learning (GBL), which has a more targeted aim of educational targets achieved as the student plays games. The goal is for the player to retain knowledge of what is learned from a game and apply this to the real world. GBL begins with the simplest game, Hide and Seek (which can be taught via augmented reality as a video game or immersive virtual reality). The hider develops visual and spatial knowledge of an environment to determine the best hiding place, just as the seeker takes cues from the environment for where best to look. One such sensitivity is learned, the knowledge can be transferred to new environments. In a sense, all gaming grows from the simple concept of hide and seek, whereby knowledge is discovered through a process of discovery.

Gameplay requires comprehension – of the rules of the game itself, of the roles of the other players, and of the environment. Gaming requires skills (and teaches those skills through the act of playing) and the mental work of devising strategies in order to win (with winning usually defined as achieving knowledge). Games teach analysis. This mirrors the learning process – games provide clues (bits of data), but the player must be able to string the clues together to advance and reach a goal. The game stands still until a player takes action and this fits perfectly with the 21st century education goal of having the learner proceed at his or her own rate and, in effect, design his or her education in an interactive way. As one educationalist put it, “The 21st Century learner is expected to be a critical thinker, make informed judgments, be a creative problem-solver, communicate and collaborate with others, use information in innovative ways, and take responsibility for himself or herself and others. Gaming provides the avenue for all of these skills to be in play.”

3.5. Governance, Policy and Support Systems

How education evolves in Africa will be determined by government policies toward education that reflect the needs and desires of nations and communities, and the success of support systems to carry out these policies. When it comes to education, the African public is conservative. The education of girls was a policy put in place against popular will in many places. Vital to people’s health, sex education is still a controversial topic in many African communities. Therefore, educationalists are leaders of their communities when it comes to what is taught in school (evolution, for instance) and how.

At present, the needs of 21st century education require a remodelling of the classroom and a reformatting of how curriculum is taught. Today’s schools in South Africa and elsewhere follow 20th century pedagogic mode of knowledge acquisition, gauging success by students’ results on examinations. 21st century education teaches the process of perpetual learning, with education acquired not only from an outside agent (teacher, instructor, mentor, etc.), but learning acquired by the individual who has developed the skills of critical thinking and analysis. At the same time, today’s education system stresses interaction with others, unlike 20th century education where the individual learner absorbs knowledge and takes an exam. Modern education stresses hands-on participation of a group. Projects are the centre of such learning and these are critiqued by everyone in order to teach that there is no success or failure. Rather, setbacks are seen as valuable to learn from and which lead to a solution that itself is ever-changing as new circumstances arise.

As indicated in Section 1, the South African government sees 21st century education in terms of merely introducing more technology-oriented studies to the curriculum, rather than remodelling the classroom mode and emphasis of teaching. Minister of Basic Education Angie Motshekga has effected a policy of training
thousands of teachers in computer coding in preparation for the introduction of coding as a subject to be introduced in 1,000 schools in five provinces starting in 2020. Classes in robotics for Grade 9 are also being introduced. President Ramaphosa wants teachers and students to be trained to “respond to emerging technologies” by learning about those technologies as they would any other subject.

This goal, however, cannot solely be achieved by learners trained to be critical thinkers and independent, creative problem-solvers. This basic concept appears in some documents in conjunction with South African and other country’s education policies, but the means to actually achieve the new paradigm of open classrooms, out-of-classroom learning, and gaming, are not offered.

This lack of action by government may be due to their reluctance to embrace the expense of restructuring education; or the resistance of powerful teachers’ labour unions to change. Also hindering momentum are competing and sometimes confusing proposals which agree on goals, but not how to achieve them. This debate is also being carried out in Kenya, another country with a well-developed education system and facing economic growth tied to the 4IR. In Ethiopia, a country whose first education policy was only promulgated in 1994 and was highlighted by an endorsement of education for girls, education is tied to fulfilment of national development agendas. Ethiopia’s sluggishness at adopting new education techniques has prompted its brightest students to seek education abroad. A review of other African nations’ education policies reveals a struggle to meet basic education infrastructure and achieve universal education, with a current aim at achievement using 20th century standards. Educational support systems such as textbook publishers respond to the direction (and contracts) presented by national education ministries and local school boards. While international support systems in ICT offer assistance from Microsoft software, Facebook apps, and Apple computer hardware, at a discount or as outright grants, these are also utilised within the directives of curriculums and schoolwork environments dictated by education ministries.

In addition to the private sector businesses that provide school textbooks, materials, hardware and ICT, a wide support system must exist to meet the needs of schools at the local level. Schools are an important part of any community and require community involvement. This is nothing new to African culture, where it has always been considered the responsibility of all to educate new generations – “It takes a village to raise a child.”
One concept integral to education in the 21st century is lifelong learning. While human beings are constantly learning through new experiences as they grow older, a formal structure is required that duplicates the childhood classroom experience. This is particularly necessary in the rapidly evolving employment situation of this century, which requires upskilling and reskilling. Here the communities provide solutions ranging from volunteer study groups to community colleges.

Public-private partnerships are accepted ways that African governments are achieving SDG goals. In terms of education, these partnerships have been directed at financing school infrastructure and providing learning tools. Actual education reforms to align learning with 21st Century education are lacking from the public-private partnership equation as a result. One solution is for educationalists in the form of academic researchers to propose to government and the private sector what is required. This work could be done through existing educational bodies, such as teacher groups or scientific grant councils such as the National Research Foundation in Southern Africa, the National Council for Science and Technology in Eastern Africa, and the Programme d’Appui Stratégique à la Recherche Scientifique in Côte d’Ivoire. However, this cannot be an academic exercise in order to succeed, but must be a real-life initiative involving school principals, teachers and students themselves. Ultimately, education is a local concern and an individual matter.

In terms of curriculum, local support is essential. Grassroots understanding of education innovations is required if these are to be implemented. Parents and stakeholders must be briefed so they will comprehend and approve; and not in any way hinder the introduction of a new subject or mode of teaching. A learner’s education is a collaborative process, which for a child involves parents and for an employee involves colleagues. Also incorporated into the process are outside institutions like churches for religious instructions and federations for apprenticeships. In South Africa, communities have been called upon to provide security for their local educational infrastructure, as when a wave of vandalism burned and destroyed schools in the Limpopo province.

3.6. Community and Stakeholder Mobilisation

The need for community and stakeholder involvement in the raising of education standards is well known to educationalists. Studies into the challenges that have inhibited such involvement have been undertaken. Experimental programmes to present innovative ways to boost community participation in formal learning have followed. For instance, a study was undertaken in Masvingo Province in Zimbabwe on ways that school principals have increased their resources, financial and otherwise, by mobilising rural populations. The school-community partnerships that were started there materially improved teaching and learning conditions, and provided a template for similar programmes in other rural areas within Zimbabwe and elsewhere.

The Community Mobilisation for School Improvement project was initiated by the UK-based organisation Link Community Development in 115 rural or impoverished communities in Ethiopia, Ghana, Malawi, Rwanda and Uganda. These communities are resource-poor, and inciting participation of community members proved a challenging goal. However, the process succeeded in using residents’ ideas on how to allocate education budgets to achieve actual change by pressuring local authorities into responding to constituents’ needs. As this was done, the gratification of community members spread, and more residents participated. School Performance Appraisal Meetings in every community were scheduled. “These are ground-breaking public meetings, informed by empirical data (based on learner testing and rankings against standards), to discuss why education at that community’s school is not up to required standards,” the NGO reported. The meetings set targets, energised residents with roles each parent or stakeholder could play, and also became platforms where issues like gender and HIV/AIDS were addressed.

It appears that such efforts are best suited for countries with decentralised governance agendas, like Kenya and Uganda. In these cases, education projects were designed from the bottom-up, so that working documents were informed by grassroots voices, rather than the usual top-down process. Thus, a chief goal of 21st century education was reached: individual and community ownership of the education process. The project concluded with the establishment of permanent School Improvement Committees. 2,135 individuals were trained to serve on these committees. Learner test results improved at schools. 185 Parent-Teacher Associations were also trained to work with schools on education improvements.
Parent-Teacher Associations have long been a way to involve the outside community with the affairs of local schools. However, the drawback to such bodies is they are comprised by only two sets of stakeholders, parents and teachers. Because it takes “a village to raise a child”, all of the community must be involved in educational issues. Here the media can take a part with news coverage that stresses the importance of educational developments for the entire community, so that non-parents will read and watch such items. For example, the economic impact of education reform can be emphasised, along with the reduction in crime that good education accomplishes, and the overall rise in standards of living of a population that can then afford to pay for even more improvements in public services.

Community mobilisation can be viewed as just that – mobilisation – to be effective. This requires an action plan to raise awareness and public interest. The media is a portion of this campaigning, but also community meetings, parades through urban centres, displays in public areas, and engagement with leaders of important civic groups such as traditional and religious leaders. International organisations like UNICEF have used public mobilisation campaigns to raise awareness of children’s rights issues, and the World Health Organisation (WHO) has mobilised communities for support in vital awareness campaigns against HIV/AIDS and other health crises. The WHO has compiled a “how to” directory on successful community mobilisation. Specific to mobilising youth in a cause that directly affects them, the NGO Advocates for Youth has worked with the US Centre for Disease Control to reduce teenage pregnancies. A programme of action to duplicate, from engagement to fundraising, has been outlined from the group’s experience as a guide for such youth mobilisation efforts.

In the end, the goals for community mobilisation are to forge individual and group partnerships that effect change in three modes:

![Figure 42: Types of changes by individual and group partnerships](image)

If 4IR strategies are to be implemented across Africa, it is imperative that communities are consulted and involved so that they are embedded within the socio-cultural context.

### 3.6.1. Empowering the disadvantaged through the 4IR

A disadvantaged individual is defined as a person of unfortunate circumstances usually in terms of their social and financial position. The category includes the poor and the elderly as a demographic, as well as the unemployed. The disadvantaged could also be rural residents when non-urban life comes with inherent economic and societal disadvantages. Other innately disadvantaged persons are the physically challenged, members of lower social castes, slaves as in Mauritania, or the descendants of slaves in Nigeria. At the start of the 21st century, gender still determines who is born at a disadvantage. Prevailing cultural norms in both the developed and developing worlds have ensured gender discrimination. Despite rising levels of education, women continue to be underrepresented in the paid workforce, especially in high status jobs. On average globally, women have less than two-thirds of the economic opportunity that men have, and the rate of progress is stalling, with current forecasts to economic parity at 170 years.
The democratising nature of 4IR technology – its ability through lower costs and universal access to allow ICT to be used by anyone – will go a long way to address societal discrimination. However, attitudes unfavourable to the education of girls and the physically and mentally disadvantaged, as well as some prejudice that exists against rural residents and the poor, must be simultaneously overcome on a societal level. Governments have pledged their dedication to gender equality goals and poverty eradication as well as universal education in their ratification of SDG goals. ICT enables access to tools and services that some groups would otherwise not have. For example, one of the greatest scientific minds of the last generation, Dr Stephen Hawking, was unable to speak or move, but pushed physics to new territories and contributed to the birth of the 4IR. ICT allowed him to speak and move.

Similarly, ICT will increase disabled persons’ access to participate in academic, workplace and other activities as never before. This is particularly impactful in Africa, where persons with disabilities are generally consigned to lives of poverty, thus placing them in two groups of the disadvantaged. The essential tool of participation in the 4IR, the human mind, is not tied to physical conditions of movement, sight, voice or hearing – even as ICT and 4IR medical science are working to assist people living with disabilities. An estimated 15% of the world’s population lives with some kind of disability – a demographic too large to ignore. As people with disabilities and women continue to excel in various fields, societal inhibitors against them are falling, which frees up more human capital to accelerate the process of human equality.

The emphasis on lifelong education, upskilling and reskilling that are the hallmarks of 21st century education means that the benefits of the 4IR are not limited to the younger generation, but are spread throughout age demographics. Indeed, even the eldest of society’s members will be affected by 4IR advances through the way they get around (autonomous vehicles that need no human driver allow the freedom of individual movement even when the vehicle occupant is denied a driver’s license due of age), to financial transactions, to voting (bio-technology used as identification for voters), and even getting into their homes (facial recognition technology to unlock doors). Online employment will allow the elderly to continue gainful employment long after they are forced into retirement by today’s arbitrary age standards. The potentially equalising effect of the 4IR on society will also assist with erasing the rural-urban divide, and lessening poverty. Both goals involve the creation of employment through new technology, to the benefit of the urban poor, or expanding agriculture using technology to make rural residents more prosperous.
3.6.2. Fostering partnerships between different stakeholders

The potential of the 4IR, as well as the goals of 21st century education, cannot be met without the full participation of society’s major stakeholders. Each holds title on a particular segment of the 4IR equation that requires all segments to work in harmony. Governments control the use of public resources; universities control the higher echelons of the education system that are expanding to include more tertiary-level learners; corporations control allocation of the resources of the private sector; and labour unions control the allocation of the resources of the workforce. Self-benefits motivate all these actors to become involved with initiatives that foster 4IR growth: reaping the rewards for pro-actively embracing the coming change and avoiding the pitfalls of being side-lined by failing to manage that change.

The main motivator to bring these stakeholders together is the economy. All four primary groups mentioned benefit from robust economic growth promised by the 4IR. Because these benefits must be realised through education systems, from preparing children for the 4IR world to vocational training and upskilling/reskilling, partnership initiatives tend to involve education. In South Africa, an inclusive partnership model has been put forth by the 4IRSA Partnership, founded in 2018 by the CEO of the Telkom Group, Sipho Maseko.

With the project receiving the endorsement of President Ramaphosa, immediate partners signing on to form the initial 4IRSA partnership were the vice-chancellors of the universities of the Witwatersrand, Johannesburg and Fort Hare; next to join was the South African Government via the Department of Telecommunications and Postal Services (DTPS); the accountancy firm Deloitte joined as the first private sector players; and The Cabinet of the Republic of South Africa endorsed 4IRSA at the Digital Economy Summit on 15 February 2019. At present, the 4IRSA is focused on process; before specific ICT and other targets are set, societal awareness of the 4IR must be raised, doing so by utilising an expanding pool of stakeholders. One necessity recognised in stakeholder workshops held by the 4IRSA in early 2019 is, “There needs to be a shift in the relationship between workers, workers’ unions, and executive management in companies and organisations, and better collaboration between these social actors in order to work towards a shared set of values and common goals pertaining to 4IR. Adequate and meaningful collaboration between large industry players and smaller entrepreneurs is essential to build an inclusive community.”

The stakeholders also recognised that labour unions must be on board for 4IR reforms because of expected labour shifts, which will change to include a need for more artisanal and technically able people and specialists, all familiar with the utilisation of new technologies. ICT skills development should be more broad-based and inclusive, requiring workforce ecosystem structures to move quickly so that no worker is left behind. While the automation of manual work is expected to result in a reduction in repetitive and heavily manual tasks, the creation of new jobs will only be possible through targeted skills development. Some workers will not be able to
make the transition or earn previous salaries. For these, financial safety nets must be in place via government programmes. Again, labour unions must be on-board with initiatives to mitigate the effects of the 4IR on some workers and to support training for new job skills. The danger is that unions may choose to be disruptive because members fear job loss.

Various models have been successfully practised to create public/private partnerships to meet SDGs and African nations’ development priorities. The World Economic Forum has assembled a database of international NGOs and private corporations that partner in 4IR initiatives. Many such initiatives tend to enrol government as an implementer of programmes to assist various segments of society. However, 4IR will also transform governance itself, with technology performing human functions today such as AI that will do government audits and handle tenders. The use of AI will free these procedures from human errors and corruption. Governments must include themselves in skills sharing initiatives today in order to support the development of leadership and human capital capabilities for future generations of civil servants and policymakers.

3.7. Reflections, challenges and recommendations

Reflection 1: Teacher capacity

- **Challenge: Learner demand is not being met** - There is a shortage of teachers across Africa and, where there are teachers, often they are not properly equipped to instruct in their subjects.

  - **Recommendation:** Incentivise teachers by offering professional development pathways and continuous learning. Education in the 21st century requires constant upskilling for teachers to understand and participate in pedagogic and technological advances in the classroom.

  - **Recommendation:** Enable teachers to use digital technology to streamline the teaching experience, such as online assessment programmes and educational content repositories.

- **Challenge: Many African teachers do not possess basic ICT skills** - Due to a number of reasons, ICT skills are in short supply across the continent. The effect on teachers is that they are not able to adopt new technologies or use them in a meaningful way in the classroom, and the effect on students is they are not exposed to ICT from a young age.

  - **Recommendation:** Acclimatise teachers to ICT in technical subjects and infuse all subjects with ICT-related skills. The biggest hurdle is the change of mindset of teachers who must adjust to an entirely new reality of imparting knowledge. Recommended by educationalists as part of teachers’ upskilling is adaptability instruction – that is, instilling flexibility in a teachers’ mindset as they conform to new teaching imperatives such as open classrooms, out of classroom teaching and the most basic change of all: the new relationship between teacher and student. This role finds students as participants in their instruction and teachers as more than explainers of curriculum subjects but partners in learners’ voyages of educational discovery.

  - **Recommendation:** Provide teachers with instructional support in how to bring ICT into the classroom.

- **Challenge: The role of teachers is evolving** - While teachers were once simply the interface between students and knowledge, in the modern age they also act as mentors, counsellors and parental figures. Already over-constrained teachers are less likely to be able to wear many hats.

  - **Recommendation:** Use digital resources to boost teacher capabilities, such as online counselling courses.

  - **Recommendation:** Continue upskilling teachers throughout their careers. The difficulty lies in building upskilling instruction into teachers’ schedules and incorporating this expense into the tight budgets of educational systems.
Reflection 2: A changing world

- **Challenge: ICT infrastructure in Africa is not yet adequate** - In order for ICT to be adopted as a *modus operandi*, there needs to be sufficient infrastructure in place such as broadband and abundant mobile towers. This is a capacity and cost challenge first and foremost.
  
  o **Recommendation:** Use public-private partnerships strategically to plug the gaps. Innovative financing mechanisms such as impact investment can attract foreign funds into African countries for ICT infrastructure.

- **Challenge: African teachers need to keep pace with ever-evolving, ICT-focused pedagogic techniques** - In the Information Age, change is the only constant. Teacher training needs to be dynamic and responsive to trends, as well as interpretive of learner results, especially when new teaching methods are implemented.
  
  o **Recommendation:** Ensure that teacher education does not stagnate and that it responds to global trends as well as addresses micro-level needs.
  
  o **Recommendation:** Create an enabling environment in which teachers have access to contemporary resources and technologies. This can be achieved through internet and mobile device access and strategies implemented through tools such as VR/AR and gamification.

  o **Recommendation:** Create a monitoring and evaluation system that keeps records and results on new teaching methods implemented. If governments are able to track these changes, the national best practices can be honed and shared throughout the education environment.

- **Challenge: Development needs in Africa persist** - Under-development, disparities in resource allocation and pervasive inequalities are some of the development challenges experienced by African countries. It is difficult to imagine a reality in which ICT prospers within this context. The challenge of utilising the education sector to achieve developmental goals is that education is itself a developmental goal, in national development plans, the SDGs and Agenda 2063.
  
  o **Recommendation:** Facilitate ICT education development alongside social development. One cannot exist without the other in the 21st century. Education in particular is integral to the realisation of the other SDGs.
  
  o **Recommendation:** Use ICT to meet development needs, such as empowering disenfranchised groups to participate in education.

Reflection 3: Education and the economy are interdependent

- **Challenge: Without the other providing a strong support base, education system and economies are doomed to fail** - Education systems are reliant on their economies to be properly funded and informed by current needs, while economies depend on education systems to provide future-ready workers. Education is a driver of economic considerations both for an individual whose earning potential is pegged to his or her academic achievements, but also for society as a whole, which benefits from more educated citizens. Occupations and jobs come and go, but economies are in constant need of adaptable, independent and creative individuals.
  
  o **Recommendation:** Curricula should be informed by 4IR skills, such as critical thinking and problem-solving.
  
  o **Recommendation:** Economic actors should fund and help to develop education programmes.
Reflection 4: Financing a 4IR education

• **Challenge: African governments are struggling to fund education systems** - Developing countries generally do not collect taxes from a broad base of people, therefore budgets are small. Without going into major debt to fund education programmes, governments are forced to think innovatively about financing education. In particular, with regards to the 4IR, large financial outlays are needed to initiate and sustain education programmes.

  o **Recommendation:** Absorb the costs in the short term to benefit the future. Investments in 4IR education are investments in future citizens, economies and livelihoods.

  o **Recommendation:** Tap into SDG-specific financing through consultations with other global stakeholders. NGOs are also offering innovative education solutions to get around budgetary constraints.

Reflection 5: Systemic, community and political support for 4IR

• **Challenge: There is not always a political will to adapt to the 4IR** - Some African countries, such as South Africa, endorse 4IR as the way forward. However, endorsement at a national level and at a provincial/municipal/district level are distinct. Some politicians bemoan the exercise as a financial black hole or obstacle to job creation.

  o **Recommendation:** Position the 4IR as an inevitability, one which needs to be adopted as soon as possible. It can be framed in terms of other countries’ success stories to win the hearts and minds of politicians.

• **Challenge: Systems are made up of diverse stakeholders, not all of whom buy into the 4IR** - Systems do not just comprise of politicians and bureaucrats. Communities and families play an important role in enabling the rollout of the 4IR, as do non-governmental organisations and private sector actors. Communities are the support systems of education - African societies have always looked after the education of their children, and the danger today is that education be delegated to educationalist like teachers and education ministries.

  o **Recommendation:** Engage with stakeholders to get their support, thus inviting collaboration and knowledge sharing instead of bottlenecking and barricading the 4IR education programmes.

  o **Recommendation:** Mobilise community resources to supplement state contributions. This can take the form of financial resources, indigenous knowledge and socio-emotional support.
### 3.8. Example of African Excellence

#### AFRICAN SUCCESS STORIES:

*Providing quality and affordable curriculum content to learners through mobile technology*

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>Kenya</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERVENTION</td>
<td>Eneza Education</td>
</tr>
<tr>
<td>FOCUS AREA</td>
<td>Innovation in Education Delivery</td>
</tr>
<tr>
<td>DATE</td>
<td>2011 - present</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>Revision and learning material via basic feature mobile phones</td>
</tr>
</tbody>
</table>

#### THE PROBLEM

As approximately 73% of the Kenyan population resides in rural areas, it is difficult to deliver full education services to children and adults of all learning levels and proficiencies. Furthermore, the cost and distribution mechanics involved in circulating learning materials to all students are detrimental to the education landscape and, as such, 70% of students do not have the adequate textbooks. Education providers are increasingly turning toward mobile networks, as they cover large regions of rural Kenya and do not require physical transport and production.

