



Summary Report

Education in the Age of the 21st Century

Responding to the challenges and opportunities
of the 4th industrial revolution

SEPTEMBER 2019



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Thabo Mbeki
FOUNDATION

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Research Partner:



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 Lehohla; Ms Tinhiko Nkuna; Ms Athambile Masola; Mr Dean Villet; Mr Phathizwe Malinga; Mr Peter Tabichi; Dr Hasmukh Gajjar; Prof. Catherine Odora-Hoppers; Prof. Nnnesi Kgabi

Sincere gratitude and appreciation to members of the Steering Committee that supported and guided the work of the Working Group who have been equally instrumental in the report:

Ms Zinhle Mkhabela; Mr Xolani Sithenjwa; Ms Sipumelele Lucwaba; Ms Modjadji Seabi; Dr Adri Drotskie; Mr Puseletso Sauli
We would like to thank the Partners of the Education in the Age of the 21st Century Working Group for their guidance and support to the Initiative and this report:

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
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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.

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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.

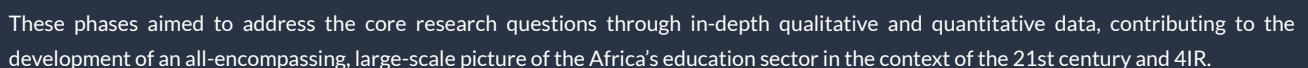
In response to President Mbeki's call, the TMF and formed a multi-stakeholder Working Group (WG) comprising of academics, educators, business, policymakers, civil society and thought-leaders to tackle the complex question of that practical steps South Africa, and Africa in general, needs to take to build a foundation for a successful transition into the 4IR.

(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.

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:



2. 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*, 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.² 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.

¹The 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

²Rich, E. 'How do you define 21st century education?', Education Week, Bethesda, Maryland, 12 October 2010. <https://www.edweek.org/tsb/articles/2010/10/12/01panel.h04.html>



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.

3. STATE OF EDUCATION IN 21ST CENTURY AFRICA

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.⁴ It is projected that by 2055, the continent will be home to 1 billion children, and estimated to be 40% of the global total.⁵ 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.⁶ 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.⁷ 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.⁸

Notwithstanding the gradual economic growth Sub-Saharan Africa has seen in recent years, the region still has a high rate of poverty. Even with governments commitment to pro-poor policies, access to education for children is still directly linked with household incomes.⁹ 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.¹⁰ The region 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.¹¹ 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 not enrolled in any form of post-primary education.^v



IN SUB-SAHARAN AFRICA, 75% OF GIRLS START PRIMARY SCHOOL, BUT ONLY 8% FINISH SECONDARY SCHOOL

Despite the sharp increase in the number of children enrolled in education systems in West and Central Africa, girls are still under-represented. 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.¹³ 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.¹⁴ Research shows that the younger the girl is when she starts school, the lower her chances are of becoming a child bride.¹⁵

Poverty has been a key driver of child labour and has also resulted in children being malnourished and unable to fight off diseases and illnesses.¹⁶ It is estimated that 29% of children in Sub-Saharan Africa between the ages of five and 17 are child labourers,¹⁷ 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. 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.¹⁸ Furthermore, children and adolescents who experience humanitarian emergencies are particularly vulnerable to missing out on schooling and dropping out of school permanently.¹⁹

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.²⁰ In both English and French speaking African countries, over half of the prospective teachers would not have necessarily received a school-leaving qualification.²¹ 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.²²

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.²³ Africa 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. 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'.

“...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,
Senior Counsel - Sub-Saharan Africa, Uber

⁴ 'State of Education in Africa Report 2015', the Africa-America Institute (AAI), 2015. <http://www.aionline.org/wp-content/uploads/2015/09/AAI-SOE-report-2015-final.pdf>

⁵ Goodwin, J. 'How play can help Africa's kids develop skills for the future', World Economic Forum (WEF), 2019. <https://www.weforum.org/agenda/2019/01/play-gives-africa-kids-skills-for-future-lego/>

⁶ Van Fleet, J., Watkins, K., and Greubel, L. 'Africa Learning Barometer', Brookings, 2012. <https://www.brookings.edu/interactives/africa-learning-barometer/>

⁷ Ibid.

⁸ Ibid.

⁹ 'Education for all in Sub-Saharan Africa: A Mirage?', Cultura Critica, 2015. <http://www.culturacritica.cc/2015/07/education-for-all-in-sub-saharan-africa-a-mirage/?lang=en>

¹⁰ Soutoul, S. 'The Right to Education in Sub-Saharan Africa', The Borgen Project, 2017. <https://borgenproject.org/the-right-to-education-in-sub-saharan-africa/>

¹¹ Ibid.