#### THE SOLUTION

Eneza Education offers services, conveyed through simple feature phones by Unstructured Supplementary Service Data, or USSD, that provide basic learning functions to students. These interactions include both revisions and learning materials, all communicated via a virtual tutor. Their results are enhanced by an “Ask-A-Teacher” function, which enables students to pose their difficulties to professionals, as well as peers. Finally, new knowledge is solidified via regular quizzes and data collected from these exercise help inform future decision-making.

#### RESULTS

Eneza Education was awarded the 2019 EdTechXGlobal Impact Award for its positive economic and societal impact, growth, scale and innovation. This is due to their impact in the lives of over 6 million learners, where academic results improved by 23% after 9 months. Their platform encourages high levels of interaction, as over 2 million messages are exchanged each day.

#### STAKEHOLDERS

Eneza ensures their content is relevant to the current schooling curricula, and therefore has established a partnership with more than 400 schools. These schools also assist in Eneza’s internal impact studies, which are implemented in selected schools for feedback that can improve systems. Telecommunication companies, such as Orange, Safaricom and MTN, are some of their principle partners, although many other NGOs and private companies looking to invest in CSR are involved. Eneza Education is an active member of the EdTech community, a forum for professionals in the Education technology field around East Africa, who come together and share insights that help improve the quality of their work in education delivery.
4. A PAN-AFRICAN APPROACH TO CURRICULUM DESIGN AND PEDAGOGY

4.1. The Role of Education in 21st Century Africa

4.1.1. Introduction

Having broadly considered the current state of education in 21st century Africa, along with key trends in the ongoing evolution of African education, we are now well positioned to consider the possibility of a distinctly Pan-African approach to curriculum design and pedagogy with regards to the 4IR. This is particularly significant in light, not only of the rich historical legacy bequeathed by the Pan-African movement, as exemplified by revolutionary figures such as Kwame Nkrumah, Muammar Gaddafi, Malcolm X, W. E. B. Du Bois and Marcus Garvey, but also of contemporary calls for an African Renaissance capable of advancing uniquely African interests through the development of an African knowledge economy, as championed by former South African president Thabo Mbeki.

In this regard, this section will evaluate global curricula trends in the context of advancing indigenous knowledge economies and cultural capital in Africa in the 4IR, followed by an assessment of relevant influences and issues for African curriculum design. Once having considered these themes, the section will outline a number of key reflections, challenges and recommendations. Before doing so, however, it is necessary to take a step back and critically contextualise the 4IR and related 21st century trends in relation to Pan-Africanism and the call for an African Renaissance, thus setting the stage for further reflection.

4.1.2. Contextualising 21st Century African Education vis-à-vis the 4IR

First coined by founder and executive chairman of the World Economic Forum, Klaus Schwab, in 2016, the term “Fourth Industrial Revolution” has since come to assume global precedence as a descriptor of the ostensibly “revolutionary” technological advances primed to transform the very nature of world society. In the words of Schwab, the 4IR “entails nothing less than a transformation of humankind...In its scale, scope and complexity...[it] is unlike anything humankind has experienced before,” ushering in unprecedented changes across all major industries and social institutions, including education.

Marked by the rapid proliferation of emerging technologies such as artificial intelligence (AI), robotics, the internet of things (IoT), autonomous vehicles, 3D printing, nanotechnology, biotechnology and quantum computing; the 4IR promises to catalyse an exponential “fusion” of physical, digital and biological worlds, thus giving rise to radically novel futures replete with hitherto unfathomed challenges and opportunities.
Precisely what this means for education remains largely unclear as the link between education and the 4IR remains by and large unexplored. However, most commentators agree that the effects will be substantial, with curriculum design and pedagogy primed for deep disruption. More recently, Schwab has gone on to identify three main challenges associated with the 4IR, namely: i) ensuring a fair distribution of benefits; ii) reducing potential risks and harms, both human and environmental; and iii) ensuring that future development remains human-led and human-centred.

In the case of Africa, development has been profoundly stifled by the historical legacy of colonialism and remains highly uneven under contemporary conditions of neoliberal globalisation; such challenges are of particular significance. This is especially so given the rising levels of inequality characteristic of the 21st century, with sub-Saharan Africa (SSA) exhibiting some of the most extreme levels of inequality in the world alongside Asia and Latin America. Given the above, it is incumbent upon African leaders and policymakers to soberly and
critically assess the growing hype surrounding the 4IR and associated 21st century changes, for beneath the near ubiquitous celebration of this increasingly hegemonic discourse lies a welter of hidden complexity, not least of which involves the possible rise of unanticipated forms of techno-colonialism alongside deepening intra-African inequality. This is not to deny the potential benefits associated with emerging technologies, as epitomised by the case of Rwanda, where drone technology is currently being used to deliver life-saving medical supplies to otherwise inaccessible areas. However, far from constituting neutral mechanisms, emerging technologies must be understood as value-laden artefacts whose production and dissemination remain inextricably bound with broader structures and relations of power.

To paraphrase Deborah Lupton, “the age of ubiquitous computing...is also that of ubiquitous politics.” As such, in addition to the narrowly technocratic aspects of technological innovation, it is necessary to couple our understanding of the 4IR with a broader appreciation of the social forces implicated therein, thus requiring a coherent ideological framework capable of guiding future policymaking. This applies as much to education as to any other institution, particularly insofar as the public good is concerned.

4.1.3. Pan-Africanism, the African Renaissance and the Challenge of 21st Century African Education

How, then, are we to regard Pan-Africanism and the call for an African Renaissance within the context of the present discussion? As noted by Hakim Adi, “there has never been one universally accepted definition of exactly what constitutes Pan-Africanism.” What can be said with some degree of confidence, however, is that the multitude of existing approaches to Pan-Africanism converge on the presumably shared unity, history and purpose of African peoples, including those of the African diaspora.

Bearing this in mind, a special publication released by the African Union (AU) during its 20th anniversary summit in May 2013, representing the shared consensus of 55 member states and organised around the central themes of Pan-Africanism and the African Renaissance, asserted the following:

“Pan-Africanism is an ideology and movement that encourages the solidarity of Africans worldwide. It is based on the belief that unity is vital to economic, social and political progress and aims to ‘unify and uplift’ people of African descent. The ideology asserts that the fates of all African peoples and countries are intertwined. At its core, Pan-Africanism is a belief that African peoples both on the continent and in the diaspora, share not merely a common history, but a common destiny.”

During the same year, ICT and the question of Africa’s “e-identity” constituted topics of key interest, particularly in relation to problems of governance and regional integration. More than a simple technology, ICT was identified as “a tool for transforming society”, as well as a “critical enabler” of education. In a 2018 article written by Schwab, this sentiment was further echoed and reinforced by the claim that the 4IR requires “a new model of education, complete with targeted programmes for teaching workers new skills.” However, Schwab also noted that the 4IR is being accompanied by new forms of tech-driven inequality, as has been demonstrated by “developed” markets such as the US, where leading-edge advances in Silicon Valley have been correlated with rising levels of urban displacement and income inequality.

Furthermore, existing trends have also demonstrated a host of additional challenges associated with the 4IR, such as unequal access to technology, intensified labour precarity, new forms of discrimination and exploitation, digital authoritarianism and growing ecological footprints in the face of mounting climate emergencies. In spite of this, however, an appropriately managed transition into the 4IR may present promising avenues for local, regional and continental development by harnessing the powers of emerging technologies for enhanced growth, integration and democratisation. However, for this to be achieved, these very powers must be strategically mediated in line with uniquely African interests, thus explaining our call for “strategic mediation and mediative embeddedness,” which jointly entail the strategic harnessing of emerging forces of production within a critically attuned, context-sensitive, ideologically coherent African development agenda. In the words of Kai Hsin Hung, the key question to be asked is: “How can we transform these emerging risks into digital dividends that maximize co-beneficial outcomes?”

It is precisely in light of the above that the legacy of Pan-Africanism assumes utmost significance, for it is by virtue of the critical vision enabled thereby that we are enjoined to navigate the passage from past to future while avoiding “the violence of organised forgetting.” Furthermore, insofar as curriculum design and
pedagogy are concerned, it is imperative to note, in the words of Brad Evans and Henry A. Giroux, that "[there] are no neutral pedagogies indifferent to matters of politics, power, and ideology. Pedagogy is, in part, always about both struggle and vision – struggles over identities, modes of agency, values, desires, and visions of the possible." In the context of post-colonial Africa, this has been explicitly recognised at least since the time of Fanon, who, in his reflections on the pitfalls of national consciousness, argued that "[to] be responsible in an underdeveloped [sic] country is to know that everything finally rests on educating the masses", and that "education means opening up the mind, awakening the mind, and introducing it to the world." Thus, not only are existing structures and approaches to education primed to be profoundly impacted by 21st century trends, but education itself has an irreducibly significant role to play in upholding just, equitable and sustainable orders while guiding Africa’s transition into the beckoning future.

Confronted with this emerging frontier of risk, promise and uncertainty, we fall under the distinct obligation of having to ensure that African education allows for the continued assertion of Africa’s dignity and humanity amid radically transformed world-historical conditions. However, precisely what this means and how it is best to be achieved remains an open question requiring extensive consultation and cross-sectoral collaboration. Hence, we seek in what follows to offer suggestive reflections on possible ways forward, beginning with an assessment of global curricular trends and the value of tapping into indigenous knowledge systems across Africa, and following with an overview of relevant influences and issues for African curricular design.

4.2. Global Curriculum Trends

New technologies and the changing nature of work in the 21st century highlight the need to think critically about curricula across Africa, where “curriculum”, as it is often used, refers not just to what is taught but also to how it is taught, including the pedagogical practices and activities used for teaching and learning, and even the kinds of assessments used. Interrogating curricula in Africa must, in turn, be placed within a context of advancing the educational aims of the African Renaissance and Pan-Africanism, which are reflected in the AU’s Agenda 2063. Aligned with Agenda 2063, the mission of the AU’s Continental Education Strategy for Africa 2016–2025 (CESA) is: “Reorienting Africa’s education and training systems to meet the knowledge, competencies, skills, innovation and creativity required to nurture African core values and promote sustainable development at the national, sub-regional and continental levels.”

Any curriculum for the 21st century in Africa must therefore tackle developing 21st century skills while promoting African values and Pan-Africanism.

4.2.1. Indigenous knowledge and knowledge creation

‘Indigenous knowledge’ refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. Indigenous knowledge is mostly tacit knowledge and know-how, deeply rooted in context, experience, practice and values. It is integral to the cultural complex that embodies language, systems of classifications, resource-use practices, social interactions, rituals and spirituality. An important facet of the world’s cultural diversity and a foundation upon which locally-appropriate sustainable development can be built, indigenous knowledge risks being lost due to a range of factors, from younger generations not being interested in the knowledge systems due to their supposedly ‘unscientific’ nature, to a lack of documentation of indigenous knowledge to pass on from one generation to the next. Compounding this state of affairs in Africa, indigenous knowledge has largely been ignored in formal curricula and pedagogy arising out of a colonial legacy that prioritizes European systems of knowledge. In pursuing the African Renaissance, critical attention must therefore be paid to the role of indigenous knowledge in promoting African systems of knowledge, as well as the educational value it can bring to the curriculum and pedagogy.

Within Africa, indigenous knowledge typically involves a worldview of wholeness, community and harmony – cultural values that also underlie Pan Africanism – and has traditionally been passed down from generation-to-generation orally. For many people across Africa, local indigenous knowledge informs decision-making about
fundamental aspects of day-to-day life, offering bodies of knowledge in areas as diverse as botany, agriculture, medicine and social governance.\textsuperscript{CCXX} While indigenous knowledge offers bodies of knowledge, it is nevertheless importantly fluid in its nature, with knowledge creation a central and defining feature of indigenous knowledge. As Frannie Leautier, the former President of the World Bank Institute describes, African communities have always coped with changing environments, where “communities not only have knowledge about practices, they also have knowledge of how to adapt to adverse environments, institutions, and policies.”\textsuperscript{CCCXXI}

Figure 46: The SECI Model by Image adapted from Nonaka and Takeuchi

A core part of the creation of indigenous knowledge has come to be known as the SECI model of knowledge creation. SECI refers to socialisation, where tacit knowledge is shared through shared experiences, such as in conversation; externalisation, where tacit knowledge is converted into explicit knowledge through the use of metaphors and analogies; combination, where explicit knowledge is systemised and refined, such as by theory; and, finally, internalisation, where explicit knowledge is transferred to tacit knowledge, such as by being put into practice.\textsuperscript{CCCXXI}

Indigenous knowledge creation thus arises from the intersection of practical, collective and interpersonal domains, bringing together cultural heritage, individual input, interpersonal interactions, and changing environments. Crucially, indigenous knowledge is not static: its creation proceeds in a cycle and involves the making of new knowledge that fits changing contexts and environments, rather than the preservation of old canons.\textsuperscript{CCCXXI} Capitalising on indigenous knowledge for the 21\textsuperscript{st} century should therefore address two aspects to the kind of knowledge at stake: (i) the cultural capital that indigenous knowledge carries in its content that is relevant to local contexts, but also (ii) the adaptability of the knowledge and means of knowledge creation. When applied to questions of curricula and pedagogy, we need to ask, respectively, how education can be a vehicle for learning about indigenous knowledge systems, the content and cultural capital, and how indigenous knowledge, through its adaptability and means of knowledge creation, could be a model for education itself.

4.2.2. Adaptable indigenous teaching and learning methods in the 4IR

If knowledge has cultural relevance and context sensitivity, then we must be careful of assuming that a particular set of concepts and methods, such as those within Western thought, are universal.\textsuperscript{CCCXXIV} Acknowledging this, it has long been observed that African contributions to the global knowledge economy are noticeably missing from many school and university curricula and textbooks, even within Africa.\textsuperscript{CCCXXV} Education across Africa tends not to be used as a vehicle for indigenous knowledge education, something which pursuing the African Renaissance in the 21\textsuperscript{st} century should address.
The threat of losing indigenous knowledge systems is not just a worry in terms of losing cultural capital and ways of knowing. The very nature of indigenous knowledge offers a potentially rewarding model for education itself, especially in terms of its adaptability for knowledge creation. A key feature of the 21st century is constant change and the need to be adaptable, and education should prepare learners to engage with a fast-changing world in a way that is sensitive to the demands of their particular contexts. The model that indigenous knowledge provides could do just that, where making use of the SECI knowledge creation model could even have the potential to enable African businesses to expand their business by preserving and using indigenous knowledge in local markets.

Within curricula, indigenous knowledge offers a model of ways in which teaching and learning can be undertaken. Just like knowledge creation involves practical, collective and interpersonal domains, as reflected in the SECI model, so too do knowledge sharing and knowledge acquisition methods core to indigenous knowledge. The methods by which indigenous knowledge is shared include socialisation, cultural heritage, songs and folk music, traditional leadership gatherings, and story-telling. Bringing the practical, collective and interpersonal domains into teaching and learning methods could thus involve promoting the use of local languages, as has been successfully done to improve primary education in West Africa. Other potential methods modelled on indigenous knowledge include incorporating apprenticeships into actual instruction, highlighting both the practical as well as the collective and interpersonal domains, as children and youth learn to work together within their communities.

### Examples of relationships between indigenous knowledge and education obtained by cross-hatching types of education with modes of relationship

<table>
<thead>
<tr>
<th>Education as a vehicle for IK</th>
<th>IK as a model for education</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formal education</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction of local history, ethno-botanical knowledge, traditional music or crafts, etc. into the formal school or university curriculum</td>
<td>Use of local languages as a vehicle for learning in schools; adoption of traditional apprenticeship formats as part of instructional delivery</td>
</tr>
<tr>
<td><strong>Non-formal education</strong></td>
<td></td>
</tr>
<tr>
<td>Training local extension agents or administrative personnel in intervention methods that blend IK and Western scientific approaches</td>
<td>In addition to the above, building new educational dimensions into existing age group societies and traditional associations</td>
</tr>
<tr>
<td><strong>Informal education</strong></td>
<td></td>
</tr>
<tr>
<td>Making available through a variety of media information on different types of IK and their applications</td>
<td>Increased use of context learning and contextualised instruction</td>
</tr>
<tr>
<td></td>
<td>At a communal level, promoting increased contact and commerce with – and increased observation of – traditional artisans by the rest of the population</td>
</tr>
</tbody>
</table>

Table 11: Relationship between education and indigenous knowledge

Data adapted from the World Bank

### 4.2.3. Essential skills for the 21st century

Promoting indigenous knowledge should inform any curricula that advances the values of the African Renaissance. There are, however, other considerations to take into account that are specific to the challenges of the 21st century, both within and without Africa, and which overlap with aspects of indigenous knowledge, such as the bringing together of practical, collective and interpersonal domains. One of the strategic objectives of CESA, for instance, is to “ensure acquisition of requisite knowledge and skills as well as improved completion rates at all levels and groups through harmonising processes across all levels for national regional integration”. Meeting this objective requires, amongst other things, identifying the requisite knowledge and skills for 21st century success, what have been called “21st century skills” in global discussions. The Assessment and Teaching of 21st Century Skills (ATC21S) Project conducted a comparison of international skills and competency frameworks, identifying four broad but useful categories for thinking about the kinds of skills at stake:
4.2.3.1. Tools for working

The skills that fall under the category of tools for working are perhaps the most obvious set of skills for the 21st century, as they speak directly to having the right kind of literacies for using new technologies. Two such literacies are information literacy and informational and communication technology (ICT) literacy. These literacies refer to the ability to access and evaluate information or data, being able to manage that information or data, and having the technical know-how to use ICTs, what has elsewhere been called digital literacy. Other skills identified as tools for working are what the World Economic Forum labels as foundational literacies, including reading and writing, numerical literacy, scientific literacy, financial literacy, and cultural and civic literacy.

4.2.3.2. Ways of thinking

The category of ways of thinking picks out skills related to creativity and innovation, critical thinking, and learning to learn. Creativity and critical thinking are two of the higher-order skills and competencies required for the 21st century that are often referred to as the “4 Cs”, where the other two are communication and collaboration, and even sometimes referred to as the “6 Cs”, including also citizenship and character education. Skills like creativity, critical thinking and learning to learn are necessary in a context of flux and change; as the Director for the OECD’s Directorate for Education and Skills, Andreas Schleicher, describes, “because of rapid economic and social change, schools have to prepare students for jobs that have not yet been created, technologies that have not yet been invented and problems that we don’t yet know will arise.”

Creativity, as the ability to imagine and create new solutions to new problems, is thus central for meeting the challenges of the 21st century. Within a context of advancing African cultures and values, creativity is also necessary for building distinctly African societies and tackling social injustice, and the creative imagination is a tool of empowerment. Here, in particular, the adaptability of indigenous knowledge systems and means of knowledge creation, could be particularly relevant. Critical thinking, in turn, is the ability to identify, analyse and evaluate information to develop a response to a problem, working hand-in-hand with associated skills of problem-solving and decision-making. Learning to learn is the metacognitive awareness of one’s own learning. This ability aids adaptability in the face of changing landscapes and is a core component of being a lifelong learner. As the AU notes, one of the guiding principles of CESA is that “holistic, inclusive and equitable education with good conditions for lifelong learning is sine qua non [...crucial...] for sustainable development.”

4.2.3.3. Ways of working

The skills within the category of ways of working are skills of communication and collaboration, two more skills of the so-called “4, or 6, Cs.” Communication requires not only being able to communicate in traditional oral and written human languages, but also to use new communication technologies effectively. Constructing an effective tweet is different to writing an essay, which is different to writing a blog post that draws readership.
an African context where formal education is often conducted in European languages that are not home languages for many learners, addressing communication within the curriculum also requires thinking critically about the language of instruction even more so as we advance indigenous knowledge economies. Collaboration, too, takes on special significance within a context of Pan-Africanism. Technology is increasingly drawing diverse people together to work in teams in new ways, requiring communication in shared languages and also collaboration in a variety of online and offline forums. In promoting a Pan-African approach, CESA highlights the need for regional collaboration and solutions, with one of the guiding principles that harmonised education and training systems are necessary for intra-Africa mobility and integration.

4.2.3.4. Ways of living in this world

This fourth category focuses on human-centred skills, such as being responsible citizens, living sustainably, and having cultural awareness. The higher-order “4 Cs” skills seen so far - creativity and critical thinking (ways of thinking) and communication and collaboration (ways of working) – are sometimes bolstered with two more “Cs” to reach “6 Cs”: citizenship and character education, highlighting how skills for living in the world also incorporate character qualities that influence how a student approaches their changing environment. Qualities like being adaptable, resilient, having initiative and curiosity, and exercising leadership. Ways of living in the world generates specific demands within a Pan-African context, where a unified Africa requires developing skills necessary for conflict prevention and resolution – one of the strategic objectives of the AU’s CESA – and directly challenging the use of colonial languages in instruction, both for ensuring that learners are learning in their home language to aid cognitive development, and also for the promotion of culture and rights.

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<th>Ways of Thinking</th>
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<tr>
<td>Creativity and innovation</td>
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<td>Critical thinking, problem solving, decision-making</td>
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<td>Learning to learn/metacognition</td>
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<th>Tools for Working</th>
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<td>Information literacy</td>
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<td>Information and communication technology literacy</td>
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<td>Citizenship – local and global</td>
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<td>Life and career</td>
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<td>Personal and social responsibility - cultural awareness and competence</td>
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<td>Communication</td>
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<td>Collaboration</td>
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Figure 48: Essential 21st century skills
Data courtesy of ATC21S (2019)

4.2.4. Teaching and learning in the 4IR

When we take a critical look at curricula, we must look both at what is taught and at how it is taught. Global trends highlight that developing the relevant 21st century skills may require more than a simple information
transfer between educator and learner; it requires adopting pedagogical practices that are student-centred and individualised.

4.2.4.1. Features of the learner

Global trends in education during the 20th and 21st centuries draw heavily on cognitive and social theories of learning, with a key insight that learning involves a process of individual transformation as learners construct knowledge through active engagement and experience. The process of construction involves building on prior experiences and, especially in diverse classrooms like those found across Africa, learners will often come into a learning context with quite different starting points, at all levels of education. Learners will have different approaches to learning. Some learners, for instance, favour convergent learning styles which involve practical application of ideas, while others may favour assimilative learning styles, which involve processes of abstraction and theoretical modelling.

An implication of having different learning styles and different learning needs is that learners will experience the same teaching in different ways. Furthermore, the learning context itself can vary substantially from the playground to online forums, from rural to urban, from resource-constrained to resource-rich, or even from learners speaking the language of instruction to learners being instructed in a language that is not their home language. Learning is becoming increasingly technologically enhanced, with classrooms in the 21st century ideally providing computers and connections to the internet. Methods of teaching and learning therefore need to be student-centred and individualised, but also appropriate to the educational context at hand.

4.2.4.2. The role of the educator

Recognising the individuality of learners and the increasing use of technology in the classroom, the traditional role of the educator as someone who imparts knowledge is found wanting. Instead, the educator is someone who facilitates learning of the relevant skills in a way that is sensitive to the learning context and who the learners are. As effective facilitators, however, educators must be knowledgeable about the world into which the learners will be entering or returning; they themselves must have the relevant 21st century skills, including the various literacies. They must be adaptive and lifelong learners, able to respond to changes in the 21st century landscape as well as variety in the student body. Working collaboratively with the learners, educators must be able to communicate and collaborate. Lastly, educators must be sensitive to their learners and respect diversity, modelling ways of living in the world together with the learners.

4.2.4.3. Methods of teaching and learning

If we focus only on what is taught, a curriculum for the 21st century requires subjects or courses in, for example, digital literacy. However, as the World Economic Forum emphasises, technology needs to be embedded across the curriculum, not just as a topic to be studied, so that learners’ educational experiences mirror how technology is used in all sectors. Consequently, technology should be used not merely as an aid for the educator but as something learners themselves operate, such as through online learning or blended learning models like the flipped classroom. On the flipped classroom model, online tools such as YouTube videos or games provide instruction and practice outside of the traditional classroom, where game-based learning allow learners to model new situations while becoming proficient in relevant technological literacies, and can be used to gather data on learners’ progress and performance. Based on that data, face-to-face classroom time can then be used in a way that is personalised and addresses actual learning needs.

Furthermore, global trends emphasise how teaching and learning should be project and inquiry-based, allowing the students to build their own knowledge through a range of activities that directly target the development of relevant skills by solving real world problems, while incorporating a range of methods and tasks that can appeal to different learning approaches. Working in teams also targets the development of the skills related to ways of working and ways of living in the world, the emotional side of 21st century living. The activities must be appropriate for the age and level of educational attainment of the learner, requiring clear frameworks for how 21st century skills develop, designing learning and teaching activities, as well as assessments, that are appropriate to a given skill level.
4.2.5. **Assessment in the 21st Century**

Assessment in the 21st century must assess 21st century skills in ways that are authentic to how the skills would be used in the workplace and real life. In this way, assessments are considered most effective when they are in fact grounded in project and inquiry-based learning. They also need to be appropriate for a learner-centred focus and the constraints of a particular educational context. Current global assessment trends show a move away from purely summative assessment to establish what has been learned, useful on a national level for systems evaluation or for learners to demonstrate proficiency to potential employers, and towards increasing use of formative assessment. Using formative assessments during a period of learning, areas needing attention can be identified and learning activities appropriately directed while there is still time for intervention.

When it comes to assessing 21st century skills, however, much work still needs to be done to establish effective methods of observing and evaluating 21st century skills in action. Nevertheless, a growing body of literature gives insight into the direction that assessment may take. Take the literacies that fall under the category of tools for working. These can be assessed through, for example, gamification like Hong Kong’s Reading Battle, an e-quiz where learners answer multiple-choice questions on selected books in order to assess reading literacy while practicing their IT skills. Learners are guided by interactive prompts when they give a wrong answer and receive e-badges as they progress, competing with one another.

Gamification can again be used for assessing ways of thinking, skills such as critical thinking, creativity and learning to learn. A game like SimScientists takes the learner through a progression of tasks in an authentic online environment, requiring the application of critical thinking to perform the tasks. Importantly, gamification used as a form of formative assessment provides immediate feedback to learners so that they can track their own progress, aiding with learning to learn, while recording learner data that educators can use to inform teaching.
According to their website, SimScientists is “comprised of a portfolio of research and development projects that focus on the roles that simulations can play in enriching science learning and assessment.”

The category of ways of working highlights skills like collaboration and communication. Traditional methods of assessment, such as speeches, performances and debates, can be used for communication but collaboration is a harder skill to observe and evaluate. Nevertheless, new technologies promise new ways to approach assessing collaboration. For instance, online tools such as Google Sites can be used for a collaborative writing project, where the input from individual students can be recorded and accessed through the revision history function.

The last category of ways of living in the world involving human-centred skills such as cultural awareness and being responsible citizens, however, are perhaps the hardest 21st century skills to assess. Ways of doing so could nevertheless be incorporated into project work, such as by including dimensions of appraisal that explicitly measure ethical or responsible use of information.

4.3. Relevant Issues for Curriculum Design in an African Context

4.3.1. Key trends and industry needs

Along with the global complexities shaping the early 21st century, there exist a number of concomitant trends specifically rooted within the African context. In order to successfully navigate the newly emerging risks and opportunities marking the contemporary period, it is necessary to consider such trends and their associated industry needs, thus informing future interventions within the educational sphere. As of present, approximately 20% of the global population under the age of 25 resides in SSA, thus rendering it one of the world’s youngest and fastest growing regions with a global youth share larger than that of China. According to current estimates, the working-age population in SSA is projected to reach approximately 600 million by 2030 thus presenting ample opportunity for the realisation of a significant demographic dividend, which, according to the United Nations Population Fund (UNPF), requires the provision of good health, quality education and decent employment for working-age populations.

Despite this, a number of key obstacles are currently preventing the full realisation of this potential. For instance, it has been estimated that only 55% of SSA’s current human capital potential is being effectively harnessed, with over 80% of its existing workforce occupying low-skilled positions in the informal sector. Moreover, it is likewise estimated that up to 50% of existing work activities in leading African economies are susceptible to automation and digitisation and, as a result, present significant concerns for future adaptation in the face of
accelerating job disruption. Given these observations, the World Economic Forum has suggested that two of the main challenges confronting Africa over the next few decades exist in the delivery of an adequate employment ecosystem capable of absorbing incoming labour market entrants – approximately 15 to 20 million per annum; as well as the provision of matching future skills training. In this latter respect, education is squarely positioned to function as one of the core drivers of continental development over the coming decades, as is echoed in Agenda 2063, wherein education is identified as a central catalyst for enhanced human capital.

What, then, are the emerging industry needs with which future skills training will have to be aligned? According to Xing et al., the technological developments accompanying the 4IR are set to usher in the consolidation of a “new data economy”, central to which will be tech-savviness and digital literacy, both will be indispensable for competently overseeing future decision-making, problem solving and process monitoring. To quote these findings:

“Even in a fully automated working environment, humans are still indispensable. When new technologies are firstly introduced, humans are needed to finalise and coordinate implementation tasks. When systems are put into operation, people need to perform a set of non-straightforward maintenance duties. Humans also have the capacity to upgrade their skills by taking over the jobs when automation fails.”

Hence, far from being outmoded, enhanced human capital inputs will be crucial for successfully meeting future industry needs. Furthermore, along with the inevitable loss incurred through automation and digitisation, new job profiles will likewise be created, thus engendering novel employment opportunities in the wake of the old. Whatever the case, leading experts tend to agree that along with the shift toward the 4IR, training in STEM (science, technology, engineering and mathematics) and uniquely human capabilities such as creativity, emotional intelligence, interpersonal skills and advanced metacognition will outpace the more narrowly mechanistic specialisations of yesteryear, especially given the imminent proliferation of autonomous cyber-physical systems (CPSs) capable of independently executing routine operations and computational functions. In this regard, many theorists are now urging a shift from STEM to STEAM (science, technology, engineering, arts and mathematics).
To quote Erik Brynjolfsson, "You want to do things machines can’t do well ... You want to be working with them, not competing with them." In this manner, one of the overarching priorities of future curricular design should be to facilitate maximally seamless “human-in-the-loop integration” while advancing uniquely African interests in relation to the rest of the world. This will be particularly important for the service sector and creative industries, which are currently primed to benefit most from the 4IR. Moreover, agriculture, export-oriented manufacturing and capital-intensive industries will likewise continue to serve as key drivers of growth and employment over the coming decades, thus requiring proportional emphasis across all phases of education.
With this in mind, we now turn toward a consideration of key action principles and core design principles, particularly as these relate to African education across different learning phases.

4.3.2. **Key action areas and design principles**

Under the 4IR, the future of development is bound to be inexorably shaped by the formative influence of technological globalisation which, as has already been noted, presents distinct challenges across the entire spectrum of existing industries and institutions. In this regard, traditional models of education and training are largely ill-equipped for impending forms of disruption due to decades of inertia and underinvestment, thus resulting in widespread adaptation deficits. With some estimates suggesting that anywhere up to 65% of children currently entering primary school will ultimately end up performing jobs that don’t yet exist.\textsuperscript{ccclxxxiii} The urgency of aligning existing systems with cutting-edge design principles capable of accommodating future change is rendered abundantly clear. However, this is not necessarily as straightforward as it might seem at first, for it is necessary to consider the broader systemic parameters (demographic, economic, historical and geopolitical) conditioning the respective affordances and constraints applicable to different institutions.

As previously noted, this is particularly relevant in the case of Africa, which has historically occupied a highly vexed position within the shifting regimes of uneven and combined development characteristics of global capitalism. Furthermore, matters are complicated by the heterogeneity of Africa itself, which precludes any attempt to conceptualise the continent as a neatly homogeneous mass. As has been argued by leading scholars, there are only several senses in which reference to Africa as a unitary whole might be justified, namely, as a collective international actor, as a collection of states with a broadly shared history, and as a discursive presence in international politics and policymaking.\textsuperscript{ccclxxxiv} Otherwise, Africa remains largely enigmatic and irreducibly complex – an “absence”, in the words of Achille Mbembe, “that those who try to decipher it only accentuate.”\textsuperscript{ccclxxxv} Not only does this complicate our ability to think “African education” in the 21\textsuperscript{st} century, but it also poses a distinct challenge to the overarching tenets of Pan-Africanism which presuppose the shared unity of all Africans and risk both a tacit essentialism and a false universalisation of hegemonic interests. It is for this reason that the regulatory ideal of democracy, so central to the AU,\textsuperscript{ccclxxxvi} must be upheld, not as a means to an end, but as a prefigurative means-in-itself. This is particularly pertinent in light of the potentially alienating, atomising and anti-democratic effects of emerging technologies, as highlighted by critical research on the social and political effects of emerging technologies.
4.3.2.1. Key action areas

Having considered the above, we are now ready to consider a number of key action areas and core design principles associated with the 4IR and related 21st century changes. According to a white paper recently published by the World Economic Forum, there are eight key action areas requiring focus and prioritisation for future education systems. These are as follows:

**Early Childhood Education**

The first few years of childhood are formative in shaping the future capabilities and life opportunities of new education entrants. This is specifically true of the first 1,000 days, during which early identity formation and cognitive development are crystallised. In this regard, it is necessary to develop adequate models to facilitate targeted early childhood education.

**Future Ready Curricula**

During the shift toward renewed education systems, it is necessary to ensure that curricular design and pedagogy are aligned with current and future market needs. To achieve this, targeted public-private partnerships must be geared to impart proficiency in key linguistic, mathematical and technological literacies along with transversal skills, such as creativity, critical thinking, problem-solving and emotional intelligence. Such curricula should be developed collaboratively, will require adaptive updates on a rolling basis, and will need to undergo regular reviews.

**Professionalised Teaching Workforce**

At present, it is estimated that an approximate 26 million teachers will be required by 2030 to meet the sustainable development goals. However, many teachers currently lack sufficient opportunities for reskilling and continuous professional development, thus requiring enhanced investment for increased teaching quality. In this regard, such opportunities must be rendered available to teachers, while incorporating forms of teacher training adequate to the 4IR.

**Exposure to Workplace and Ongoing Guidance**

In addition to future ready curricula, renewed education systems must also prioritise early exposure to the workplace, along with ongoing career guidance, thereby facilitating the targeted professionalization of the incoming labour market entrants. Such exposure may be obtained through multi-sectoral partnerships, enabling career-oriented internships, learnerships, apprenticeships and networking opportunities. Furthermore, added career guidance can assist in keeping learners informed on evolving career options and corresponding education pathways.

**Digital Fluency**

Along with the rise of the 4IR, digital literacy will become increasingly important, as dominant systems and institutions are subject to accelerating digital disruption. In this regard, increased training in STEM-related fields has been identified as of great importance, but this must be coupled with the social and creative dexterity of the arts, humanities and social sciences to yield truly holistic results. Furthermore, to enhance applied digital literacy, emerging technologies must be embedded across educational ecosystems, with integrations suitable for different age levels and learning phases, thus allowing for the adaptive upskilling of learners and instructors alike.
4.3.2.2. Core design principles

Along with the key action areas mentioned above, the World Economic Forum has also identified several core design principles capable of guiding future pedagogy and curricular design, namely:

**Universal and Equal Access**

At present, approximately 25% of the global literate population resides in SSA, with many developing countries in the Global South lacking the basic infrastructure required to promote efficient learning. This is particularly true of SSA, which faces some of the greatest hurdles in education provision across both primary and secondary phases, with less than 50% of schools equipped with electricity, internet and/or basic ICT infrastructure. In this regard, the core design principle of universal equal access is particularly pertinent for SSA, where racial and gendered inequalities and the rural-urban divide pose particular difficulties for education reform. To ensure just, equitable and sustainable solutions, this design principle must guide decision-making vis-à-vis distinctly local development challenges.

**Multi-stakeholder Leadership and Governance**

At present, the majority of existing education systems are overshadowed by single-stakeholder inputs, thus failing to integrate the broader landscape of cross-sectoral complexity constitutive of the 21st century. In this regard, an interdisciplinary, multi-stakeholder approach is required to factor the imperatives of key ministries, employers, unions, civil society groups, parents, teachers, students and related stakeholder groups, as has been promoted in the OECD National Skill Strategy. In doing so, it will be possible to reform existing education systems and align evolving regulatory frameworks with the coordinated inputs of multiple actors across society, thus engendering optimally harmonised learning ecosystems calibrated for targeted growth and development.
4.3.3. Critical notes on African adaptations

As previously noted, Africa is a highly complex and internally heterogeneous region occupying a complicated position within the contemporary world-system; this being due to a combination of demographic, economic, historical and geopolitical factors. As such, in seeking to transform existing education systems, it is necessary to adapt emerging global best practices to local realities through strategic mediation and critical contextual embeddedness, as highlighted and explained in section 4.1.2. This is necessary because Africa is currently faced with a host of unique challenges requiring equally unique solutions. Accordingly, this section will provide some critical notes on African adaptations in relation to the respective learning phases of Early Childhood Development (ECD), primary and secondary education, as well as tertiary and post-school education and training.

4.3.3.1. ECD

The first few years of life are formative in shaping the future capabilities and life opportunities of new education entrants, as has been amply demonstrated by leading research in neuroscience and developmental psychology. There are also significant social and economic benefits associated with early childhood development. This is explicitly foregrounded in the 2030 Global Agenda and the Sustainable Development Goals (SDGs), wherein early childhood development is identified as a core focal area for ongoing development. This is particularly relevant for Africa, which currently boasts one of the largest youth shares on the planet and is projected to account for approximately 42% of global childbirths by 2050 and 50% of the world’s children by 2100. However, following the setbacks incurred under the structural adjustment paradigm of the 1980’s, African education systems have suffered widespread inertia and underinvestment, with approximately 70% of African countries facing severe teaching and infrastructural deficits, including lack of access to textbooks, electricity and basic sanitation. This is a problem not only for primary and secondary schools, but even for pre-primary schools, where a lack of resources is a problem facing early childhood education in countries as diverse as Nigeria, South Africa and Kenya. Deficits extend so far as a lack of pre-primary schools or playgroups, adequately trained teachers, and enough teachers to avoid high teacher-child ratios. In addition to this, SSA has some of the highest child mortality and youth poverty rates in the world, accounting for more than half of all deaths of children under five and with approximately 70% of youth living on less than $2 per day. With the prevalence of poverty across the continent, many young children lack sufficient nutrition for this crucial stage of psychophysical development, which can have profound impacts on future learning and earning power. These factors are further exacerbated by additional variables, such as conflict and disease, which have resulted in orphan rates ranging from 15-25%. As such, any attempt to improve early childhood development in Africa must form part of a larger strategy geared toward holistic reform across multiple fronts, for which there is no simple cut-and-paste solution. Of particular importance, therefore, are the core design principles of multi-stakeholder leadership and governance and long-term planning and reform – in the absence of which, successful optimisation of early childhood development in Africa remains unlikely.

In addition to the above, early childhood interventions will also have to incorporate the key action areas of future-ready curricula, digital fluency, openness to innovation, and a more professionalised teaching workforce; thus requiring significant investment and research. It will be necessary to balance the narrowly instrumental demands of early childhood development with broader questions of social, cultural and intersubjective integration, particularly regarding the underlying values informing early childhood education and Pan-Africanism. In this respect, educators and policymakers would be well advised to focus on the development of uniquely African tools for working, ways of thinking, ways of working and ways of living in the world, with a
significant step forward consisting in the integration of indigenous languages and knowledge systems into existing curricula and pedagogical approaches. The insights arising from indigenous knowledge systems could be a potentially fruitful route to explore in this regard.

4.3.3.2. Primary and secondary education

When it comes to primary and secondary education, most of the findings applicable to early childhood education remain applicable. For instance, approximately 24% of African children of primary and secondary school age have never attended school, have dropped out before completing their studies or have been wholly deprived of access; with Nigeria, Ethiopia and the DRC accounting for nearly 40% of this number. Furthermore, for those in school, learning levels are generally quite low, with less than 50% of students satisfying minimum learning standards in literacy and numeracy.

One factor that has been argued to feed into the ineffectiveness of schooling and low academic achievement in countries like South Africa is the use of a language of instruction that is not the home language of the learners or, even, of the educators. A number of countries, especially in SSA, employ English as a primary language of instruction. In Kenya, for instance, English is the language of instruction and, while some learners in urban areas may be exposed to English before entering school, many in rural areas will not. This use of English or other non-home languages exists contrary to the research which shows that learners benefit from learning in their home language thereby increasing access, improving learning outcomes, reducing repetition or drop-out rates, as well as the socio-cultural benefits of promoting one’s language and culture. Such obstacles emerge early on in primary and secondary training, and their respective solutions must be timed and tailored accordingly. During these phases, the core design principles of universal, equal access, multi-stakeholder leadership and governance, as well as long-term planning and reform assume utmost significance. Likewise, the key action areas of future-ready curricula, digital fluency, early exposure to ongoing career guidance, openness to innovation and a more professionalised teaching workforce are also central to achieving robust learning systems capable of accommodating 21st century changes.

To achieve this, experts recommend several key strategies. Firstly, it is necessary to bridge existing gaps in infrastructure and service delivery across all learning phases so as to complete the universalisation of primary and secondary education. Secondly, it is necessary to ensure adequate management, support and training of teachers. Thirdly, it is necessary to increase financing for education so as to facilitate enhanced research, development and investment. Likewise, per capita expenditure on students must be increased and streamlined so as to allow for optimised resourcing. Finally, it is once again worth noting the necessity of balancing the narrowly instrumental demands of primary and secondary education with broader questions of social, cultural and intersubjective integration. Once again, the incorporation of indigenous languages and knowledge systems constitutes a central ingredient.
4.3.3.3. **Post-school and tertiary education**

The range of needs of adults pursuing education or training at the post-school or tertiary level are diverse. Unlike at the ECD and school level, we are not only tackling questions of how to prepare a future workforce from scratch, so to speak, but also how to equip and retrain a current workforce, both in the formal and informal sectors. With this variety in types of learner and learning needs, curriculum design at the higher-education level must also be sensitive to contextual factors across Africa that influence tackling the educational needs of adults, which range from the different educational levels of learners and the diverse experiences they bring to bear on their own learning, to the diversity of populations, and even to inadequate basic and informational infrastructure.

The key action areas of future-ready curricula, technical and vocational education and training are fundamental. For school leavers wishing to gain a qualification, formal institutions like universities or vocational colleges offer training and accreditation, which, if it is to be future-ready, requires that educational institutions work in tandem with businesses to ensure that they are contextually relevant. As such, curricular design at this level must be sensitive to industry demands for that workforce and be part of a larger learning ecosystem. However, similar to ECD, primary, and secondary level schooling, the demands of industry are not the only influences on designing future-ready curricula for degrees and vocational training. Skills necessary in the 21st century include *ways of living in the world*, and pursuing the ideals of Pan-Africanism requires developing African intellectual capital that is grounded in African values and thinking. Questions of decolonisation highlight the need for critical review of curricula in universities across the continent, with students in countries like South Africa actively demanding a decolonised education that is relevant to the African context.

Formal institutions also offer educational opportunities for those wishing to upskill, where the continuous pace of change that is a defining feature of the 21st century requires on-going education and training. For many, upskilling is not a matter of choice as they face replacement by automation. This highlights the necessity of the key action area of lifelong learning, with the demand for workplace training or short courses that are sensitive to the educational background and time constraints of those seeking to move into different jobs. If such training is to have broad reach across both urban and rural areas, it needs to be low-cost, efficient and capable of leveraging mobile technology. Universities and other educational institutions can capitalise on new technologies to increase their reach and meet this demand, such as through Massive Open Online Course (MOOCs.) In 2016, for instance, South Africa’s University of the Witwatersrand was the first African university to offer courses via the edX platform, and the World Bank’s New Economy Skills for Africa Program-Information and Communication Technologies (NEWSAP-ICT) has explored bolstering formal degree programmes in Tanzania in partnership with local stakeholders and Coursera. Online and offline courses can instil *tools for working* by fostering digital fluency, but should also respond to needs to develop other higher-level skills, such as managerial skills. Nevertheless, these varying means of delivering training and knowledge must still be sensitive to the requirements of future-ready curricula, recognising that 21st century proficiency is not limited to developing digital literacy and that student engagement and instructor quality are vital. In a recent study, it was found that students who took an online course performed worse than those who had engaged in in-person instruction.

MOOCs are usually not accredited and as such employers may not recognise the training that a learner has undergone. If learners are to be welcomed into the workforce, they must be recognised as having the requisite skills and knowledge. Institutions offering skills training need to offer programmes with standards that are agreed upon and recognised by different countries and regions. This is also central to promoting the inter-Africa mobility of Pan-Africanism and the possibilities of collaboration in the 21st century. As the world sees a growth in international enrolment at foreign universities – with Africa being no different – universities and training institutions need to ensure that their qualifications are regionally and internationally recognised.

The East African Qualifications Framework for Higher Education was approved in 2016, and efforts are underway to establish a comprehensive qualifications framework within the South African Development Community (SADC).
Not everyone receiving post-school or adult education will be in a formal institution; especially across Africa where many people work in the informal sector and do not necessarily have a comprehensive formal education background. In SSA, up to 75% of the workforce operates in the informal economy. Online courses may not reach many of the informal economy, who may lack not only the infrastructure to access the courses and technical literacy, but also basic literacies like reading and writing. In this context, partnerships with local businesses and communities to provide educational interventions that are relevant and sensitive to the learning needs of specific members of a given population, at a very fine-grained and on-the-ground level, are fundamental as part of a wider ecosystem of learning.