¹² 'Statistics Year Book 2016 Edition', UNESCO Institute of Statistics (UIS), 2016. <https://unstats.un.org/unsd/publications/statistical-yearbook/files/syb59/syb59.pdf>

¹³ Wodon, Q., Male, C., Onagoruwa, A., and Yedan, A. 2017. 'Girls' education and child marriage in West and Central Africa', Global Partnership for Education (GPE), The World Bank and Children's Investment Fund Foundation. <https://www.girlsnotbrides.org/wp-content/uploads/2017/12/2017-10-gpe-world-bank-early-marriage-girls-education-lovepdf-compressed.pdf>

¹⁴ 'How schooling can save African girls from becoming child brides', The Conversation, 2016. <https://theconversation.com/how-schooling-can-save-african-girls-from-becoming-child-brides-5623>

¹⁵ Ibid.

4. DECOLONISING EDUCATION TO MEET AFRICA'S NEEDS

The colonial education system still characterises many African states today.²⁴ 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. 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.²⁵ 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.²⁶ 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.²⁷ 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.²⁸ 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.³⁰

“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.³¹

¹⁶ Ibid.

¹⁷ 'Child labour', UNICEF, 2017. <https://data.unicef.org/topic/child-protection/child-labour/#>

¹⁸ 'Education for all in Sub-Saharan Africa: A Mirage?', *Cultura Critica*, 2015. <http://www.culturacritica.co/2015/07/education-for-all-in-sub-saharan-africa-a-mirage/?lang=en>

¹⁹ 'Education', UNICEF, 2011. <https://www.unicef.org/wca/what-we-do/education>

²⁰ Lauwerier, T and Akkari, A. 'Teachers and the quality of basic education in Sub-Saharan Africa', Working Paper, UNESCO, 2015. https://unesdoc.unesco.org/ark:/48223/pf0000232733_eng

²¹ Ibid.

²² Ibid.

²³ Games, D., 'The View: 'Fourth industrial revolution' is a long way off for Africa', *African Business*, 2019. https://africanbusinessmagazine.com/sectors/technology/_trashed/#

²⁴ 'Education for the 21st century', *The Zimbabwean*, 2014. <https://www.thezimbabwean.co/2014/08/education-for-the-21st-century/>

²⁵ Ramadiro, B. and Porteus, K., 'Foundation Phase Matters: Language and Learning in South African Rural Classrooms', Research Gate, 2017. <https://www.researchgate.net/publication/321330576>

²⁶ Linden, A., 'New book promotes bilingual teaching in EC rural schools', *DispatchLive*, 2018. <https://www.dispatchlive.co.za/news/2018-04-16-new-book-promotes-bilingual-teaching-in-ec-rural-schools/>

²⁷ Ibid.

²⁸ 'Education in Africa in the 21st Century: what is the greatest challenge', *Africanations*, 2017. <https://africanations.wordpress.com/2017/02/08/education-in-africa-in-the-21st-century-what-is-the-greatest-challenge/>

²⁹ Snow, C., 'Public lecture at the University of Johannesburg', 20 August 2019.

³⁰ Henning, E., 'Learning concepts, language, and literacy in hybrid linguistic codes: the multilingual maze of urban grade 1 classrooms in South Africa', *Perspectives in Education*, 30(3) 61–77.