We therefore see again that, along with the key action areas identified above, the core design principles of universal, equal access, multi-stakeholder leadership and governance, as well as long-term planning and reform are important at this level of education and curricular design.

4.4. Considerations for Teaching and Learning

The skills needed to meet industry demand are interconnected – skills of communication and collaboration, for instance, require cultural awareness, while critical thinking and problem solving require fluency in the digital landscape. What is apparent is that these skills cannot be taught in a traditional information-transfer model or as individual and disconnected subjects. Rather, teaching and learning need to be learner-centred and the interconnected nature of the skills favours project or inquiry-based learning, where the skills for real life are modelled and practised. Technology needs to be embedded across the curriculum and the educator needs to serve as a facilitator of learning. The implication is that developing 21st century skills at all levels of education requires that learners can practice the skill in similar contexts to where they will be used. Project and inquiry-based work best suits the nature of the skills, but for projects and inquiries to be effective, they must resemble real world issues that the learners will face. As such, the teaching and learning activities within a curriculum need to be specific to the context and needs at hand, requiring critical contextual embeddedness.

For instance, in Ghana, the Meltwater School of Technology (MEST), aimed at school leavers, offers short coding programmes that make use of peer-to-peer pedagogy and are centred on project-based learning or in tackling questions relevant to their communities. Plan International in Zambia focuses on developing ways of thinking such as decision making by involving children in the problem solving for issues in their schools. Not only...
does this approach develop ways of thinking, but it also develops ways of living in the world by empowering the children as rights holders and as members of a community. It also potentially capitalises and draws on systems of indigenous knowledge, involving young children in the process of knowledge creation. Critical contextual embeddedness speaks in favour of promoting collaborations between businesses, government and learning institutions, both in order to identify the needs of future-ready curricula as well to offer workplace experience and training in the forms of apprenticeships or internships that are not just incidental to the curriculum, but core.

If Africa is to meet the 4IR on its own terms, the ideals and values of Pan-Africanism and the African Renaissance need to underlie any curriculum for the 21st century in Africa. Curricula should promote African core values, indigenous knowledge systems, sustainable development, and the necessary skills and knowledge for harnessing the possibilities created by new technologies. In order to pursue the Pan-African ideal, human capital should be mobile and collaborative, allowing regional and intra-African movement and engagement. It is important to design curricula and learning environments that develop technical skills and fluencies. These are the so-called tools for working, including skills like information literacy and ICT literacy. Initiatives to address this category of 21st century skills are already underway, spearheaded by the AU.

For instance, the African Digital Schools Initiative (ADSI) programme rolled out in Tanzania and Côte D’Ivoire in 2017 and expanded in Kenya in 2018, aims to turn secondary schools into Digital Schools of Distinction by leading them through a process of digitisation from e-Initial to e-Mature. In our excitement to harness the possibilities presented by the technical nature of the 4IR, however, we should not overlook the fact that many youth and adults across Africa lack other foundational literacies like reading and writing, numerical literacy and financial literacy. Any effective curricula design will be influenced by the need to develop a full suite of tools for working, including these perennial skills.

In addition, the requisite skills for 21st century success do not stop with the literacies that make up the tools for working. The fast-changing 21st century environment also requires skills like creativity, critical thinking and learning to learn (ways of thinking), communication and collaboration (ways of working), and the emotional set of skills to do with ways of living in the world, such as being responsible citizens, living sustainably, and being culturally aware. These “softer” skills are not only as important as generic 21st century skills but are central to promoting the ideals of Pan-Africanism, such as regional cooperation and collaboration and investment in African intellectual capital. The softer skills are nevertheless harder to pin down and to specify trajectories of development and means of assessment. While we might be tempted to focus on providing technical training, overlooking the wider emotional side is short-sighted. Intra-African mobility and collaboration and mobility, central to advancing Pan-Africanism, also requires that we have ways of recognising the skills that people from other societies and educational systems do have. In other words, degrees and diplomas need to be accredited, whereby accreditation is the process of quality assurance, where a set of minimum norms and standards are identified and met.
4.5. Reflections, Challenges and Recommendations

Reflection 1: Indigenous knowledge systems are under threat yet could yield benefits for the curricula and pedagogy

- **Challenge: Indigenous knowledge systems need to be preserved** – Indigenous knowledge systems have traditionally been passed down orally from one generation to the next, but increasingly such a method is less likely to work as younger generations become less interested in traditional knowledge.
  - **Recommendation:** Promote the documentation of indigenous knowledge in a systematic way, such as by funding university research and recruiting IT systems to aid in the recording and management of bodies of indigenous knowledge.
  - **Recommendation:** Fund existing centres for indigenous knowledge, such as the Centre for Scientific Research, Indigenous Knowledge and Innovation at the University of Botswana and the Centre of Excellence in Indigenous Knowledge Studies across three universities in South Africa. Use these centres as models for setting up new centres at more universities. Similarly, explore the practicalities of setting up national centres for indigenous knowledge, as has already been done in Ghana, Burkino Faso, Cameroon, Madagascar and Nigeria.
  - **Recommendation:** Explore collaborations with countries like China and India, who have experience in the successful promotion of indigenous knowledge systems.
  - **Recommendation:** Use university students to assist in developing indigenous learning resources. As part of the fulfilment of a tertiary qualification, students can develop a small component of a larger curriculum, focusing particularly on their own background and skills they have developed by way of their indigenous communities.

- **Challenge: Incorporate indigenous knowledge systems into curriculum content** – Indigenous knowledge is noticeably missing from curriculum content at all levels of education, with African contributions to the global knowledge economy not always highlighted or mentioned.
  - **Recommendation:** Develop teaching resources that engage with indigenous knowledge that is itself local and context specific.
  - **Recommendation:** Promote the value of indigenous knowledge through a variety of media by sharing information about different types of indigenous knowledge and their applications, in order to promote awareness and tackle negative “unscientific” associations amongst the youth.

- **Challenge: Incorporate indigenous knowledge systems into teaching and learning methods** – Indigenous knowledge creation and sharing methods promote adaptability and context sensitivity, skills that are core to 21st century success.
  - **Recommendation:** Promote the use of local languages as the language of instruction at school, such as by developing textbooks and learning tools in the local language.
  - **Recommendation:** Train educators to make use of indigenous knowledge sharing methods, such as story-telling, which will also foster 21st century skills such as creativity, communication and collaboration.
  - **Recommendation:** Develop partnerships between schools and businesses to foster apprenticeships and community immersion at all levels of schooling.
Reflection 2: Working Towards Pan-Africanism and the African Renaissance

- **Challenge: Wide-range of skill literacies required** - The 4IR demands that people are not only digitally fluent, but that they are fluent in other basic literacies such as reading, writing, numeracy, and have a broad suite of skills including communication, collaboration and even citizenship.
  
  o **Recommendation:** Accelerate drives to improve literacy rates across Africa by building more libraries, advancing a bi/multilingual education and nurturing storytelling. Promote initiatives like the AU’s Peace Education Sharing Workshop – held in Ethiopia in 2018 – to foster discussion and action plans for promoting peace, education and negotiating skills.

- **Challenge: Making technology work requires critical contextual embeddedness** - We need to critically reflect on the suitability of introducing technology into the classroom, and how best to put it to use. For instance, blended learning has been heralded as a way to tackle educator constraints – where an educator can use a YouTube video, such as those produced by the Khan Academy, to instruct a class. However, this requires ensuring that the videos used are in fact relevant for the particular context at hand. Do American instructors naturally have relevance in an African classroom? Could we pursue initiatives to capitalise on short online courses to supplement training? Doing so cannot be a simple matter of using a MOOC from Stanford University, for instance. It might require working in tandem with businesses and institutions in a particular country to develop a new course that is sensitive to the precise educational needs of a given population.
  
  o **Recommendation:** Critically review existing online resources to assess suitability for different Africa contexts on a local, national and regional level, depending on purpose. There should also be the development of databases of existing online resources that are suitability for particular educational contexts, on local, national and regional levels.

- **Challenge: Making technology work is not a quick fix** - The use of online tools also cannot straightforwardly replace in-person facilitation and engagement. The emphasis of a blended learning model like the flipped classroom is that online and face-to-face methods can be combined, where online resources can be used for basic instruction and practice, such as through videos and games but, crucially, the educator is able to gather information about learning needs through monitoring how learners fare.
  
  o **Recommendation:** Encouraging a blended learning approach, being cognisant of the fact that technology cannot replace educator. It is there to facilitate and improve ways in which education is delivered. In contexts where there is a shortage of teachers in school, the blended learning model can replace the need for an in-person teacher. The face-to-face time can then be maximised to directly address actual learning needs and develop other 21\textsuperscript{st} century skills, such as communication and collaboration. This, however, requires that the technology used is able to gather learner data and that educators are able to interpret and analyse that data to inform learning plans.

- **Challenge: Accreditation** - If our African institutions are to develop a workforce that is employable and mobile, both within and outside Africa, then it is fundamental that the training offered by those institutions is recognised as being of sufficient standard – that is, their qualifications need to be accredited. This applies to both degree and diploma-level offerings, as well as short online courses and MOOCs. We need African regional and continental accreditation frameworks that address the demands of what a 21\textsuperscript{st} century qualification should achieve; recognising industry demands that may vary across countries and regions, while still ensuring that the qualification framework aligns with global standards. Challenges facing the accreditation of skills include the work-intensive resource needs of continuous monitoring and updating of standards in a complex process – ensuring that accreditations are globally comparable and aligned with business needs.
Recommendation: Ensure that all countries have national qualifications frameworks that are aligned with regional frameworks, where applicable. There should be investments in developing and maintaining qualification authorities at the national and regional levels.

Reflection 3: Interconnectedness of the Skills and the Need for a Learner-Centred Approach

- **Challenge: Adapting to a learner-centred approach** - Previous models of education typically operated on an educator-as-instructor model, where an educator transferred knowledge from themselves to the learners. Such a model, however, is inadequate to address the educational demands of the 21st century, which require that skills are developed together. Instead, teaching and learning should be student-centred; and project and inquiry-based learning should be prioritised, where learners engage with real-world problems that model issues that they may face in their future.

  - **Recommendation:** Promote ecosystems of learning by funding community centres such as libraries and museums as spaces where learners at all levels can work and meet. Critically assess what kind of infrastructure is required for effective learner-centred approaches and for project-based work. There is also a need to develop frameworks for projects that are contextually sensitive. Incentivise businesses to form partnerships with schools, universities and TVETs to provide internships and work-place experience.

- **Challenge: Fostering a pool of educators capable of facilitating 21st century learning** - Current teachers and educators are typically trained to teach one or two subjects, when they may not even be subject specialists themselves. Often, they do not even speak the language of instruction fluently – a European language like English, Portuguese or French – let-alone have digital fluency. Nevertheless, educators as facilitators need to be versed in 21st century skills themselves as well as be able to be responsive to learners’ needs within their learning context. This is a demanding role for educators, creating a challenge for the current pool of educators who may be required to retrain, as well as a challenge for how to train new teachers suitable for the changing educational needs of the 21st century.

  - **Recommendation:** Train educators across all levels on how children and adults learn and in techniques for learning-centred teaching and learning. There should also be an assessment of current teaching education programmes, including distant learning, to establish whether they include 21st century skills. Incentivise continuing professional development for educators by introducing a points system or by sponsoring time off work to upskill. There should also be an increase in the range of continuing professional development options that are available to educators.

- **Challenge: Lack of understanding of how to develop 21st century skills** - Globally, there is a gap in understanding of how to develop 21st century skills in tandem with how to assess them. Without that understanding, it is difficult to design curricula that are appropriate to different educational levels, and difficult to assess 21st century skills in ways that are relevant to educational levels and available resources. While some current curriculum models identify the kind of skills needed for the 21st century, they do not explicitly detail how these skills can be developed – especially noticeable in a number of East African countries. Kenya serves as an exception, where skills are explicitly identified and a learning outcome is stated for each level, but work is still needed to offer guidance for how to assess those skills.

  - **Recommendation:** A critical review of national and regional education policies to establish whether the development of 21st century skills has been prioritised. It is important that there is an explicit incorporation of 21st century skills into education policies, mission statements and the curricula. Develop national descriptions of how the 21st century skills develop and progress through the education levels, perhaps based on existing taxonomies of cognitive and affective development, such as Bloom’s Taxonomy or the SOLO Taxonomy. Balancing technical
specialisation with transversal skill requirements through emphasis of the arts, humanities and social sciences alongside science, technology, engineering and mathematics. This is important in developing 21st century skills such as creativity, emotional intelligence and interpersonal skills.

- **Challenge: Lack of education experimentation** – To achieve the implementation of curricula that address needs specific to the African continent and its learners, current education models need to be experimented with. Both the private and public sector education environments require constant modification and improvement and this remains difficult without attempting new pedagogies and interpreting their results.

  - **Recommendation:** Education systems should be implementing incentive schemes for existing public sector and the private sector to help solve this problem. The public sector can be incentivised through project grants to experiment with new models of teaching and learning. The private sector is capitalist in nature, and if African governments implemented similar incentive schemes to those of the 12J schemes (and other potential tax breaks), the private sector’s involvement can be attained.
4.6. Example of African Excellence

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<th>AFRICAN SUCCESS STORIES:</th>
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<td>Changing how the developing world learns through innovative technology and skilled coaches</td>
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<th>COUNTRY</th>
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<td>INTERVENTION</td>
<td>National Education Reimagination Plan</td>
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<td>FOCUS AREA</td>
<td>Curriculum, Assessment and Pedagogy Design</td>
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<td>DATE</td>
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<td>DESCRIPTION</td>
<td>Reforming the current education system by changing the underlying assessment model</td>
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<td>Egypt’s education landscape sees 19 million learners attending 45,000 public and 7,000 private schools. These students, although exhibiting high enrolment and attendance rates, are finding difficulty in the memorisation-based and single-exam learning models. Moreover, teachers are seen as underpaid and printed teaching material as costly. There is also a lack of digital integration in schools, where learners are not adequately trained in new technologies that are increasingly becoming part of the Egyptian economy.</td>
<td>As part of Egypt’s 2030 development trajectory, government has introduced a replacement of the education system. They have announced plans to increase teacher salaries, as well as double the number of teachers employed. Most notably, Egypt is changing its assessment models, from using a single exam to describe advancement, to a series of ongoing assessments. Furthermore, these tests will check for understanding rather than memorisation. This will be achieved, in part, by a digital transformation, whereby schools will replace printed textbooks with closed-network tablets.</td>
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<th>RESULTS</th>
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<td>Tarek Galal Shawki, as the newly appointed Minister for Education and Technical Education, coordinated the replacement of the curricula, which govern over the learning of around 22 million children. In September 2018, his plan was implemented and all learners were freshly exposed to the new methods of assessment. To achieve this, the ministry trained approximately 200,000 school teachers prior to the commencement of the new school year. Teacher salaries have increased and digital integration has been completed, however the true academic and workplace results will be experienced in the years to come.</td>
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<td>The achievement of Egypt’s educational transformation has been ensured by a US$ 500 million loan from the World Bank, which has played a role in affording higher salaries, new equipment and enhanced curricula. Egypt also partnered with Samsung to obtain the 708,000 new tablets that serve the basis of the digital education, while the Ministry of Investment and International Cooperation ensured the streamlined acquisition of funds, contracts and procurement.</td>
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5. AFRICA’S LABOUR MARKET IN THE 4IR

5.1. Introduction

Digitisation has shaped and continues to change the rules of the global economy, from production and distribution to consumption. Forecasted to double in growth from US$ 11.5 trillion in 2016 to over US$ 23 trillion by 2025, the global digital economy will continue to undermine conventional notions of business structures and education relevance in the 21st century. In the digitised economy, value is driven by data, digital assets, information and knowledge goods, which allow marketers to reach a larger and more global consumer market than ever before. The digital economy is, in this sense, the plain economy that has been affected by digital technologies resulting from the 4IR.

In terms of the economic growth priorities of Africa, governments have ensured that their policies focus on developing and expanding all critical sectors, such as ICT, agriculture and finance. Agriculture has received special focus as rapidly expanding populations demand larger food supplies with more efficient distribution networks. Both ICT and finance also endure a greater demand from the consumer population, with mobile phone and bank account penetration exponentially increasing with large youth demographics across Africa.

However, much of Africa’s focus is on moving away from resource-dependent economies and towards service-oriented revenue models. The advent of the 4IR places Africa in a position to utilise its tech-savvy youth to establish technology hubs and, therefore, provide business process outsourcing services. These services will allow African economies to diversify their offerings and transform their workforce into one that suits the conditions of the 4IR.

![Value-added Services (% of GDP)](image)

Figure 55: Proportion of GDP accounted for by services (2000-2018)

Data courtesy of the World Bank

5.2. Africa in a Digitised Economy

The 4IR is a rising debate within the African context. While some worry about the lack of required infrastructure and skills pertinent to embracing another technological revolution, others warn about human redundancy and job losses in the face of automation. Therefore, in order to harness the power of technological innovation, African countries will have to adapt their systems and infrastructure in key areas, including internet reach and
coverage, overall tech capacity, the education system, regulatory frameworks and payment systems, among others, while focusing on reskilling and upskilling their human capital.

![Readiness of the African Labour Market](image)

**Figure 56: Survey data on the readiness of the African labour market for 4IR**

“How prepared do you think Africa’s labour market is for embracing the 4IR?”

As the 4IR continues to develop, new types of jobs (with new types of skills) grow in demand. Whether or not Africa will be able to manage their workforce to fulfill these requirements remains to be seen, however, a majority of survey respondents (75%) do not believe Africa’s labour market has the correct skillset, experience and adaptability to cater for these new requirements. Of the remaining 25% of respondents, only 4% express any positivity about the workforce’s readiness, while no respondents believe that Africa is completely ready for the changes associated with increased reliance on and integration with technology.

### 5.2.1. Overview

Digitising African economies is becoming a growing priority in most government agendas as more leaders believe that, through digitisation, Africa has the potential to enhance productivity in key sectors of their economies. The adoption of a digitised economy is vital for the advancement of African economies and for reducing poverty. Already accounting for more than 5% of GDP in some African economies, the digital economy is set to transform the African landscape in the coming years by promoting strong economic integration and reducing the costs of doing business.

According to the World Bank’s most recent bi-annual analysis of the state of African economies, the digital transformation of Africa could potentially accelerate regional economic growth by over 1.5% per annum and reduce poverty by 0.7% over the same period. This report also forecasts that digitised African economies will create more job opportunities, increase farmers’ productivity, create new innovative markets and encourage entrepreneurship initiatives.

Technological innovations – such as advanced analytics, AI, big data, blockchain and IoT, which are empowering global businesses to run more effectively and derive greater value – will inexorably have a great impact on African economies. However, though some African countries are showing satisfactory signs of technological readiness, particularly in the uptake of mobile phone technologies, the continent still lags in access to broadband and mobile connectivity, with only 1.4% of Africans estimated to have access to a fixed broadband connection. Despite relatively large public-private investments in the construction of fixed broadband lines, the cost of internet and data packages continues to be significantly high throughout the continent. The limited and slow penetration of broadband and ICT infrastructure constitute major barriers to the continent’s digital transformation, especially since modern digital economic activities are highly dependent on ICT and cloud infrastructure and require large bandwidth and computation.
5.2.2. Addressing inequalities through technology

While the 4IR is anticipated to provide Africa with important avenues for economic growth, digitisation is projected to enable the continent to bridge the gap of inequality in the spheres of governance, commerce and social development, while promoting inclusiveness and the participation of women, youth and marginalised communities in the formal economy. Despite the enduring infrastructural and skill deficits that defy the continent, the advent of the 4IR offers an advantage to some African economies, especially economies that do not need to de-industrialise, to leapfrog directly to a digital-based economic model. Digital commerce is an example: valued at US$ 18 billion in 2019, e-commerce in Africa is forecasted to show an annual growth rate of 15.4% and reach US$ 75 billion by 2025, while bypassing the challenges related to logistic and traditional banking. The eminent success of digital commerce and mobile banking platforms on the continent suggests a rapid shift in efficient service and product delivery through cloud-based technologies rather than through traditional physical markets or banking infrastructure. On the other hand, new technologies are adding more complexities to the future of African economies, most of which lack the co-ordination and sophistication required to compete in the global digital value chain.

“In most African countries, we are still working on 1.0 level. 2.0 level and ... runs in logistics. It makes sense to automate or digitalise in Europe or in Japan where there is this logistics guy who is pushing a cart that costs US$ 60,000 per year. Here in South Africa, that person will possibly not even get US$ 4,000 per year, and the machine and all the logistics and all the digitalisation that you need to put in place – you will never get the money back.”

Markus Thill
President of Africa Region, Bosch

5.2.3. Region-specific trends analysis

Despite many challenges, Africa’s technological revolution is hastening. The continent is fast becoming a hub of technological innovations and, as seen in the increasing number of remarkable inventions, is surely embracing the 4IR, although at a slower pace than the developed world. The speed of change brought about by the 4IR also varies between regions within Africa and from one economy to another. East and Southern Africa, in
particular, has demonstrated higher than expected technological advancements in the past few years compared to other regions on the continent. Countries like Kenya, Malawi, Mozambique, Rwanda and Uganda are predominantly leading the innovation wave in the region.\textsuperscript{cdli}

Throughout the continent, however, five countries – namely Egypt, Kenya, Morocco, Nigeria and South Africa – have been registering significant technological advancements in the past two years, with 45% of technology hubs reported to be concentrated in these countries in 2018. Despite this concentration of innovations, the technological landscape on the continent is decidedly pan-African as seen in the spread of innovative inventions in each country on the continent.\textsuperscript{cdli}

Currently, the impacts of the 4IR have been remarkable in every industry of African economies, from agriculture, healthcare and manufacturing to wholesale and retail spaces.\textsuperscript{cdlii} Some extraordinary, tech-driven inventions that the continent has seen in the last few years include the development of 3-D printers from e-waste in Togo, the invention of a biomedical smart jacket called ‘MamaOpe’ – or ‘Mother’s Hope’ – that provides real-time and accurate diagnosis of pneumonia in Uganda, and the development of the Southern African Large Telescope in South Africa, which is one of the largest single-optical telescopes in the world.\textsuperscript{cdlvi} Ghana’s iSpace is also one of the notable technological innovations that the continent has registered, along with the successful rollout of M-Pesa in Kenya.\textsuperscript{cdlv} There are numerous other promising innovative initiatives across regions of Africa, from FinTech to healthcare and environmental conservation, which are set to improve the continent’s economies in the coming years.\textsuperscript{cdlvii}

The biomedical smart jacket called ‘MamaOpe’ was designed by Ugandan inventor Brian Turyabagye in 2016 and diagnoses pneumonia faster and four-times more accurately than a doctor. Image courtesy of MamaOpe

5.3. The African Labour Market in the 4IR

Africa has one of the youngest populations in the world, with approximately three-fifths of its populace currently under the age of 25, constituting about one-fifth of the world’s youth population.\textsuperscript{cdlvi} The share of Africa’s youth is rapidly growing and is forecasted to rise to 42% by 2030. The working-age population is also projected to reach approximately 600 million by 2030.\textsuperscript{cdlvi} However, a good proportion of this human capital is currently not being harnessed. For instance, it is estimated that only 55% of Sub-Saharan Africa’s current human capital is economically active, with over 80% of its existing workforce fitting in the low-skilled labour category.\textsuperscript{cdlx}
Whether Africa’s hasty population growth will be beneficial for the realisation of a significant demographic dividend or if it is a demographic time bomb will be determined by the extent to which African governments invest in human capital development.\textsuperscript{cdlx} Investment in education and vocational training, healthcare infrastructure, food security, job creation and entrepreneurship are crucial in harnessing the benefits of the potential demographic dividend.\textsuperscript{cdlx} Moreover, while jobs become more technologically intense with the advent of digital economies in Africa, inadequately skilled workforces will constitute a major constraint to the continent’s business environment.\textsuperscript{cdlx}

### 5.3.1. Current technological trends emerging

The 4IR is expected to disrupt business models and the overall labour market in the near future. Developments in previously distinct fields – such as AI, 3-D printing, genetics and biotechnology, machine-learning and nanotechnology and robotics – are changing market demands and skills requirements.\textsuperscript{cdlxii} Whereas the service sector and creative industries are currently primed to benefit most from the 4IR, agriculture, export-oriented manufacturing and capital-intensive industries will not be exempted from digitisation.\textsuperscript{cdlxiv}

As summarised in the table below, technological innovations will impact all sectors of Africa’s economies, although to varying degrees. The impact of AI, cloud computing and digitalisation will be particularly prominent across most sectors, if not all.\textsuperscript{cdlxv}

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<th>Agriculture</th>
<th>Construction &amp; Engineering</th>
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### 5.3.2. Sector-specific analysis across industries

Agriculture, energy, healthcare and financial and government services are forecasted to serve as key drivers of growth and employment in Africa over the coming decades.\textsuperscript{cxvi} These sectors, along with other key sectors of African economies, are already registering significant technological disruptions. While in some cases, the technological innovations are addressing long-faced challenges that have delayed the continent’s development for years, in other scenarios, these innovations are exacerbating the digital divide that has left the continent lagging behind its developed counterparts.\textsuperscript{cdlxvi}

#### 5.3.2.1. Agriculture

In the agriculture sector, internet connectivity is allowing farmers around the globe to access precision weather and rainfall forecasts to maximise crop growth and yields. Advanced agricultural technologies have improved agrochemicals, crop varieties, fertilisers, inoculants and crop management methods in developed parts of the world, which have, in turn, increased food production.\textsuperscript{cdlxviii}

Moreover, as drones are fast becoming a real green-tech tool and modern GPS is progressively being introduced, farmers are able to harvest even in the poorest of weather conditions.\textsuperscript{cdlxvii} Global research also shows that biotechnology, advanced analytics, machine learning and satellite imagery will be the main enabling factors in increasing the world’s agricultural production capacity to meet the demands of growing populations.\textsuperscript{cdlxv}

The agriculture sector is estimated to create 65% of the Africa’s overall jobs and accounts for about 32% of the continent’s GDP. According to the 2017 Africa Competitiveness Report, most of the new jobs in Africa will continue to be generated from agriculture and microenterprises in the coming years.\textsuperscript{cdlxvi} However, despite being one of Africa’s industries of subsistence and a significant contributor to the continent’s development, the agriculture sector continues to face escalating challenges, from land degradation to dropping water table and unpredictable climate.\textsuperscript{cdlxvii} The continent has the lowest use of fertilisers compared to other parts of the world,
and less than a third of African farmers make use of crop improvements. This is particularly concerning, since smallholder farmers, who make up the majority of the agriculture workforce in Africa and contribute up to 80% of the continent’s food supply, continue to experience significant barriers accessing agricultural inputs to increase their yields.

With a population that is projected to grow by 1.3 billion by 2050, and with the intensifying climate change, crop and livestock production, as well as food security, will experience further strains if no adaptation occurs. Sustainable agricultural production should thus be urgently prioritised in Africa. The adoption of agri-weather analytical tools, precision technologies, IoT devices and other cutting-edge innovations, such as blockchain and drones, are in need of integration to boost sustainable agricultural productivity and resilience in the African context. Moreover, enhancing the capacity of smallholder farmers will provide the continent with better prospects of meeting the food demand for the growing population, both in urban and rural areas, while farm mechanisation and optimal access to inputs will improve agricultural yields and profitability.

5.3.2.2. Power & energy

Africa is poised to become a key consumer of renewable energy in the coming years, particularly as more governments are contemplating energy sources like wind, solar photovoltaic and concentrated solar energy as attractive options to achieve rapid and cost-effective electricity access for the growing populations. Waste-to-energy electricity generation is also projected to play a significant role in supplementing fossil-fuel baseload generation on the continent. Electrification, decentralisation and digitisation are the key drivers of this change in the energy sector, both globally and in Africa. While the energy sector in Africa is registering significant changes in intelligent power monitoring and control (facilitated by IoT) and a drop in operational risk and transactional costs (facilitated by blockchain), the rise in focus on green economy will create new opportunities for employment.

5.3.2.3. Financial services

The financial services sector is one of the fastest growing industries in the world and has seen drastic tech-led innovations, from basic analytical computation to blockchain and robotics. However, financial service providers in Africa worry that, while the pace of technological transformation is the most creative force, it can also be the most destructive. The rise in FinTech as an industry has led to a decline in traditional sources of transactions, particularly with the introduction of peer-to-peer lending systems and other vertical platforms that match ordinary debtors with investors.
While Africa’s banking sector continue to face unique challenges, including low banking penetration, limited availability of bank branches and ATM systems and scarce accessibility to credit bureaus, peer-to-peer systems are growing in density across the continent at a faster pace than traditional banking. Although physical banking distribution will continue to evolve in African countries, the future outlook of the sector suggests that the continent will see the emergence of more alternative distribution channels. Peer-to-peer lending systems, blockchain and digital currencies may thus, in the long run, render traditional banking systems obsolete.

5.3.2.4. Healthcare

The healthcare sector in Africa has been witnessing inimitable tech-led transformations in the last few years. Technologies such as AI, cloud computing, genomics, IoT, telemedicine and VR are developing treatment options that were previously not available and are improving healthcare services on the continent.

While telemedicine is bridging the geographic divide by making quality healthcare accessible in remote areas, cloud technologies are allowing healthcare professionals to store and share patients’ medical records to perform real-time examinations and provide accurate diagnoses, regardless of the patient’s location. IoT-powered devices are also forecasted to help Africa achieve universal health coverage. However, the implementation of these healthcare technology innovations remains seriously challenging in Africa. Some of these challenges include issues of interoperability and co-ordination between healthcare providers and a centralised national health ecosystem, limited availability of adequate human resources with the required technical skills to operate digital health technologies, as well as limited availability of electricity and connectivity in most parts of the continent.

5.3.3. Current and future skill requirements

The technological advances that are accompanying the 4IR are consolidating the global digital economy, central to which are tech-savviness and digital literacy. Such technological and digital skills will be indispensable in the African digital economy to competently drive future decision-making, problem solving and process monitoring. In this environment, the workplace is an environment where, according to Max Marx, “processes, technology, and the company converge to improve business productivity and employee engagement.” From this perspective, the employee of the future will have to be fluent in digital concepts, automation and AI, be a leader and a futurist and have advanced interpersonal skills. They will need to be analytical, have advanced literacy and writing skills, as well as quantitative and statistical skills, be a critical thinker and be able to process complex information using volumes of data. They will also need to be creative and be able to identify complex problems and devise strategic solutions using contextually relevant tools.

The employee of the future will thus not be a passive recipient of orders within an organisation but an active participant in strategic decision-making.

“I have children right now. They grow within technology, and they like it, and they don’t want to be taught in the manner in which we were taught. They are just a different species, and we bore them if you come into the classroom and ... talk all the time, whereas you can give them a tablet [and] let them find something for themselves.”

Professor Nkidi Phatudi
Department of ECD

Automation is changing and will continue to transform the skills requirement landscape globally. Many businesses in developed markets are already investing in digital and automation processes and shifting tasks to robots, while also focusing on re- and upskilling their human workforce and equipping them to perform new and complementary tasks to those done by machines. Organisations in Africa will need to embrace a blended workforce of automated processes and humans, while increasingly investing in training and upskilling initiatives to equip their human workforce with the required technological competencies.

“We’re not training people to go and sit in the factories and move one box from one place to another conveyor belt. That’s not what we’re trying to do anymore, and I think we need to change the education system to catch up with that.”
Furthermore, to sustain the emerging e-centred spaces, employees will require skills development in web analytics, cyber security, e-commerce, online marketing, web design, secure transactions, social media, public relations, customer service problem-solving and communication, to name a few. According to analyses by the World Economic Forum and LinkedIn in 2017, ICT-intensive jobs in Africa will, in the long term, be in digital design, creation and engineering rather than in the delivery of digital products and services. While professions like data centre manager, 3-D designer or food technologist are currently trending, demand in the longer term will shift towards more green jobs, hard and soft infrastructure, ICT experts, as well as other new formats of digital types of work.

The intensity of these current and future skill requirements will vary across industries. For instance, financial service providers are reporting urgent demands for tech-savvy data scientists and software developers who can adapt to and master the pace of disruptive technologies. In the energy sector, the African continent has been short of qualified electrical engineers for years and now, more than ever, needs to prioritise the development and training of this knowledge and expertise in the areas of energy and electrical technology to respond to current as well as future demands of the green economy and the renewable energy industries. The demand for skilled electricians, technicians, nuclear technologists, environmentalists, as well as researchers and scientists, is soaring in the energy production value chain throughout the continent.

It is, therefore, essential for businesses to place their employees at the core of the digital transformation by providing them with the necessary technological skills development and career guidance to ensure continuous relevance of their skills. However, while technological skills will be indispensable in the age of the 4IR, businesses are cautioned to fine-tune their talent strategies to account for soft skills. Skills such as communication, curiosity, business acumen and leadership will continue to be of particular relevance in the 4IR-enabled business environment.

“Most of the hard skills can be done through technology, but the soft skills, I think, are going to increase because you need to manage people in this new environment.”

Dr Adri Drotskie
Head of Research and Faculty Development, Henley Business School

5.4. The Role of Humans in the Age of Automation and Robotics

The age of automation has seen growing tendencies of human – robot interactions, where humans work alongside robots in centaur teams, each bringing their specialised strengths to improve business productivity. However, the fear of robots taking over humans’ jobs is one of the worst anxieties confronting workers in the 21st century. Many fear that as more companies automate their processes, millions of jobs, particularly low-skilled tasks and manual labour in predictable environments, will be susceptible to automation. With the World Economic Forum prediction that 41% of jobs in South Africa are susceptible to automation, as will be 44% in Ethiopia, 46% in Nigeria and 52% in Kenya, concerns are rising about the continent’s capacity to withstand the upcoming job disruption.

However, despite the inevitable mass structural unemployment that may be incurred through automation and digitisation in the coming years, the ubiquitous digital transformation will see the emergence of novel job profiles and careers. This is particularly true because technology cannot supplant human cognitive abilities, and the successful implementation of any new technology lies in the knowledge of the worker who uses the tools. Therefore, even in a fully automated working environment, human cognitive capabilities are still indispensable. Human reasoning is required to develop and programme the actual automated machines, and when they are established, humans are needed to finalize and coordinate their tasks. Moreover, when automated systems are put into operation, humans continuously ensure their maintenance; when automation fails humans are able to step in and compliment the efforts of machines.

This further emphasises the fact that, far from being outmoded, enhanced human capital with capabilities such as adaptability, creativity, emotional intelligence, interpersonal skills and logical reasoning will be essential in the digitised workplace.
5.5. The Future of Work

To be successful in the digital era, businesses are having to be creative in enhancing the effectiveness of their operating models to stay ahead of the competition by continually innovating their service delivery. In most developed economies, organisations are endlessly competing with each other to provide the best end-to-end digital engagement models and strategic digital operating systems. They either enhance or transform their existing models or invent completely new models that are adapted to digital transactions. Consequently, companies that are yet to embrace the wave of technological revolution will have to follow the trend and implement the strategies outlined in the graphic below.

In this regard, companies will increasingly require speedy operations and more specialised talents to stay ahead of the competition. Companies of the future will see the collapse of hierarchical teams and the emergence of agile networks made up of groups of T-shaped professionals, who are multiskilled across a diversity of sectors.

As the requirements of employees and workplaces change in the 4IR, the future of employment in Africa will need to adapt. Chief among these changes, according to the survey respondents, is the need for interdisciplinary skills (2.65), which was ranked 1st by 38% of the sample. Following that, respondents believed that the workforce would need to be reskilled (2.96) and that the use of technology would have to increase (3.38) to be ready for the future workplace. Noticeably, flexible employment contracts were not considered a priority for change in the face of the 4IR, registering in last place for 34% of survey respondents.
Despite the proliferation of online freelance employment, the ability to work multiple jobs (4.17) is not viewed as a comparatively important change to respondents when considering the future of work. This may be explained by an environment that already promotes ‘multi-jobbing’ or ‘side hustling’, thus does not need any adaptation.

“Gig work isn’t necessarily new in the African context. It’s something that we’ve been doing for years, for decade - and that might be a consequence of many of our societies traditionally being underemployed. So someone always had the side hustle.”

Lindi Vundla
Focus Group Member, Uber
5.5.1. **Flexible contracts**

The use of cloud platforms in the digital economy has made it possible for companies to keep all strategic data and information on digital media and devices, which are accessible from anywhere. This has allowed employees flexible working conditions and adjustability in their personal needs and lifestyles. Therefore, the traditional structure of work has changed, with more companies becoming increasingly dependent on contractual employees who have the required technological skills but work remotely via internet and digital platforms.

“To me, it looks like that it’s going to be much more flexible and that the employer will have to start understanding this. You will have staff members who have three or four different jobs that they are doing, and they might not necessarily be in a workplace that can do it from anywhere. I think they need to understand very clearly what you can do physically in your work and what can be supported by technology.”

Dr Adri Drotskie  
Head of Research and Faculty Development, Henley Business School

It is believed that the growing propensity of remote and flexible contracts allows for higher levels of collaboration, critical thinking and innovation among employees, while also enabling companies to attract and retain flexible talent. However, while more companies become increasingly dependent on contractual employees, this is resulting in a growing risk of intellectual property (IP) loss, where these contractual employees migrate from company to company with their knowledge after the end of a contract.

5.5.2. **Entrepreneurship**

The increasing digitalisation of Africa provides new opportunities for entrepreneurs to participate in the economy. Due to the unpredictability of the employment landscape across the continent, most Africans embrace entrepreneurship in a bid to survive. The 4IR promises to create an African digital renaissance, provided that African entrepreneurs embrace the digital trends with a pan-African mindset. Already, the African technology scene is booming and is seeing the emergence of new tech hubs at an unprecedented speed across all regions of the continent.

While a mapping exercise by the GSMA identified about 300 tech hubs throughout the continent in 2016, the technology ecosystem has grown exponentially in the last three years, with over 600 hubs reported in 2019, representing close to a 50% leap from 2016. This growth was mainly driven by the ever-growing African entrepreneurship community, as well as a boost in venture funds, development finance and corporate involvement from multiple sources. Now more than ever, Africa needs to embrace the emerging forms of technological innovations and education geared towards entrepreneurial enterprises to realise the continent’s potential for inclusive growth. African governments are encouraged to harness the power of entrepreneurship by funding micro-enterprises and providing other forms of sponsorship and business incubation. These efforts should also be replicated in rural areas, where the majority of the African population is concentrated. The concept of smart villages, though still in its early stages, needs to be incorporated in governments’ plans to ensure that rural communities are not forgotten in this drive toward the 4IR.
In some sectors, like retail and financial services, entrepreneurship has taken the form of peer-to-peer service delivery, altering what traditional transactions look like. Within this internet-facilitated peer-to-peer market, exchanges are directly made between consumers, who also act as producers. This type of shared economy has introduced an entirely new sector that is generating additional employment and revenue opportunities among users. Though criticised for blurring the lines between formal and informal trade, this new economy increases flexibility in traditional methods of work and raises participation in non-permanent employment careers and entrepreneurship.

Africa has the fastest growing middle class in the world. With it, the continent is set to experience significant shifts in spending patterns from basic necessities towards discretionary products. This provides further
avenues for local entrepreneurs to exploit the growing consumer-spending power and provide African solutions to meet African demands.\textsuperscript{dxxvi}

5.5.3. Uber’s Perspective on the Future of Work

Technology is changing the nature of work, the skills and competencies required in the workplace, and how people are hired. According to Uber, the future of work denotes new jobs that will require more skills and the retraining of millions of people.\textsuperscript{dxxvii} The company posits that technology and digital platforms can play a pivotal role in improving the quality of work. In a world characterised by stagnant incomes, under- and unemployment, more than 3 million people around the world have chosen to work for Uber as a means of earning an income in a way that fits their lifestyle. Uber maintains that there are four areas that need to be focused on when thinking about the future of work:\textsuperscript{dxxix}

- **Easier access** to work: there are too many people that have been excluded from the labour market, with the majority of the marginalised being those with caring responsibilities, people with disabilities, people who have been involved in criminal-justice system, and immigrants. Uber holds that work should be easily accessible to these groups.
- **Greater flexibility** in work: while traditional 9-5 jobs will likely remain the norm, many people want more control over how and when they work. Uber believes that work should fit around the lives of people and not the other way around. This is particularly important for those who are re-entering the workforce, those with caring responsibilities, those studying or starting a business, and those in transition from one industry to the next.
- **Better protection**: the needs of workers in the 21\textsuperscript{st} century, for Uber, can be solved through offering flexibility and security through innovative products and partnerships that ensure that no one slips through the social safety net, and by modernising policies to help improve protection for independent workers.
- **Opportunity** and growth: Uber believes this can be achieved through creating tools to enable progress and social mobility through education, experience and lifelong learning

Uber perceives adaptability to be one of the key skills required for the 21\textsuperscript{st} century—it is important for individuals to be able to adapt to the ever-changing workplace, new ways of work and technological disruptions. The company reiterates the importance of skills such as emotional intelligence, communication and problem solving skills for the future of work.

“I think in a large way we feel that we are very much part of the future of work right where I think the or rather what the future of work looks like, where people want flexibility to, to choose their own schedules when they work, where they work, and have the flexibility to choose who they work with as well... I think this is a big piece... the world is changing at a faster pace than it ever has before. And I think that that pace of change is only going to increase into the future.”

Alon Lits
Focus Group Member, Uber

Africa presents a complex and multifaceted context. The continent offers a unique environment, owing to the high levels of informal employment. Out of the approximated 37 million jobs that were created in the past decade in Sub-Saharan Africa, 28% of them were formal. In Sub-Saharan Africa, Uber has been operating since 2013 and has enabled over 42,000 economic opportunities.

“One of our values, norms at work is that we build globally but live locally and it’s very simple. You create an idea of what you want to do at the global level. But at the end of the day, all of us that take care are locals. So when we’re implementing a global plan, we know what’s going to work in South Africa or in Kenya or in Nigeria because these are our homes... that’s the only way you can really respond to what the local need is by making sure you have local partners or local leads that understand what the reality on the ground is and take them seriously as well.”

Lindi Vundla
Focus Group Member, Uber
5.6. Key Considerations for the Future of Work

There is currently much debate and attention given to the 4IR and its meaning and relevance in developing economies like African markets. On the one hand, technological advancements are believed to speed up growth and help countries overcome development barriers across industries. On the other hand, it is suggested that the 4IR may exacerbate global inequalities and the vicious cycle of poverty by creating a digital divide between countries that can adapt to new technologies and those that cannot. In Africa, the digital divide between rural and urban settings is a big contributor to the widening income gap, and if the unbalanced distribution of technological and ICT infrastructure is not addressed, the 4IR may increase the burden of poverty and inequality on the continent.

Although digital innovation is widely forecasted to provide Africa with the ability to unlock huge economic and financial potential, there are still great structural and functional obstructions impeding the digitisation of the continent. For instance, while access to broadband is critical for the realisation of digitised economies, African countries continue to experience delays in the development of reliable and fast internet infrastructure. The continent currently has the lowest internet coverage in the world, with only an estimated 27% of the population having access to the internet. While businesses are slowly adopting digital technologies, only a few governments are investing in digital infrastructure development, digital service delivery and digital skills training agendas and entrepreneurship.

In addition to these, weak financial institutions and low levels of cross-regional trade and integration are key challenges to the continent’s ability to facilitate better employment and entrepreneurship, particularly for its large youth population. Furthermore, while Africa currently relies on low labour costs for economic development, the advent of digitisation and automation may reduce the advantage and relevance of low labour costs as a more skilled and specialised labour force develops, particularly in labour-intensive sectors like agriculture, construction and manufacturing.

5.6.1. Impending job losses or job creation

Whereas the 4IR has raised global concerns of deepening inequality, research evidence suggests that the digital revolution has the potential to generate real jobs and bring inclusive growth into Africa. For example, the rise in focus on green economy is expected to create new jobs in areas like renewable energy and energy efficiency. Grid modernisation will also have a positive spill-over impact on other industries, including agriculture, construction, manufacturing and transportation, thereby improving activities in these sectors and promoting their abilities to generate new jobs. Moreover, the adoption of AI, machine learning and robotics in digital economies are altering the very idea of what a job entails. AI and automation are projected to become credible substitutes for blue collar and low-skill jobs. Unless the current workforce is retrained and upskilled, the innovations that the 4IR is bringing will negatively affect the employability of the low-skilled workforce, particularly in labour intensive sectors.

“You have to understand that we are going into more of a machine world and the role that technology plays ... The jobs that used to be in the system before are not going to be there in future.”

Dr Adri Drotskie
Head of Research and Faculty Development, Henley Business School

Therefore, though it is true that certain routine low-skill tasks may easily be automated, a majority of jobs will require an upskilled workforce that has the unique human qualities of adaptability, creativity, critical thinking, and overall emotional intelligence, which automated robots or machines lack.