SCHOOL/DISTRICT/PROVINCE FUNCTIONALITY

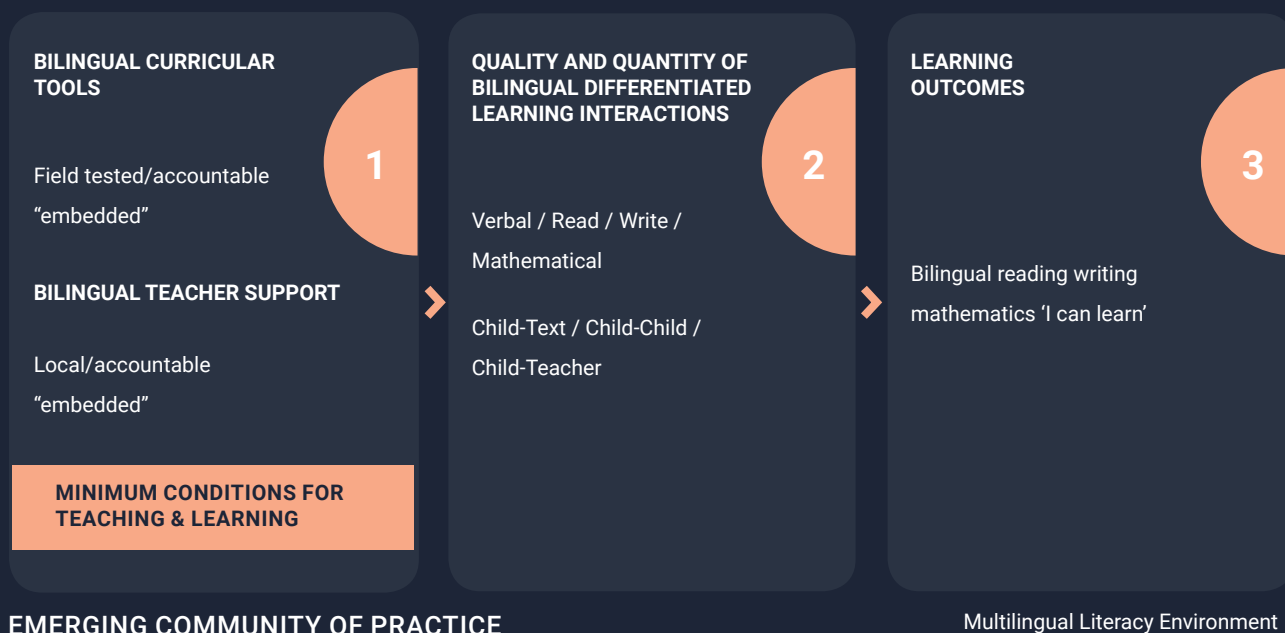


Figure 9: Framework for change: multilingual interactive primary schooling Image adapted from Ramadiro and Porteus (2017)

The above diagram summaries 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 emphasise 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.³²

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.³³

³¹ Ramadiro, B. and Porteus, K., 'Foundation Phase Matters: Language and Learning in South African Rural Classrooms', Research Gate, 2017 <https://www.researchgate.net/publication/321330576>

³² Ibid.

³³ Ibid.

5. MAKING TECHNOLOGY ACCESSIBLE TO ALL LEARNERS

Many African states have realised the potential of education to act as an instrument to achieve economic development and have invested in expanding the sector.³⁴ 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.³⁵ Owing to these developments, there have been commendable efforts by both the public and private sectors to introduce smart educational technologies to learners.³⁶ Countries such as Kenya, Nigeria and South Africa have been able to take instrumental steps in the digitisation of their education systems.³⁷ 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.³⁸ 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.³⁹ 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.⁴⁰ 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. 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. 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.

“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 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 21st century skills.”

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³⁴ Sawyerr, H., 'Issues of educational development in Africa: Towards the 21st century', Hiroshima University, 2014. <https://home.hiroshima-u.ac.jp/cice/wp-content/uploads/2014/03/2-2-2.pdf>

³⁵ Stuart, J., 'Education in the 21st century digital world', Tralac, 2018. <https://www.tralac.org/blog/article/13468-education-in-the-21st-century-digital-world.html>

³⁶ Mohapi, T., 'How do we get Africa's youth ready for the fourth industrial revolution', Mail & Guardian, 2017. <https://mg.co.za/article/2017-07-21-00-how-do-we-get-africas-youth-ready-for-the-fourth-industrial-revolution>

³⁷ Ibid.

³⁸ Stuart, J., 'Education in the 21st century digital world', Tralac, 2018. <https://www.tralac.org/blog/article/13468-education-in-the-21st-century-digital-world.html>

³⁹ 'South African schools will soon get these new subjects', Business Tech, Johannesburg, 9 July 2019. <https://businesstech.co.za/news/technology/327893/south-african-schools-will-soon-get-these-new-subjects/?source=newsletter>

⁴⁰ TVET: Smart classrooms for technical vocational education and training', Devotra, The Netherlands, 2016. <https://www.smartclassroom.nl/tvet/>

More than any previous industrial revolution, the 4IR is linked to education. It 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.⁴¹ Learning institutions are important consumers of new technologies and, in turn, produce innovators and workers who advance societies.

Digital technology experts hold that a country's youthful workforce needs to be equipped with 21st 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.

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.⁴² 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.

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.⁴³

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.