5.6.2. Rise of cyber threats and subsequent need for cybersecurity

As businesses become more digital and more dependent on data and cloud infrastructure, cyber threats are becoming an extremely important risk. Where new technologies emerge, cyberattacks also grow in sophistication and prevalence, raising concerns about the safety of personal information and financial data, which are increasingly being stored in clouds. Organisations are challenged with building protective mechanisms to avert the destructive force of cyber threats. Interestingly, the need for cybersecurity has spawned a new
career path that is increasing in demand: that of ethical hacking in testing software and systems to protect them from cyberattacks.

Figure 62: Protective measures against cyber threats

*Image adapted from Brookings Institute*
5.7. Reflections, Challenges and Recommendations

While the rapidly developing set of technological innovations offers Africa’s countries the potential to drive growth in core sectors of their economies, addressing the most pressing structural challenges that hamper the adoption of the digital ecosystem is imperative. Low internet coverage, slow bandwidth, high data costs, as well as ICT infrastructure obstructions make it harder for the continent to capture the benefits of automation and digital innovations and embrace digital and structural transformations. Only countries that embrace digitisation, invest in the required infrastructure and adopt the appropriate regulatory technologies are set to fully benefit from the 4IR.

In addition to prioritising ICT and support infrastructure development, African governments will need to recalibrate legal and regulatory frameworks to support data-driven technologies and innovation-driven growth. Among other aspects, they will need to be proactive in implementing powerful tech-friendly policies and regulations that promote technological development and encourage innovation and investment. The focus of these policies will need to be on areas like cloud adoption, data privacy and security, digital strategies, intellectual property and public procurement.

Reflection 1: Security

- **Challenge: Data privacy and security** - The rise of the 4IR means that African countries will be constantly increasing their number of connected individuals and business. With each new entrant, more data is added to the collective pool and, therefore, each person and institution should retain and enjoy their right to anonymity.
  
  - **Recommendation:** African governments need to develop data privacy and security laws aimed at protecting users’ data without restricting cross border data sharing and other benefits of digitisation.

- **Challenge: Cybersecurity** - The new businesses and individuals will also become new targets for professional criminals and scammers. Banking details, personal identification information and company information are valuable commodities on black markets of the internet.
  
  - **Recommendation:** African policymakers should also adopt cybersecurity laws that incentivise investment and provide meaningful enforcement mechanisms.

Reflection 2: Policy priorities and frameworks

- **Challenge: Intellectual property** - With the advancement of African society and education comes new inventions and discoveries. These will need to be subject to IP rights to ensure profits and credit are given to those responsible.
  
  - **Recommendation:** Governments should support continuous innovations and advancement of technologies by implementing IP laws that protect against misappropriation and infringement of proprietary innovations, and that support the growth of local developers.

- **Challenge: Procurement policies** - African governments, given the advancement of a tech-savvy population, will be faced with greater local procurement options, especially in terms of digital services and products.
  
  - **Recommendation:** Investment in public sector innovation should be prioritised, and the use of advanced technological solutions in the provision of public services should be enabled in all African government structures.
• **Challenge: International harmonisation of rules** - International trade, especially through digital means, will prove an excellent source of revenue for African economies and, therefore, the standards used during these exchanges need to be compliant and compatible with other countries’ processes.
  
o **Recommendation:** African governments should remain abreast of ICT international standards and harmonisation rules to ensure smooth data flow and portability.

• **Challenge: Investment in supporting infrastructure** - The uptake of digital economies is largely dependent on robust connectivity or broadband infrastructure. Although Africa has seen improvements in investment on ICT infrastructure, the continent still has a lot to do to ensure the development of ubiquitous and affordable connectivity infrastructure.
  
o **Recommendation:** In addition to broadband infrastructure, African economies need to prioritise the improvement of other basic complementary infrastructure like electricity and roads, without which the potential of the 4IR will be limited and only be accessible by the elites.

**Reflection 3: Transfer into the digital realm**

• **Challenge: Cloud adoption initiatives** - Data storage and accessibility remain a challenge for both Africans and the world at large. As companies move into the online realm, more information and operating systems will need to be accessed through the internet.
  
o **Recommendation:** Governments should encourage widespread cloud adoption by developing national digital strategies and policies that democratise the use of advanced technologies.

• **Challenge: Digital adoption in public provision and institutional relationships** - The success of digital economies in Africa will be as much dependant on the transformation of the education system to include more technology training and STEM subjects, as on the introduction and promotion of digital systems in public and private sector provisions. This will result in a cohesive digital environment for economic growth which will also maximise human welfare.
  
o **Recommendation:** African governments must incorporate digital principles and practices into their administration of the population, ensuring that growing African populations are effectively managed.

• **Challenge: the capacity of rural smallholder farmers to adopt new technologies** – While the digitisation of farming practices presents a golden opportunity for the continent to modernise the agriculture sector, this transformation presents more challenges than opportunities for smallholder farmers, who neither have the skills nor tools to extend their small farmlands into sizeable commercial farms.
  
o **Recommendation:** To ensure that the digital transformation also benefits rural smallholder farmers, policy makers need to facilitate farm mechanisation in rural settings, revitalize agricultural extension systems and access to inputs, while promoting the adoption of new technologies through incubation and education.

**Reflection 4: The human element**

• **Challenge: Conserving and catalysing indigenous industries** - While there is an increased need for the adoption of the 4IR, it will be important for African governments to balance large-scale global digitisation with their support for emerging local technologies and industries to endorse the
development of African solutions adapted for African problems. A globalisation through digitisation poses the risk of losing national identity and economic success.

- **Recommendation:** African governments should incentivise programmes that encourage a combination of indigenous traditions and cultures with the new platforms made available through the 4IR.

- **Challenge: Bridging the urban-rural divide** – While lifting rural communities out of poverty is a positive prospect to accelerating Africa’s growth, rapid population growth presents a key challenge in eradicating poverty, particularly as more people migrate from rural areas to the cities, further adding to the growing numbers of the urban poor.

- **Recommendation:** Although rural communities are likely to escape poverty by staying in rural areas, it is essential that governments drive investment to these areas in order to raise productivity in agriculture and the industrial sector to reduce the need for migration. Governments must also invest in upskilling and reskilling the rural workforce to increase their employability and relevance in the digitised economy.

- **Challenge: Preserving human input for change management** - Human capabilities - such as creativity, rational thinking and emotional intelligence - are unique to humankind and are valuable assets for businesses, governments and other institutions.

- **Recommendation:** Organisations should develop user-centred approaches that put the human workforce and the consumers at the centre of innovation.

The current unemployment rate on the continent, though as a result of a shortage of jobs, is also a symptom of an inadequately educated workforce. Education systems, which were designed in the 19th century for different economies, have not kept the pace with today’s workforce. With the inevitable transformation that the fast-paced technological innovations are bringing to African markets, the rates of unemployment on the continent are likely to be amplified, especially if education and training systems do not update their curricula to include technological and analytical content.

It is a widely held belief among business leaders that investing in skills development is the key to successful management of the disruption of the 4IR in the long term. As such, leaders across businesses, labour markets and governments around the globe – and in Africa – have publicly recognised the need for action, although a myriad of legal and political hurdles have to date prevented meaningful progress towards curricular transformation in education systems. Therefore, it is critical for Africans to revolutionise their education systems in line with technological advancements in order for the continent’s human capital to turn into more of a dividend and less of a burden. It is particularly important for African governments to invest in STEM and language skills to ensure that the necessary skills for global competitiveness in the digital economy are continuously honed.

While rural settings tend to be excluded from the conversations of digitisation, it is important for Africa to bring its rural population, which constitutes more than half of the continent populace, up to speed with the emerging technological trends. Investing in digitising rural areas through the development of tech-led initiatives such as smart villages, while also prioritising digital skills transfer, the development of broadband infrastructure, and access to reliable electricity and affordable data, will maximise the benefits of the 4IR for the continent.

In addition to the above, African governments need to encourage the digitisation of public service provision and need to be strategic in adapting technologies to their respective economic capacities to catalyse developing local innovations, as well as to place human workforce at the centre of technological innovations.
### AFRICAN SUCCESS STORIES:

*Changing how the developing world learns through innovative technology and skilled coaches*

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<th>COUNTRY</th>
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<td>DESCRIPTION</td>
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#### THE PROBLEM

According to the African Development Bank 2 out of 3 African graduates face unemployment upon graduation. This is despite the availability of 2.5 million entry-level jobs that are unfilled each year. This indicates incongruity in Africa’s labour markets and the continent’s ever-increasing need to find the balance between the skills acquired by university graduates and those expected by employers in the job market.

#### THE SOLUTION

Slatecube is an online portal that utilises smart, adaptive algorithms to train and integrate entry-level talents into the African workforce. Through their services, Slatecube supports businesses in re-engineering their recruitment processes and provides them access to a robust entry-level talent pool. This solution does not only enable companies to connect with top talents, but also aims to positively impact youth employment outcomes throughout Africa.

#### RESULTS

The African Leadership Academy acknowledged Slatecube’s progress and ingenuity by shortlisting them for the Anzisha Prize for Entrepreneurship. This acknowledgement was as a result of Slatecube having trained over 13,000 students across Sub-Saharan Africa in technological subjects, such as graphics and animation, robotics and digital marketing. These essential 4IR skills have translated into the surrounding economy, where 78% of those who complete these courses are placed into jobs. The platform continues this success with the 10,000 current active users.

#### STAKEHOLDERS

Slatecube’s footprint is expanding, as the organisation now partners with governments throughout Africa and has partnered with Injini – a Cape Town based educational technology accelerator. However, Slatecube’s business model is premised on the idea of having as many stakeholders as possible – each company that creates a profile on their website is afforded access to their database and analytics, and therefore has a stake in the direction the platform takes. Examples of these clients include Webber Wentzel, Mastercard and Intel.
6. **DESIGNING CURRICULA AND IMPLEMENTING INTERNATIONAL BEST PRACTICES**

6.1. **Introduction**

In the qualitative component of the survey, we asked two questions to help inform the way forwards for Africa’s education sector in the context of the 21st century. These questions were:

**Designing curricula for Africa:**

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• In your opinion, how can we design a curriculum that speaks to Africa’s developmental needs and can bridge the urban and rural divide?
```

**Implementing international best practices in Africa:**

```
• In thinking about international best practices for developing a 21st century education system, what considerations do you think are the most important when implementing these practices in the African context?
```

Through detailed thematic analysis, the following general themes were derived from each of the aforementioned questions:

![Figure 63: Survey data on the general themes in African curriculum design](image)

*“In your opinion, how can we design a curriculum that speaks to Africa’s developmental needs and can bridge the urban and rural divide?”*
**Implementing International Best Practices in Africa**

- Competent management and administration
- Inclusive curriculum design
- Contextual learning
- Holistic skill integration
- Developmentally appropriate learning
- Tech-focused curriculum design
- Values-based education
- Enhanced infrastructure provision
- Integrative curriculum design
- Entrepreneurship
- Increased funding
- Blended learning
- Youth empowerment
- Regular curricular review
- International standards
- Higher learning standards

**Figure 64:** Survey data on the implementation of international best practice

“In thinking about international best practices for developing a 21st century education system, what considerations do you think are the most important when implementing these practices in the African context?”
When juxtaposed, these results yield the following patterns of overlap and divergence, for the most part, exhibiting strong correlations:

![General Theme Comparison](image)

Figure 65: Comparison of thematic analysis across qualitative survey questions

In broad terms, the intersecting values displayed above represent the overarching consensus of survey respondents, regarding the general curricular design principles and factors to consider for the incorporation of international best practices most relevant for education and development in 21st century Africa. Additionally, the nonintersecting values represent those factors uniquely tailored for successful implementation within the African context.

In what follows, detailed vignettes of the above will be sketched to reveal, in more granular form, the qualitative nuances embedded within the general thematic areas thus derived.
6.2. Holistic Skill Integration

Among the qualitative recommendations provided, holistic skill integration features most prominently both in terms of general curricular design and international best practice implementation. Within this thematic area, innovation, creativity, critical thinking, foundational skill development, entrepreneurship, literacy, numeracy, and problem-solving constitute the most noteworthy overlapping skill recommendations.

On the other hand, communication, design thinking, emotional intelligence, systems thinking and the capacity to successfully navigate evolving complexity have been noted as items uniquely relevant for curriculum design.

In terms of the hard/soft skill distinction, the following list represents this split as per respondent inputs.
According to respondents, the particular significance of the abovementioned skills lies in their inestimable importance for successfully confronting contemporary globalisation and the 4IR, both of which require seamlessly integrated blends of hard and soft skills capable of mediating emerging forms of global complexity and disruption.

**Key Quotes:**

“We need a curriculum that addresses both hard skills and soft skills. We need to start with the basics to form a foundation and then prepare people for life, change, a different way of thinking, complexity, creativity, entrepreneurial thinking.”

“Design a system that creates a generation of creative thinkers and problem solvers. We need to create a system that allows the entire individual to grow and be rounded.”

Anonymous survey respondents
6.3. Inclusive Curriculum Design

Following holistic skill integration, inclusive curriculum design was the second most prominent thematic area. More specifically, respondents contend that curriculum design must be collaborative and community-led, thus ensuring broad-based democratic participation and representation along with equitable education provision. In this regard, factors such as race, gender, language and rural-urban variance feature prominently as items requiring specialised attention alongside personalised learning and humanistic values, particularly in light of the 4IR, which challenge our understanding of what it means to be human amid accelerating technological change.

Consequently, focus on STEM and tech-focused curriculum designs need to be balanced with corresponding emphasis on the arts, humanities and social sciences. This reflects a growing shift in emphasis from STEM to STEAM.
6.4. Contextual Learning

In line with the above, respondents have stressed the growing need for contextual learning, which requires taking into account the particular needs, challenges and potentials within Africa in light of historical, contemporary and anticipated future trends. This theme runs deep, demanding multidimensional answers to the complex intersection of local and global dynamics. In this regard, a number of respondents have stressed the need for unified Afrocentric curricula that are capable of breaking with the historical dominance of
Eurocentric learning paradigms. Additional this is the incorporation of indigenous knowledge, language systems and modes of socialisation into an integrative, multidisciplinary learning paradigm. This must be achieved to rectify ongoing historical imbalances and to develop novel abilities capable of repositioning Africa within the world while addressing urgent development challenges. In this latter respect, respondents have also recommended a dynamic coupling of global awareness and local adaptation within self-determined curricula that can accommodate capable theme-based and multidisciplinary learning.

**Key Quotes:**

“The curriculum must be developed in Africa, with focus on Africa’s needs, but also on how to be players on the global stage. We need to educate to produce developers, innovators instead of consumers.”

“Contexts in Europe and the US are vastly different. We need to draw standards which will be effective in our context as Africa in the 21st century with the challenges as a result of colonisation and maintaining the idea that ‘the west knows best’.”

Anonymous survey respondents

6.5. Developmentally Appropriate Learning

![Thematic analysis – Contextual learning word cloud and quotes](image)

![Thematic analysis – Developmentally appropriate learning](image)
In addition to contextualism, respondents have stressed the need for developmentally appropriate learning. To begin with, this means that education must be sensitive to the particular needs, challenges and potentials of Africa. This will need to take into account both existing realities and emerging trends, such as globalisation, the rural-urban divide, the 4IR, as well as the growing need for African entrepreneurship. Secondly, this means that curricula must be planned and sequenced to coincide with the specific learning abilities of targeted demographic sub-groups that range across all learning phases, from ECD, primary and secondary learning to tertiary learning and beyond. Thirdly, respondents have emphasised the need for blended, collaborative, project-based learning that will facilitate the application of transferable skills development for the 21st century.

With this in mind, curricula design must remain critically attuned to the ongoing impact of evolving trends, such as digitisation and distance learning, on education systems in relation to broader socio-economic landscapes, thus allowing for broad-based life-long learning across the continent.

Key Quotes:

“With the curriculum open and accessible, we can open up entrepreneurial opportunities to the economy ... This in turn will help fill in the gaps ... in creating ... stable economies and communities.”

“A curriculum must speak to what South Africa and Africa is facing in terms of poverty and reduction measures, entrepreneurial skills, technology innovation and skills.”

Anonymous survey respondents

6.6. Tech-focused Curriculum Design

Figure 75: Thematic analysis – Tech-focused curriculum design

<table>
<thead>
<tr>
<th>Granular Theme</th>
<th>Freq. in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designing Curricula for Africa</td>
<td></td>
</tr>
<tr>
<td>Implementing International Best Practices in Africa</td>
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</tbody>
</table>
Given the mounting significance of technology and the impending rise of the 4IR, many respondents have argued for an explicit emphasis on tech-focused curricula design. Within Africa, this requires broadly enhanced technological infrastructure across rural-urban divides, particularly electricity and ICT facilities. Given the rising centrality of digital 21st century development and career advancement, data literacy should be enshrined as a fundamental right, with curricula designed to facilitate integrated technological competence.

Once again, tech-focused curricula design requires enhanced focus on STEM-related fields. However, as indicated before, such training must be complemented with the corresponding prominence of the arts, without which culture and education risk atrophying under the disproportionate sway of purely instrumental rationality.

Key Quotes:

“We are entering a world in which access to data must be considered a human right - the divide in opportunity between those with and those without access is that significant. So whatever the cost, the investment and ongoing commitment to ensure equal access to opportunities provided by [the] 4IR must be made and maintained.”

“Understanding the opportunities ... of the 4IR are crucial, as well as ... the role of the human ... [and] the ability of humans to work alongside [machines].”

Anonymous survey respondents

6.7. Competent Management and Administration

In order to meet the aforementioned objectives, respondents have called attention to the necessity of more competent management and administration in African education systems. On the one hand, those tasked with
overseeing the governance and regulation of education systems need to be appointed strictly on the basis of
competence, transparency and accountability, all of which are too often lacking in existing bureaucratic
structures.

Such leaders should remain cautious and systematic in their approach to education reform, upholding consistent
standards of quality assurance and implementing pilots when and where possible. On the other hand, teachers
themselves are often desperate for enhanced training and support, both of which constitute necessary
provisions in light of accelerating changes. Moreover, respondents have highlighted a need for higher learning
standards, especially in contexts where learning standards are continuously dropping.

Key Quotes:

“We need to empower teachers to act as the facilitators for students to learn and develop
critical thinking and skills.”

“One must not underestimate the importance of the evolution of the role of teaching and
education in the 21st century and thus the importance of reskilling teachers in this
regard.”

“Be ruthless when dealing with corruption when it affects delivery of education.”

Anonymous survey respondents

6.8. Value-based Education

Overlapping tightly with the needs for contextual and developmentally appropriate learning, respondents have
underscored the demand for more deeply value-based education in Africa. While responding to evolving needs
and realities across the continent, education should also foster a keen sense of uniquely African values among
learners. Echoing the need for Afrocentric curricula design, future education should be articulated around a set
of core values reflective of indigenous modes of knowing and being, thus honouring the hidden undercurrent of
historically marginalised perspectives in need of contemporary integration. Furthermore, respondents
emphasised that enhanced self-awareness among students is required, as well as an orientation toward social
justice and publicly beneficial learning outcomes.
6.9. Enhanced Infrastructure Provision

According to respondents, key to the resolution of existing barriers and inequalities in African education is the enhancement of infrastructure provision. This echoes the earlier recommendation for broadly enhanced technological infrastructure across rural-urban divides, especially access to electricity and ICT. However, the need for infrastructure goes well beyond these narrow confines, requiring an extended focus on basic needs like water, sanitation, textbooks, stationary and safe learning environments, all of which are lacking across the continent.

In this context, the prevailing hype surrounding the 4IR must be critically tempered with a corresponding awareness of widely unmet foundational needs, which cannot simply be side-stepped or hastily thrust aside in favour of naively techno-utopian visions. Echoing the logic of Maslow’s hierarchy, we must ensure that basic needs are met before attempting a premature leap into an overwhelmingly inaccessible future.

Key Quotes:

“Different types of intelligence are important…. Allow for flexible study methods and learning styles. Teach children the importance of self-awareness. Focus on creativity, communication, collaboration and critical thinking.”

“The humanities need to be central to this conversation so that we can maintain the art of being human while everything around us changes.”

Anonymous survey respondents

Figure 79: Thematic analysis – Value-based education word cloud and quotes

Figure 80: Thematic analysis – Enhanced infrastructure provision word cloud and quotes
6.10. Implementation-specific Recommendations

Finally, in terms of implementation, respondents have emphasised the specific need for increased funding, blended learning and the adoption of international standards. These should be coupled, as already alluded to previously, with emerging forms of regular curricular review and an emphasis on youth empowerment, the latter of which is particularly significant for harnessing Africa’s enormous youth dividend as the 21st century unfolds.

Key Quotes:

“It can’t be business as usual anymore…. The services and products sold in an economy must see their profits reinvested in these same communities that allow these companies to thrive... profits should be put in place to improve community’s quality of life.”

“Leverage and incorporate ... international best practices with an African context in view.”

Anonymous survey respondents

Figure 81: Thematic analysis – Implementation recommendations word cloud and quotes
7. THE WAY FORWARD FOR EDUCATION IN THE 21ST CENTURY

7.1. Key Priorities for Improvement

There are numerous challenges facing education on the African continent, particularly with regards to adapting to the 21st century and the 4IR. The preceding sections honed in on the views and opinions of various education stakeholders surrounding 4IR in the African context, highlighting the enabling and obstructive factors that contribute to or hinder 21st century education. From the extensive research conducted, the following key priority areas should underpin the efforts of governments and other stakeholders in advancing 21st century education in Africa:

▪ **Priority 1: Improving the quality of education** – Our research has confirmed that the majority of students in many African countries do not have access to quality education as a result of inadequate infrastructure, poor quality of teachers, untrained teachers, or rudimentary learning materials. Governments have to prioritise improving the quality of basic education to adequately prepare learners for the 21st century.

▪ **Priority 2: Addressing socio-economic inequality** – Inequality remains one of Africa’s greatest problems. It can be recognised along gender lines, geography (rural vs. urban) and socio-economic status, among others. Due to unequal resource allocation and opportunities, millions across the African continent are not in a position to benefit from or contribute to the 4IR. This is a missed opportunity because people who are economically or socially active are less of a burden on welfare services and offer the potential for socio-economic development.

▪ **Priority 3: Toward an Afrocentric, Pan African curriculum** – A legacy of colonialism continues to cast aside traditional African ways of living, learning and being. There has never been a sustained effort to celebrate and highlight indigenous knowledge and culture. If traditional African values and systems are not considered in the adoption of 4IR, policy and programmes, uptake, perpetuation and sustainability of the 4IR are unlikely to take place.

▪ **Priority 4: Providing an enabling environment** – For the 4IR to become a way of life, policy and practice have to put it at the forefront. Currently, the 4IR is not as integrated as it should be in policy and implementation. The policy landscape is complex, with many actors who represent different interests and agendas. To successfully navigate the process of infusing the 4IR into education and related policies, attention should be paid to political wills and appetites.

▪ **Priority 5: Developing and improving infrastructure** – Without the correct infrastructure in place, it will be challenging for the 4IR to be realised. Infrastructure includes basics such as electricity, and 4IR-specifics, such as broadband and mobile phone towers. Infrastructure in Africa represents one of the areas that receives the most capital investment, particularly from foreign aid. Attention should be paid to how and where this money is spent, to maximise the positive effects on the adoption of the 4IR.

▪ **Priority 6: Making financial provisions for a 4IR education** – In developing countries, education spending lags behind that of developed countries. Without sufficient investment into 4IR, the chances of it becoming a way of life in Africa are slim. Although many African countries are on par with the Global North in terms of education spending as a percentage of GDP, the resultant spending is not adequate enough to address education’s developmental needs. Ensuring that Africa joins the 4IR in education and other spheres will require significant upfront and ongoing spending.

▪ **Priority 7: Strengthening systems of governance** – Ensuring that African countries align with 4IR needs and demands requires an integrated governance approach. This approach should be considered at the levels of continental bodies such as the African Union and SADC, national bodies like ministries and agencies, provincial bodies or governments, municipalities, districts, and wards. Governance activities related to the 4IR should include policy making, monitoring and evaluating policy implementation, research, and knowledge sharing.
*Priority 8: Equipping learners with skills for the 4IR* – The world is changing at a breathless pace and students are expected to be able to adapt and evolve. 4IR-ready skills do not stop at digital literacies: creativity, critical-thinking, collaboration, communication, citizenship and character development are all essential in the 21st century. By embedding relevant pedagogies into teacher training and curricula, education systems will harmonise with the 4IR.

### 7.2. Recommended Pilot Studies

Based on the research that has been conducted, the TMF proposes the following four pilot studies:

**Pilot Study 1: “Develop inclusive, decolonised curricula”** – Mass social movements such as #RhodesMustFall, and the work of academics in post-colonial societies have popularised the mantra: “decolonise education”. However, there is still a great deal of work to be done to define the theoretical contexts and practical applications, e.g. if/how African and Western knowledge systems and practices can be integrated; as well as how information can transcend physical space and time. The objective, therefore, is to ensure that African values, cultures and pedagogies are placed at the centre of a 4IR education, in such a way that the integrity and significance are highlighted without compromising African education systems’ competitiveness and relevance in a global context. “Decolonising education” is not simply a case of doing away with current systems entirely but working towards a modern body of knowledge that takes the best out of indigenous and international information. The researchers propose conducting a pilot study within African countries or communities where curricula decolonisation has been done successfully, and selecting at least one community to leverage the findings and assist in designing a short course or module.

**Pilot Study 2: “Examine existing online resources”** – Throughout this report, there are references to online resources such as MOOCs. In an African context, where the rural/urban divide is palpable, online courses and learning materials are an ideal way to reach far-flung communities—provided that they have access to digital services. Leveraging information from Pilot Study 1, there should be an audit of existing online courses and resource repositories to determine which are applicable to African students. In order to address any identified gaps, we recommend an exercise that draws on African academics, community leaders and experts to create African-inspired content. For example, these courses may be tested via implementation on platforms such as EdX or Coursera.

**Pilot Study 3: “Emulate global best practice in a 4IR education”** – In order to gain a deep understanding of Africa’s participation in the 4IR on an international scale, Pilot Study 3 focuses on undertaking an extensive evaluation of global 4IR education trends. Although not all trends will be applicable, a study of what other countries are doing—especially in a cost-effective manner—is important to position African countries as global players across the 4IR value-chain. Suggested streams for consideration include 4IR-specific curricula and subject integration, innovative hardware and software solutions, and assessment techniques. As a starting point, it may be possible to commence with one stream of analysis.

**Pilot Study 4: “Bring teachers into the 4IR”** – This report has identified a number of cutting-edge teaching techniques, for example: learner-focused pedagogies, gamification, resources such as MOOCs, and tools such as VR/AR and multimedia, which can be used to enhance the classroom experience. For there to be significant uptake, teachers need to feel comfortable using digital technologies and should sanction its use in the classroom. Governments need to consult with teachers and their representative bodies (i.e. teacher unions) to discuss how the 4IR can benefit students and their teachers. Through these consultative processes, potential obstacles can be identified and teachers can trial some of the proposed tools and techniques. The logic is that involving teachers in decision-making around the 4IR will foster better relationships among education stakeholders and will result in a strong, implementing workforce who will enable 4IR to flourish in the classroom and beyond.
7.3. Strategic Recommendations

It is not possible to solve all issues identified in this report all at once, nor is it possible to implement every suggestion made in each section. Rather, the researchers have conceptualised a set of strategic recommendations that speak to the key priority areas in 7.1 and industry expert insights throughout the report. The approach is to identify actionable and tangible steps that should be taken to bring education in Africa into the 21st century.

The following recommendations should be consulted in developing enabling policies.

HOLISTIC SKILLS INTEGRATION

- Digital skills should be taught in distinct subjects as well as part of all other subjects.
- Linguistic and mathematical literacies should be strengthened to form the basis of digital literacies.
- STEM should be adapted to STEAM (where 'A' represents the arts) to produce well-rounded, critically thinking learners.

INCLUSIVE CURRICULUM DESIGN

- Through community and expert consultation, there should be a move towards multi-lingual and multi-cultural curricula that speak to 4IR.
- Curricula should be designed with 21st century industry and economic needs in mind.
- There should be an audit of existing online courses to determine which are applicable to African students and gaps should be filled by African academics.

CONTEXTUAL LEARNING

- Blended learning models (such as use of multimedia and studio learning) should be used strategically to enhance the learning environment.
- Other ways of enabling students to learn within their home environments include encouraging educational institutions to expand their reach into far-flung areas through physical or virtual presence.

DEVELOPMENTALLY APPROPRIATE LEARNING

- There should be regional frameworks put in place which speak to developmentally appropriate learning and national frameworks which align.
- Early Childhood Development (ECD) is the cornerstone of all other levels of education. Investment into ECD means that students are provided with the best possible start in life. Research has shown there to be positive social and economic returns on investment in the early years. Investment into ECD-focused agencies and ECD practitioner development should be prioritised.

COMPETENT MANAGEMENT AND ADMINISTRATION

- Teachers need to be equipped with digital skills to enhance their teaching practices.
- Teachers should be taught how to use the latest 4IR-ready pedagogies and technologies.
- Through access to e-resources, a teacher’s role in the classroom can be enhanced and they can offer more socio-emotional support to students.
- Teachers require continuous professional development and training to keep ahead of 4IR trends.
- Politicians and bureaucrats should endorse the 4IR if there is to be any traction. Winning the hearts and minds of these key players is critical.

TECH-FOCUSED CURRICULUM DESIGN
• There should be an alignment with global standards of tech-focused curricula.
• Through innovation challenges, students’ ideas can be brought into the 21st century.

FINANCING 4IR EDUCATION

• Governments should consider the long-term view of investment in 4IR education – where there are likely to be positive consequences in the form of economic growth and innovation.
• In addition to the government’s educational spending, there should be an emphasis on innovative financing of 4IR in the form of impact investment, SDG-related funding and public-private partnerships (bursaries, learnerships and apprenticeships in particular).
• To enable all students to access education, varying funding options should be explored.

COLLABORATION BETWEEN STAKEHOLDERS

• To strengthen efforts to gear education in Africa towards the 4IR, there must be extensive stakeholder collaboration. The public sector, private sector and non-profit sector all have a vested interest in 21st century educational practices, as do community members.
• Stakeholder consultations should form the basis of any major decision-making processes, policies and dialogues.

Table 13: Strategic recommendations
7.3. **Action Plan**

The following table describes short-, medium- and long-term objectives that can be achieved by all involved stakeholders:

<table>
<thead>
<tr>
<th>Short-Term</th>
<th>Medium-Term</th>
<th>Long-Term</th>
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<tbody>
<tr>
<td><strong>Government</strong></td>
<td></td>
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</tr>
<tr>
<td>• Design and implement a series of pilot studies that speak to potential 4IR interventions. (See 7.2)</td>
<td>• Revise all sector plans to align with the 4IR umbrella policy.</td>
<td></td>
</tr>
<tr>
<td>• Commission a continental umbrella policy on the 4IR, aligning it with the SDGs and Agenda 2063.</td>
<td>• Revise the 4IR umbrella policy on a 5-year basis, ensuring that it is always relevant.</td>
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</tr>
<tr>
<td>• Forge strategic 4IR partnerships with other countries, development agencies, industry and the non-profit sector.</td>
<td>• Use 4IR to address digital inequality and minimise the digital divide between the haves and have-nots.</td>
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<tr>
<td>• Develop laws and regulatory frameworks conducive to the 4IR, including data protection, cyber security, cross-border information flows.</td>
<td>• Engage with educational institutions, industry, SDG investors and development agencies to co-fund the basic and technical infrastructure needed to realise the 4IR across Africa.</td>
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<tr>
<td>• Consult with top curriculum developers and educational experts to develop an integrated teacher and learner curriculum roadmap across education levels, taking into consideration technical and ‘soft’ skills needed for the 4IR.</td>
<td>• Engage with communities and other stakeholders to assess whether existing interventions are succeeding, and pivot if necessary.</td>
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</tr>
<tr>
<td>• Engage with communities using an asset-based, community development methodology to determine priority education strategies and to mobilise community resources.</td>
<td>• Invest significant financial and expert resources into the ECD phase (ECD-focused agency, curriculum, theoretical training, practical training and ongoing mentorship) with a focus on under-resourced communities.</td>
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<tr>
<td>• Perform an audit of existing online courses to determine which are applicable to the African context. Commission a working group of experts to create complementary material as needed.</td>
<td>• Implement alternative education programmes, including e-learning, blended learning and digital toolkits.</td>
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<tr>
<td>• Prioritise teacher and principal professional development, training and incentive schemes, ensuring that socio-emotional support to students is a focal point.</td>
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<tr>
<td>Labour</td>
<td>Education Providers</td>
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<tr>
<td>• Engage with government to align on policy and priority areas.</td>
<td>• Align with government’s 4IR policy and frameworks.</td>
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</tr>
<tr>
<td>• Work with government and other stakeholders to carry out initial pilot studies. (7.2)</td>
<td>• Consult with government and other stakeholders on the best way forward, with an emphasis on collaboration.</td>
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<tr>
<td>• Harness the power of entrepreneurship by funding and incubating tech initiatives.</td>
<td>• Retain and retrain current and future teachers through adequate incentives and enhanced programmes.</td>
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<tr>
<td>• Ensure the promotion and prioritisation of TVET colleges for the betterment of a growing labour force, with a focus on tech.</td>
<td>• Implement tech-focused schooling models in basic education, and leverage technologies to re-engineer and enhance student’s learning and better understand their subjects.</td>
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<tr>
<td>• Empower agricultural communities with digital literacy skills, encouraging the adoption of advanced technologies, improving agro-processing techniques, and improving access to networks in both an urban and a rural setting.</td>
<td>• Gear learning modalities towards blended forms of learning (face-to-face and online learning).</td>
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<tr>
<td>• Place the labour force at the core of the digital transformation by providing the necessary targeted technological and soft skills training and career guidance to ensure continuous relevance of the continent’s human capital.</td>
<td>• Revolutionise the education system in line with technological advancements, and emphasise</td>
<td></td>
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<tr>
<td>• Develop upskilling and reskilling programmes with a focus on AI, machine learning, and robotics to maintain the employability of the current labour force for the new roles that the 4IR is set to create.</td>
<td>• Reconstruct, redefine and decolonise current education systems to introduce an element of Africanisation.</td>
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<tr>
<td>• Focus on developing ICT-intensive jobs, particularly in digital design, creation and engineering to create more jobs.</td>
<td>• Partner with educational specialists to develop online courses suitable for each student’s individual needs.</td>
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</tr>
<tr>
<td>• Tech should feature prominently in the education curriculum to equip learnings with the four C’s - critical thinking, collaboration, communication and creativity, all of which are necessary to ensure their value in a digitised world.</td>
<td>• To ensure and enhance the quality of African education, suitable qualification frameworks need to be developed to constantly update curriculum with industry trends and global standards.</td>
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<td></td>
<td>• Introduce coding as a subject into all levels of education curricula.</td>
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<tr>
<td></td>
<td>• Promote the preservation of indigenous knowledge systems by erecting national centres and engaging with communities to develop resources and pedagogies.</td>
<td></td>
</tr>
<tr>
<td><strong>Education in the Age of the 21st Century</strong></td>
<td><strong>August 2019</strong></td>
<td></td>
</tr>
</tbody>
</table>

| **Short-Term** | **Medium-Term** | **Long-Term** |

- STE(A)M, linguistic skills, adaptability, creativity, critical thinking, emotional intelligence and logical reasoning.
- Embrace the emerging forms of education geared towards entrepreneurial ventures.
- Enable the use of digital technologies in schools (in both urban and rural settings) to streamline the teaching experience and facilitate students’ access to repositories of educational content.
- Assess the appropriateness of introducing technology into the classroom, and how to best utilise it.

- Incorporate aspects of ICT in all school subjects and provide teachers with instructional support, using a learner-based approach.
- Take initiative to roll out and scale up viable 4IR technologies in conjunction with other stakeholders.
- Invest in developing shared learning platforms and open source technologies to disseminate and share best practice.
- Develop more tech incubation hubs which serve as research and innovation centres for homegrown technologies and “techpreneurs”.

| **Corporates** | **NPOs/NGOs** |

- Participate in official processes to develop policies and frameworks.
- Develop strategic partnerships with learning institutions to create contextually relevant and industry-orientated curricular and development programmes.
- Develop user-centred approaches which put the human workforce and consumers at the centre of innovation.
- Invest in educational programmes (bursaries, scholarships, learnerships) geared towards the 4IR.

- Ensure that the continental move towards the 4IR is supported by rigorous research and oversight mechanisms.
- Participate in official processes to develop policies and frameworks.
- Provide innovative education solutions and budgetary support.
- Assist government with community consultation and mobilisation efforts.
- Accelerate the implementation of flexible and informal digital skills training programmes, particularly in rural areas.
- Implement select 4IR educational programmes on behalf of government.

- Embrace a blended workforce of automated processes and humans, with investment in human upskilling.
7.4. **Overarching Questions and Answers**

The following is a list of overarching questions that were posed ahead of this study and which helped guide the research throughout the course of the project. While their focus is on South Africa, their relevance is continental.

1) **What does a Fourth Industrial Revolution-transformed South Africa look like?**

The 4IR, as noted throughout the report, is set to usher in new technologies that will fuse digital, biological and physical worlds while impacting all industries, economies and disciplines. With South Africa being the most unequal country in the world, the 4IR is set to have both a positive and negative impact on the country and its citizens. The majority of people in the country continue to be disadvantaged and economically marginalised – making it difficult for them to access technological resources. In the face of these socio-economic conditions, the 4IR can potentially exacerbate the inequalities as a result of imminent job losses that will result from automation. With the poor and sometimes non-existent technological infrastructure in rural and townships areas, people living in these areas will be marginalised from the value that will be brought about by the technological advancement.