⁴¹ Gwata, M., 'To flourish in the Fourth Industrial Revolution, we need to rethink these 3 things', World Economic Forum, 2019. <https://www.weforum.org/agenda/2019/08/fourth-industrial-revolution-education/>

⁴² Kardas, N., 'Aligning education to the Fourth Industrial Revolution as a means to achieve the fourth SDG', Naseba, 2018. <https://www.naseba.com/content-hub/sector/technology/aligning-education-to-the-fourth-industrial-revolution-as-a-mean-to-achieve-the-fourth-sdg/>

⁴³ Rodny-Gumede, Y., 'South Africa needs to think differently and embrace 4IR', Mail & Guardian, Johannesburg, 8 March 2019. <https://mg.co.za/article/2019-03-08-00-south-africa-needs-to-think-differently-and-embrace-4ir>

6. A CASE STUDY OF SOUTH AFRICA'S EDUCATION SECTOR

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.

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. Although South Africa 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 in the country 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 country's education system.

Presently, the South African government has allocated a large budget to the education sector, with US\$ 17.3 billion (R262.4 billion) pledged to basic education alone for the next financial term.⁴⁴ 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.⁴⁵ The education system is said to be in a state of crisis, with high rates of enrolment each year yet progressively poor Grade 12 outputs.⁴⁶ 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.⁴⁷

“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

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.⁴⁸ The low quality teacher training is also a key challenge hindering the improvement of the country's education sector. Robinson (2019) posts that if more is to be expected from teachers ⁴⁹, 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.⁵⁰ Teachers are also misallocated, with some being allocated to subjects that they are not qualified in.⁵¹

Infrastructure and resource constraints continue to hinder the delivery of quality of education at many schools, especially those in rural areas. The changes South Africa has seen since the new dispensation in 1994 have not responded to the major problems confronting rural schools, with poor classroom infrastructure being a perpetual problem.⁵³ 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.⁵⁴

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.⁵⁵ 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.⁵⁶

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."⁵⁷



Key inhibitors in implementing technology education in (especially rural) South Africa Data courtesy of the World Bank

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.⁵⁸ 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.

⁵⁵ Presence, C., 'Budget2019: Education and culture biggest spend items in budget', 2019. <https://www.iol.co.za/news/politics/budget2019-education-and-culture-biggest-spend-items-in-budget-19403738>

⁵⁶ 'South Africa has one of the world's worst education systems: why it is the bottom of the class', The Economist, 2017. <https://www.economist.com/middle-east-and-africa/2017/01/07/south-africa-has-one-of-the-worlds-worst-education-systems>

⁵⁷ Modisaotsile, B.M., 'The failing standard of basic education in South Africa', Africa Institute of South Africa (AISA), 2012. <http://www.ai.org.za/wp-content/uploads/downloads/2012/03/No-72-The-Failing-Standard-of-Basic-Education-in-South-Africa1.pdf>

⁵⁸ Roodt, M., 'The South African education crisis: giving the power back to parents', The South African Institute for Race Relations, 2008. <https://irr.org.za/reports/occasional-reports/the-south-african-education-crisis-giving-power-back-to-parents>

⁵⁹ 'Do teachers in South Africa make the grade? Human Factor', DGMT, 2018. <https://dgmt.co.za/wp-content/uploads/2018/11/DGMT-HUMAN-FACTOR1-DIGITAL-final.pdf>

⁶⁰ Ibid.

⁶¹ Jordaan, N., 'Deeply troubling' increase in teacher absenteeism: Angie Motshekga: Report card for basic education department's successes and challenges', Times Live, 2019. <https://www.timeslive.co.za/politics/2019-04-08-deeply-troubling-increase-in-teacher-absenteeism-angie-motshekga/>

⁶² Savides, M., 'South African schools have 5,139 teachers who are unqualified or under-qualified', Times Live, 2017. <https://www.timeslive.co.za/news/south-africa/2017-06-06-south-african-schools-have-5139-teachers-who-are-unqualified-or-under-qualified/>

⁶³ 'Do teachers in South Africa make the grade? Human Factor', DGMT, 2018. <https://dgmt.co.za/wp-content/uploads/2018/11/DGMT-HUMAN-FACTOR1-DIGITAL-final.pdf>

⁶⁴ Ibid.

⁶⁵ 'General Household Survey: Focus on Schooling 2016', Department of Basic Education, 2018.

⁶⁶ '21 Century Competencies: Towards Defining 21st Century Competencies for Ontario', Ontario, 2016. http://www.edugains.ca/resources/21CL/About21stCentury/21CL_21stCenturyCompetencies.pdf

⁶⁷ Nokwali, M.P., Mammen, K. J. and Mphosa, C., 'How is Technology Education Implemented in South African Schools?', Technology Education Learners International Journal of Education Science, 2015. [http://www.krepublishers.com/02-Journals/IJES/IJES-08-0-000-15-Web/IJES-08-3-000-15-Abst-PDF/IJES-8-3-563-15-466-Mammen-K-J/IJES-8-3-563-15-466-Mammen-K-J-Tx\[14\].pdf](http://www.krepublishers.com/02-Journals/IJES/IJES-08-0-000-15-Web/IJES-08-3-000-15-Abst-PDF/IJES-8-3-563-15-466-Mammen-K-J/IJES-8-3-563-15-466-Mammen-K-J-Tx[14].pdf)

⁶⁸ 'Technology use in education in low resource, poor, rural and isolated communities', The World Bank, <https://www.worldbank.org/en/topic/edutech/brief/technology-use-in-education-in-low-resource-poor-rural-and-isolated-communities>

⁶⁹ Suto, I., and Eccles, H., 'The Cambridge approach to 21st century skills: Definitions, development and dilemmas for assessment', IAEA conference, 2014. <https://www.cambridgeassessment.org.uk/Images/461811-the-cambridge-approach-to-21st-century-skills-definitions-development-and-dilemmas-for-assessment-pdf>

7. 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. From the extensive research that has been done on a myriad of issues surrounding education, the following are key priority areas that TMF believes 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 shown 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, particularly within an educational context. 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.

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.

8. PROPOSED 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.

9. 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.

1. 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.

2. 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.

3. 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.

4. 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.

5. 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.

6. 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.

7. 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.

8. 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.

10. ACTION PLAN

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

	SHORT-TERM	MEDIUM-TERM	LONG-TERM
LABOUR	•Engage with government to align on policy and priority areas. •Work with government and other stakeholders to carry out initial pilot studies. (7.2) •Harness the power of entrepreneurship by funding and incubating tech initiatives. •Ensure the promotion and prioritisation of TVET colleges for the betterment of a growing labour force, with a focus on tech. •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.	•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. •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.	•Focus on developing ICT-intensive jobs, particularly in digital design, creation and engineering to create more jobs.

	SHORT-TERM	MEDIUM-TERM	LONG-TERM
EDUCATION PROVIDERS	•Align with government's 4IR policy and frameworks. •Consult with government and other stakeholders on the best way forward, with an emphasis on collaboration. •Retain and retrain current and future teachers through adequate incentives and enhanced programmes. •Implement tech-focused schooling models in basic education, and leverage technologies to re-engineer and enhance student's learning and better understand their subjects. •Gear learning modalities towards blended forms of learning (face-to-face and online learning). •Revolutionise the education system in line with technological advancements, and emphasise 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.	•Reconstruct, redefine and decolonise current education systems to introduce an element of Africanisation. •Partner with educational specialists to develop online courses suitable for each student's individual needs. •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. •Introduce coding as a subject into all levels of education curricula. •Promote the preservation of indigenous knowledge systems by erecting national centres and engaging with communities to develop resources and pedagogies. •Incorporate aspects of ICT in all school subjects and provide teachers with instructional support, using a learner-based approach.	•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.

	SHORT-TERM	MEDIUM-TERM	LONG-TERM
CORPORATES	•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.	•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”.	•Embrace a blended workforce of automated processes and humans, with investment in human upskilling.
NPOS/NGOS	•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.	•Ensure that the continental move towards the 4IR is supported by rigorous research and oversight mechanisms.
CITIZENS	•Participate in official processes to develop policies and frameworks. •Engage in self-learning using available repositories of knowledge.	•Feedback to government and other stakeholders on what is working well, what could be improved and what needs to change in 4IR education.	•Maintain a combination of indigenous traditions and cultures within new platforms made available through the 4IR.

9. CONCLUSION

Through this research, the Thabo Mbeki Foundation in collaboration with the Working Group and In On Africa, undertook to understand the meaning and impact of the 4IR in Africa, and South Africa in particular. As a response to former President Thabo Mbeki's call to assess whether South Africa is prepared for the 4IR, the research endeavoured to highlight the challenges and opportunities that the 4IR presents and how these might impact the unique African context. The research also 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 4IR.

Through extensive consultation with the Working Group, experts in the education space and a wide range of sources, it has become clear that 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

In On Africa 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.

Thabo Mbeki

FOUNDATION

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.



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2019
**Summary
Report**

DISCLAIMER

This report has been produced by a team from the Thabo Mbeki Foundation, which takes full responsibility for the report's contents and conclusions. In On Africa provided research support. While the members of the Working Group and experts consulted and acknowledged in the report have provided substantial input to the development of this report, their participation does not necessarily imply endorsement of the report's contents or conclusions.

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