A 4IR-transformed South Africa is also one with opportunities for job creation, and new ways of learning initiated. The decentralisation of the workplace, and subsequently work will mean that people will have more flexibility in terms of choosing how many hours to work, where and how to work. Technology will also afford people access to work opportunities that would have otherwise been inaccessible.

It cannot be predicted, with accuracy and certainty, what the impact of the 4IR will be in South Africa, however, it can be said that it will bring both positive and negative consequences as the three previous revolutions have done.

2) **What does the education system of 2030/2063 look like? What is the desired future?**

Education, according to the Agenda 2063, is premised on Africa investing in skills and science, technology, engineering and mathematics (STEM) subjects so that Africans can be able to drive the continent’s development. The vision and framework for realising this encompasses: 

- the expansion of universal access to quality early childhood, primary and secondary education;
- the strengthening of technical and vocational education and training through scaled up investments to establish high-quality TVET centres across Africa, foster greater links with industries and alignment to labour markets with a view to improve the skills profile, employability and entrepreneurship of youth and women, all in order to close the continental skills gap; and
- the expansion and building of a knowledgeable African society through transformation and investments in universities, science, technology, research and innovation. It is also through harmonising education standards and mutual recognition of academic and professional qualifications.

The NDP’s vision for education is premised on ensuring that all children have access to a quality education, particularly in relation to mathematics, science and languages. The policy’s aim is to ensure that 90% of learners
pass subjects with at least 50% by 2030.\textsuperscript{4}\textsuperscript{4} According to the NDP, areas such as innovation, education and training are pertinent to enhancing economic growth, reducing inequality and eliminating poverty. More specifically, the NDP’s vision for education has the following attributes:\textsuperscript{4}\textsuperscript{4}

- high quality of early childhood education (ECE), with access rates exceeding 90%
- wider systems of innovation linking key public institutions with areas of the economy consistent with the country’s priorities
- expanding the higher education sector that is able to contribute towards rising incomes, higher productivity, and the move towards a more knowledgeable-intensive economy
- Higher Education and Further Education Training (FET) that provides people with real opportunities to reach their full potential
- quality school education with literacy and numeracy at globally competitive standards

The desired future is for South Africa, and Africa to have an educated population that is able to contribute to the continent’s development.

3) How will the Fourth Industrial Revolution affect education in South Africa? How might we transform the SA education system in the context of the Fourth Industrial Revolution?

It is certain that the 4IR will disrupt many sectors of the economy in different ways. Education is one sector that will not be left behind. This has been reiterated in the following quote by the Founder of CEO of IDEA Digital Education, Dr Corrin Varaday who said: “Five years ago, if I look at my experience both here in South Africa and East Africa, we were probably too early with what we were doing. The devices weren’t rolling, they weren’t a lot of low-cost devices and even mobile technology like 4G five years ago was still coming in. Were we able to be there and embrace digital learning? The reality is probably not but five years later we are in an extraordinary place and I keep thinking ‘imagine what’s going to happen next year or in another five years’ time?’ The infrastructure problems, the electricity, the devices, those are challenges but they’re not insurmountable”. Collaboration between different stakeholders will result in changes across schools in South Africa. The 4IR will require South Africa’s education sector to produce learners who will be able to blend digital skills with business and arts.

The transformation of South Africa’s education sector in the context of the 4IR will be largely premised on the country addressing the many challenges that affect basic and higher education, with the primary being increasing teacher quality and training. The education sector cannot be transformed when teachers still lack the basic skills in terms of content and pedagogy. It is also through redefining and reconstructing the current curriculum in alignment with the needs of the country and global economy. This transformation will also require rethinking how TVETs are perceived and furthermore, utilised. The prioritisation of these institutions is especially important in providing workplace training that many university graduates do not have. It is through TVETs that people can be equipped with the necessary practical skills needed for ushering the 4IR so that the country is able to compete in the global economy.

4) What is the meaning of 21\textsuperscript{st} century education in SA?

According to the National Development Policy 2030, 21st century education means ensuring universal access to education at the different levels, establishing more schools in impoverished areas, improving infrastructure, increasing availability of educational resources. When analysing some of these goals on a microscopic level, that means ensuring all educational institutions have:

- proper functioning toilets
- textbooks and other educational material
- disabled-person-friendly infrastructure

The issues that the South African education system faces as a result of having a large number of unqualified educators calls on the future of education to incorporate necessary systems to improve the training of teachers. As such, premised on the present factors, a 21\textsuperscript{st} century education could simply mean meeting the needs of the current education system.
Yet, when realising that the integration of innovations as potentially serving as solutions to the current issues, as well as prepare youth for 4IR, South Africa has integrated first-world countries’ concepts of the 21st century education. This has led to policies and curriculum highlighting the need for ICT and education technology integration. By which learners/students and educators are required to learn to adapt and work with the various digitalised tools and content. And in this context 21st century, education is defined as preparing for the digitalised future. When reviewing the above, it could be understood that 21st century education in South Africa has more than one meaning, which is informed by the state of the nation-politically, socially and otherwise.

5) Is digital transformation required for the education system to become globally competitive? If so, what would we hope for it to achieve?

Due to first-world countries moving towards advancing education through integration of technology, digital transformation in the South African will help place the South African education system at a level that may facilitate its competitiveness with other countries. This is supported by the kinds of outcomes generated from the integration of ICT in curriculum and the innovations in education. Certain institutions have seen the integration of ICT facilitating of skills needed for 4IR labour force (critical and creative thinking, as well as problem-solving) for both the youth and the educators.\(^{vii}\) However, we continue to hope for more of it to aggressively tackle issues related to illiteracy, enable increased educational experience for the disabled, and improve the quality of education and overall preparation for the youth.\(^{viii}\)

Additionally, digital transformation of education in the form of online learning has enabled education to reach people of various backgrounds, overriding the financial and social constraints that impede education deficit.\(^{ix}\) When considering the educational challenges of South Africa, we cannot base the level of competitiveness solely on the digital transformation. If the improvement of education has been geared towards facilitating the digitised future, non-digitised/non-digital issues will limit the strides made within education.

6) What needs to change in South Africa to equip our young people for the future?

The necessary changes needed when considering the current state of education will need to target the various intuitions that inform the kind of education received by learners and students. When identifying changes from a bottom-to-top approach, we can start with changes needed for learners within the education system.\(^{ix}\) Curriculum needs to be updated to assist learners and students develop skills for the future labour force (e.g. critical and creative thinking, problem solving) and not skills needed for prior centuries (e.g. memory/rote-based). There is a need for more resources to be available for learners and students to improve the quality of education. The emphasis on improving the quality of education leads to the experiences within the classroom.\(^{x}\)

Teachers are known for establishing the educational atmosphere in the classroom. As such, changes need to be aimed towards improving the educational and continuous development of educators, as well as other staff contributing to the provision of education. Professional teacher development should be geared towards assisting educators to be skilful to take on various hats that enable for effective social development of the youth.\(^{xi}\) It is also important for teachers hired by various institutions to have a qualification fitting for the position they may be or want to assume. However, practicing teachers without qualifications need to be allocated programmes and courses to enable them to be qualified.\(^{xii}\) There is also a need for change in terms of policies. Government has to update educational policies to meet the current and future needs. However, procedures must be implemented to ensure such policies are reviewed to stay up to date.

7) What skills will people need to innovate, compete and succeed in the future, and how can we teach them?

While there are numerous stakeholders in South Africa’s transition to the 4IR education, there needs to be a considerable effort towards upskilling South Africa’s educators. The existing teacher base already struggles with core subject knowledge and pedagogical techniques because of a lack of teacher training and professional development. In any manifestation of the 4IR, it is important have the right foundation before inundating teachers with new skills for which they have little or no foundation. Once core literacies (mathematical and linguistic) are in place, the goal should be to build on these with digital literacy. Teachers should be equipped with elementary ICT skills such as navigating computers, mobile devices and commonly used programmes. Teachers have to be able to use content resources from digital platforms such as video streaming services, e-learning portals and educational games. Elevating teachers’ methods of teaching into the 21st century is equally
as important as ensuring they are able to use technology in the classroom: modern pedagogical techniques such as learner-centred education, blended learning and technological tools (for example, gamification, VR and AR) enable teachers to leverage the latest research for enhancing the learning environment.

It is widely agreed that most 21st century skills are underpinned by the 6 Cs: critical thinking, collaboration, communication, creativity, citizenship and character education. These 21st century skills need to underpin the education that is given to learners so that they are best positioned to compete in the current and future labour market. The 4IR job market demands necessitate the repositioning of ‘human’ skills that machines struggle to master. Most jobs of the future will require people to incorporate at least some of the 6 Cs in their daily work in conjunction with digital literacy. These skills are difficult to grasp in isolation and should be integrated into the curriculum at multiple levels. Not only has the employment landscape been disrupted both locally and globally, new possibilities of work and knowledge are continuously made available. People are changing jobs more often than ever, whether job title, industry or even from employee to entrepreneur. In the 4IR, education has to keep pace with labour market changes and allow opportunities for workers to be skilled, upskilled or reskilled. The same principles apply as with students: skills traditionally considered part of the arts or humanities are increasingly being brought to the forefront of working life. 4IR hard skills (digital literacy, for example) and soft skills (the 6 Cs) should be available to workers via self-learning systems, on-the-job training and other channels.
7.5. Conclusion

The point of departure for this project was Former President Thabo Mbeki’s comment on whether South Africa was sufficiently prepared for the imminent Fourth Industrial Revolution. The Thabo Mbeki Foundation (TMF) then decided to convene a multi-stakeholder Working Group (WG) to build a vision, strategic framework and action plan to prepare South Africa (in particular, South Africa’s education sector) for the 4IR. While the core objectives of the project were initially founded on interrogating the readiness of South Africa’s education sector for the 4IR, a decision was made to expand the research focus to the continent. It was important for the TMF to determine whether education systems across Africa are prepared for the opportunities and challenges that will come with the 4IR and whether the sector is producing the skills and competencies necessary to meet Africa’s development needs.

To achieve this, the TMF engaged in primary and secondary research efforts, including the analysis of existing industry and specialist insights, as well as direct contact with key stakeholders in the African educational and technological environments.

Through extensive consultation with the Working Group, experts in the education space and a wide range of sources, it has become clear that the Patron of the TMF was right – South Africa (as well as other African countries) is not currently equipped to join the 4IR. This is for a number of reasons, including a lack of basic and technical infrastructure, poorly trained teachers, curricula that are no longer relevant, and education stakeholders not collaborating effectively. The outcomes of the research have highlighted the following priority areas relevant across all data:

1. Improving the quality of learner and teacher education
2. Addressing socio-economic inequality
3. Toward an Afrocentric, Pan African curriculum
4. Providing an enabling environment
5. Developing and improving infrastructure
6. Making financial provisions for a 4IR education
7. Strengthening systems of governance
8. Equipping learners with skills for the 4IR

The TMF has used evidence of best practices, as well as other quantitative and qualitative data, to inform strategic recommendations, including a series of initial pilot studies. The proposed pilot studies are designed to address multiple priority areas, and to formalise the beginning of the move toward education in the 4IR. As this report was commissioned with policy at the forefront of interventions, it is recommended that government takes ownership of these pilot studies in conjunction with strategic and implementing partners.

One of the key deliverables of this report is the action plan. This plan has been developed with multiple stakeholder groups in mind, and provides tangible, actionable steps for each group to follow in the short-, medium- and long-term. Since the move toward 4IR-aligned education is a dynamic process, the action plan will shift as time goes on and as more data is available to inform the strategy. It is envisaged that the TMF will continue to lead this process and ensure that the African Renaissance is within reach.

This report is concluded with the reassertion that leading South African and African education toward the 4IR, to address multiple development priorities, and to position Africa as a leader in the world of the future, is the main priority. The aim is that education stakeholders, such as governments, labour, education providers, corporates, the non-profit sector and citizens use this report as a springboard for future discussions and activities focused on education in the 4IR. The multidisciplinary and niche nature of this report allows for the establishment of baselines and the placement of MEAL (monitoring, evaluation, accountability and learning) measures, as well as informing other research studies, policies and strategies. This is a significant and momentous step towards the 4IR in Africa, by Africa.
OUR SPRINGBOARD

The Thabo Mbeki Foundation was established in 2008 as non-profit organisation by its Patron, Mr Thabo Mbeki, upon his retirement as president of the Republic of South Africa. The central mission of the Foundation is to enable us to continue the work to contribute whatever we can to the vitally important objective of promoting the achievement of Africa’s renaissance. This was given rise by the Patron’s determination for South Africa to develop direct association with the rest of the African continent. The country shared a common struggle for liberation from colonialism with other African countries, so it was prudent for it to be at one with them and respond practically in the liberation and development challenges of the African continent.

THE CHALLENGE

At the core of our challenge is the leadership deficit on the continent, poor policy formulation and implementation, and the continued interpretation of the African story by others other than Africans themselves.

THE VISION

The rebirth of Africa which we foresee and for which millions throughout Africa should work must mean that indeed we succeed to eradicate poverty and underdevelopment on the Continent, build relations of friendship and peaceful cooperation among the peoples of Africa, reaffirm the dignity of all Africans, including those in the Diaspora, achieve progress on the important challenge of gender equality and the upliftment of women, and ensure that Africa takes her rightful place among the peoples of the world as an equal player in the universal effort to determine the future of our common globe.
Education in the Age of the 21st Century
August 2019

Thabo Mbeki Foundation
Report Launch | September 2019
Cape Town
APPENDIX 1

Working Group and Steering Committee membership

Working Group

1. Dr Wendy Ngoma
   Angle Tide Business Solutions
2. Prof. Nkidi Phatudi
   University of South Africa
3. Dr Kimberley Porteus
   University of Fort Hare
4. Prof. Elizabeth Henning
   University of Johannesburg
5. Prof. Thobeka Mda
   Cape Peninsula University of Technology
6. Prof N’dri Assie-Lumumba
   Cornell University
7. Mr Sam Paddock
   GetSmarter
8. Prof. Brian Armstrong
   Wits Business School
9. Ms Rapelang Rabana
   Rekindle Learning
10. Ms S’onqoba Vuba
    Perpetu8
11. Mr Fred Roed
    Heavy Chef
12. Dr Pali Lehohla
    Former Statistician-General of South Africa
13. Ms Tinhiko Nkuna
    St Mary’s School
14. Ms Athambile Masola
    University of Pretoria
15. Mr Dean Villet
    Michael & Susan Dell Foundation South Africa
16. Mr Phathizwe Malinga
    SqwidNet
17. Mr Peter Tabichi
    Educator
18. Dr Hasmukh Gajjar
    MobiLearnAfrica
19. Prof. Catherine Odora-Hoppers
    University of South Africa
20. Prof. Nnenesi Kgabi

Steering Committee

1. Mr Lukhanyo Neer
   Convener & Project Lead: Working Group
2. Dr Adri Drotskie
   Henley Business School
3. Mr Puseletso Sauli
   Thabo Mbeki Foundation
4. Mr Xolani Sthenjwa
   Educator
5. Ms Sipumelele Lucwaba
   Educationist
6. Ms Zinhle Mkhabela
   Independent Consultant
7. Ms Modjadji Seabi
   Kagiso Trust
   North-West University
Methodology

During an event held by the Thabo Mbeki Foundation (TMF) in 2018 in partnership with Heavy Chef, President Mbeki stressed the pertinence of comprehending the meaning of the 4IR for the African context, and especially expressed concern about whether South Africans in general, and educators in particular, are adequately prepared to respond to the challenges of the 4IR. He asked about what the implications would be, for not only the economy and nature of work, but also teaching and learning. President Mbeki then issued a call to those who were present at the event to examine the impact of the 4IR on education; more specifically the challenges and opportunities that the 4IR will bring, practical solutions that can be utilised to influence and improve the training of educators and to transform teaching and learning in schools.

In response to President Mbeki’s call, the TMF and formed a multi-stakeholder Working Group (WG) comprising of academics, educators, business, policymakers, civil society and thought-leaders to tackle the complex question of that practical steps South Africa, and Africa in general, needs to take to build a foundation for a successful transition into the 4IR. The purpose of the WG was to: (1) create a vision, (2) develop a strategic framework, and (3) present an action plan to prepare Africa and its education system for the 4IR.

The Group aimed to answer three key questions:

1. **What is the meaning and impact of the 4IR on education in South Africa?**
2. **What practical steps does South Africa need to take in order to be adequately prepared to meet the challenges and opportunities of the 4IR?**
3. **What solutions can be used to improve the training of educators and transform teaching and learning in South African schools?**

The TMF contracted Africa-focused research and consulting firm In On Africa (IOA) to lead the comprehensive research assessment and analytical work of the WG, and provide support throughout the project on the planning, managing, implementing, assessing and reporting.

To provide the TMF with the information, analysis and insights required to understand the African education landscape and the 4IR, IOA carried out five distinct project phases, namely:

<table>
<thead>
<tr>
<th>Phase 1: Project Planning</th>
<th>Phase 2: Desktop Research</th>
<th>Phase 3: Primary Research</th>
<th>Phase 4: Data Analysis</th>
<th>Phase 5: Report Development</th>
</tr>
</thead>
</table>

These phases aimed to address the core research questions through in-depth qualitative and quantitative data, contributing to the development of an all-encompassing, large-scale picture of the Africa’s education sector in the context of the 21st century and 4IR.
Below are further details regarding the data collection and analysis:

**Desktop research**

IOA used a multitude of online resources in search of information relating to themes and focus areas agreed upon at the beginning of the project. These resources ranged from government publications and policy documents to industry reports and news articles.

<table>
<thead>
<tr>
<th>Focus Areas</th>
<th>Early Childhood Education</th>
<th>Education in the 4IR</th>
<th>Governance</th>
<th>Primary and Secondary Education</th>
<th>Tertiary and Post-School Education</th>
<th>Workplace and Vocational Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>181</td>
<td>21</td>
<td>22</td>
<td>22</td>
<td>50</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 15: Resource distribution among focus areas

<table>
<thead>
<tr>
<th>Thematic Areas</th>
<th>Community and Stakeholder Mobilisation</th>
<th>Education as an Economic Driver</th>
<th>Governance and Support Systems</th>
<th>Innovation in Education Delivery</th>
<th>Policy and Curriculum Design</th>
<th>Teacher Education and Continuous Development</th>
<th>ALL AREAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>181</td>
<td>18</td>
<td>19</td>
<td>33</td>
<td>29</td>
<td>40</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 16: Resource distribution among thematic areas
In addition to the above resources, IOA consulted various reflection papers written by the WG members as part of the project. These papers provided key insights and an analytical framing for the report, its conclusions and the strategic recommendations.

**Primary research**

Adding critical primary insights to add to the desktop research findings, IOA conducted in-depth interviews (IDIs) and an online survey with individuals who operate in the educational and technological spheres. The first-hand accounts and opinions of these individuals were analysed and integrated into the report findings.

**In-depth interviews (IDIs)**

IOA interviewed 10 individuals and organisations, ranging from education specialists to business leaders. These interviews combined for more than 7 hours of talk-time.

The following individuals and organisations were interviewed for this study:

<table>
<thead>
<tr>
<th>INTERVIEWEE</th>
<th>TITLE</th>
<th>ORGANISATION</th>
<th>BIOGRAPHY</th>
<th>DATE</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor Nkidi Phatudi</td>
<td>COD for the Department of Early Childhood Education</td>
<td>UNISA</td>
<td>Professor Nkidi Phatudi is the head of the Department of Early Childhood Education at UNISA and, through her experience and work, has published multiple books and journal articles focusing on the instruction of young children in educational settings.</td>
<td>18/07/2019</td>
<td>0:34:14</td>
</tr>
<tr>
<td>Dr Adri Drotskie</td>
<td>Head of Research and Faculty Development</td>
<td>Henley Africa</td>
<td>Dr Adri Drotskie is currently the head of Research and Faculty Development at Henley Africa, having previously been the MBA Director. She also lectures in Business Management at the University of Johannesburg.</td>
<td>19/07/2019</td>
<td>0:24:28</td>
</tr>
<tr>
<td>Lorinda McGhee</td>
<td>Managing Director</td>
<td>Inspireware</td>
<td>Lorinda McGhee is an IT specialist and company owner that has been working in the technology industry for more than 20 years. She has founded and owns two companies that specialise in education and the labour market.</td>
<td>25/07/2019</td>
<td>1:12:38</td>
</tr>
<tr>
<td>Joao C. Fidalgo</td>
<td>Business Consumption Lead</td>
<td>Intel Corporation</td>
<td>Joao Fidalgo, as the Business Consumption Lead at Intel Corporation South Africa, has implemented multiple technology-based interventions on multiple levels, including education, and has been in the industry for 24 years.</td>
<td>18/07/2019</td>
<td>0:42:16</td>
</tr>
<tr>
<td>Professor Elizabeth Henning</td>
<td>Director of Centre for Education Practice Research</td>
<td>University of Johannesburg</td>
<td>Professor Elizabeth Henning, in addition to her directorship, is the SARChl Chair and works as a lecturer at the University of Johannesburg.</td>
<td>29/07/19</td>
<td>0:26:22</td>
</tr>
<tr>
<td>INTERVIEWEE</td>
<td>TITLE</td>
<td>ORGANISATION</td>
<td>BIOGRAPHY</td>
<td>DATE</td>
<td>LENGTH</td>
</tr>
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</tr>
<tr>
<td><strong>Tinhiko Nkuna</strong></td>
<td>Deputy Headmistress</td>
<td>St Mary’s School, Waverley</td>
<td>Tinhiko Nkuna is the Deputy Headmistress of St. Mary’s School, Waverley, and has completed postgraduate studies in Educational Management. She takes a special interest in curriculum design and skill transfers.</td>
<td>31/07/19</td>
<td>0:37:32</td>
</tr>
<tr>
<td><strong>Ntjantja Ned</strong></td>
<td>Trustee</td>
<td>Hollard Foundation</td>
<td>Ntjantja Ned is the lead for Hollard Foundation’s efforts in the ECD environment. She previously worked with the South African government on initiatives that empowered women and children.</td>
<td>01/08/19</td>
<td>0:42:56</td>
</tr>
<tr>
<td><strong>Markus Thill</strong></td>
<td>President of Africa Region</td>
<td>Bosch</td>
<td>Markus Thill, while being responsible for Bosch’s operations in Africa, has founded Bosch’s global venture division, developing companies and initiatives of all sizes and scope.</td>
<td>02/08/19</td>
<td>0:43:56</td>
</tr>
<tr>
<td><strong>Uber Team Members</strong></td>
<td>Focus Group</td>
<td>Uber</td>
<td>Uber Africa has been involved in the evolution of the future of work in Africa and uses their reach to provide online education access to their drivers and partners.</td>
<td>01/08/19</td>
<td>1:02:27</td>
</tr>
<tr>
<td><strong>IBM</strong></td>
<td>Confidential</td>
<td>IBM</td>
<td>Confidential</td>
<td>22/07/19</td>
<td>Approx. 1 hour in person</td>
</tr>
</tbody>
</table>

Table 17: Details of interviews conducted
Surveys

IOA implemented an online survey from 23 July to 1 August 2019 which asked qualified respondents a range of questions pertaining to 4IR and education in Africa. These questions (and their results) have been incorporated throughout the report.

The following graphics illustrate the sample of 52 respondents who completed the survey:

**Figure 85: Age ranges of survey respondents**

- 18-24 years: 4%
- 25-34 years: 36%
- 35-44 years: 27%
- 45-54 years: 19%
- 55-64 years: 12%
- 65+ years: 2%

**Figure 86: Distribution of gender among survey respondents**

- Female: 71%
- Male: 27%
- Prefer not to say: 2%

**Figure 87: Types of employment among survey respondents**

- Full-time employment: 59%
- Self-employment: 12%
- Part-time employment: 17%
- Fixed term employment: 8%
- Unemployed: 4%
Figure 88: Types of role-players among survey respondents

- Education professional: 46%
- Entrepreneur: 19%
- Corporate leader: 10%
- CSR professional: 19%
- 4IR expert: 2%
- Other: 2%

Figure 89: Places of residence among survey respondents

- Gauteng: 57%
- Western Cape: 23%
- KwaZulu Natal: 6%
- North West: 8%
- Eastern Cape: 2%
- Northern Cape: 2%
- Kenya: 2%
- Namibia: 2%
- Japan: 2%
- Nigeria: 2%
- Outside of SA: 2%
Data analysis

IOA conducted qualitative and quantitative data analysis of all research that was conducted during the project. The analysis included, but not limited to, was:

- **Mapping and analysing** the key policies and practices that require attention from all education stakeholders.
- **Summarising** the current state of knowledge and research related to education in the context of the 21st Century.
- **Illuminating** trends relating to the current and future labour market, identifying sectors and industries that are most likely to absorb young workers in the 4IR.
- **Identifying** key considerations and best practices for South Africa’s education system to take into account in efforts to transition within and adapt to 4IR.
- **Benchmarking** (qualitatively and quantitatively) global and local 21st-century curriculum models and pedagogical approaches.
- **Providing** specific recommendations to influence the evolution of the South African education system and drive decision-making and action.

Figure 90: Analysis conducted a part of the project

IOA utilised a combination of manual data analysis and software-driven analytics to ensure in-depth and well-informed qualitative and quantitative insights.

**Qualitative data:**
- Insights gained from desktop research
- Quotations and themes extracted from the in-depth interviews and focus groups
- Open-ended survey questions

**Quantitative data:**
- Quantitative data collected through the online survey
- Aggregated data derived from online data repositories, such as the World Bank

Figure 91: Qualitative and quantitative data
Survey Questionnaire

1. Please indicate which age range you fall within:
   a. 18-24
   b. 25-34
   c. 35-44
   d. 45-54
   e. 55-64
   f. 65+

2. Please select the gender you identify with:
   a. Female
   b. Male
   c. Other (open)
   d. Prefer not to say

3. Please indicate your employment status:
   a) Self-employment
   b) Full-time employment
   c) Part-time employment
   d) Fixed term employment
   e) Casual employment
   f) Unemployed
   g) Retired

4. Which role-player do you identify with most?
   a) Education professional
   b) Corporate leader
   c) 4IR expert
   d) Entrepreneur
   e) CSR professional
   f) Labour representative
   g) Government official
   h) Other (open)

5. Do you live in South Africa?
   a) Yes
   b) No
   c) If yes, which province do you reside in?
   d) Eastern Cape
   e) Gauteng
   f) Kwazulu-Natal
   g) Limpopo
   h) Mpumalanga
   i) North-West
   j) Northern Cape
   k) Orange Free State
   l) Western Cape
   m) If no, where do you reside?

6. Do you feel like you understand the concept of the "Fourth Industrial Revolution (4IR)?"
   a. Yes
   b. No (if no, a banner providing a short description appeared)
7. The 4IR will help address Africa’s development needs. On a scale of 1-5, with 1 being “Strongly disagree” and 5 being “Strongly disagree”, how much do you agree with this statement?
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

8. Please rank the following socio-economic and political challenges in order of their impact on education in Africa. (The highest ranked factor should be that which you consider the biggest problem)
   a. Poverty
   b. Low levels of literacy
   c. Racism and discrimination
   d. Diseases and illnesses
   e. Cultural norms and traditions (e.g. girls not being allowed to finish school)
   f. Conflict and war
   g. Language of instruction

9. Please rank the following infrastructural challenges in order of their impact on education in Africa. (The highest ranked factor should be that which you consider the biggest problem)
   a. Electricity
   b. Housing
   c. Transportation
   d. Infrastructural maintenance
   e. Telecommunications
   f. Not enough schools
   g. Distance to schools

10. In your opinion, do you think the education sector in South Africa is ready for 4IR?
    a. Yes
    b. No
    i. If no, why do you think the education sector is not ready for 4IR? (You can select multiple options)
       I. Corruption
       II. Financial constraints
       III. Inadequate education policies
       IV. Irrelevant/outdated curriculum
       V. Lack of organisational support for teachers (i.e. teacher training courses)
       VI. Low skilled teachers/education practitioners
       VII. Poor infrastructure (i.e. access to technology facilities)
       VIII. Poverty
       IX. Skills shortage

11. The South African government plans on introducing technology-focused subjects (e.g. robotics, artificial intelligence) into the school curriculum. On a scale of 1 to 5, with 1 being “Not at all effective” and 5 being “Extremely effective”, how effective do you think this plan will be in preparing students for the 4IR?
    a. Not at all effective
    b. Slightly effective
    c. Moderately
    d. Very effective
    e. Extremely effective
12. Teachers and educators in Africa are adequately skilled to facilitate the content’s education sector in the Fourth Industrial Revolution. On a scale of 1 to 5, with 1 being “Strongly disagree” and 5 being “Strongly agree”, how much do you agree with the statement? – **Slider scale**
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

13. With the advent of online learning platforms and open-source courses, education has become more personal and relatively accessible. In light of this, do you think there is a place for traditional universities and learning institutions in the future education sector?
   a. Yes
   b. No
   c. I’m not sure.

14. In your opinion, how can we design a curriculum that is able to bridge the urban and rural divide? (Open-ended)

15. How prepared do you think Africa’s labour market is for embracing 4IR? Please rate the level of preparedness on a scale of 1-5, with 1 being “Not ready at all” and 5 being “Completely ready”.
   a. Not ready at all
   b. Slightly ready
   c. Neutral/I don’t know
   d. Quite ready
   e. Completely ready

16. Based on your understanding of Africa’s labour market and 4IR, could you please indicate which industries would be mostly affected by disruption and digital innovation? (You can select multiple options)
   a. Banking
   b. Construction
   c. Consulting
   d. Education
   e. Financial services
   f. FMCG
   g. Food processing
   h. Franchising
   i. Gambling
   j. Government
   k. Healthcare/hospitals
   l. Hospitality/tourism
   m. Information technology
   n. Insurance
   o. Legal services
   p. Mass media
   q. Pharmaceuticals
   r. Public health
   s. Real estate
   t. Retail sales
   u. Telecommunications
   v. Waste disposal
w. ALL

17. Please rank factors you consider to be the most important for the workplace in the 4IR. *(The highest ranked factor should be that which you consider the biggest problem)*
   a. Flexible employment contracts
   b. Interdisciplinary skills
   c. The ability to work multiple jobs
   d. Increasing the use of technologies
   e. Reskilling of current workforce
   f. Increased entrepreneurship

18. In thinking about international best practices for developing a 21st century curriculum in the 4IR, what considerations do you think are important when in implementing these practices into the African context? *(Open-ended)*
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