

DIGITAL REVOLUTION AND CURRICULUM CHANGE IN AFRICA: MATTERS ARISING

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Abstract

A paradigm shift is needed in African education as new innovations are destroying old ways of doing things and smart young innovators are at the forefront of this quiet but historic transformation. Day-by-day nowadays, phenomenal and monumental leaps of unprecedented magnitudes are springing up in astronomical proportions owing to a quantum leap in computer technology. The world has finally metamorphosed into a global village with a seamless dissemination of information at a speed that even lightning is marveled. Dedicated teams of skilled developers and programmers have sprung up in innovation hubs, incubators, and accelerators across the country to build information and telecom solutions that capitalize on the country's mix of challenges and opportunities. Gradually, distance is no longer a barrier in almost every facet of human endeavours on earth. There has arisen another industrial revolution occasioned by digital revolution and technological innovations that seem to transcend human comprehension. The global education system has witnessed information sharing which has eased educational pursuits and other endeavours. The African continent however seems to be missing out of these global developmental strides that have brought about the ease of doing things. This paper assesses the importance of digitalization revolution and how the African educational system can be repositioned to key into and benefit from this positive technological revolution for positive transformation of the continent and the world at large.

Keywords: Digital, revolution, curriculum, change, Africa.

Introduction

Many African countries have leapfrogged into the mediated world of smartphones and apps without passing through the stage of wired telephone use. Through smartphone technology, the internet is more easily and flexibly accessible to more and more Africans. Global service providers of digital technologies stretch their business interests into formerly remote and difficult to access markets such as sub-Saharan Africa. Given the political, societal and economic impact of the digital revolution in the northern hemisphere, the opportunities and challenges emerging around the increasing implementation of Information and Communication Technology (ICT) in the African education system should be explored and discussed. On the one hand, Bai, Pan, Hirumi, and Kebritchi, (2018) note that digital technology per se has been criticized as a form of cultural imperialism because implementing ICTs in Africa (created predominantly in Western societies) implicitly imposes non-African cultural codes, norms and standards such as copyright and English as the dominant language. For example, the tradition of owning and protecting information is not ingrained in many African traditions and legal cultures as digitalization projects of African heritage material such as the Cooperative African Microform Project or the Digital Imaging Project of South Africa clearly demonstrates (Udemmm, 2018).

On the other hand, ICTs bear the potential to encourage Africans to actively engage in expressing their points of view in cultural production rather than copying international codes and standards. In the view of Udemmm (2018), as technological change continues to accelerate, the digital economy is rapidly permeating the whole of the world knowledge economy, making digital skills key for almost everyone. The Fourth Industrial Revolution (4IR)—characterized by the fusion of the digital, biological, and physical worlds, as well as the growing utilization of new technologies such as artificial intelligence, clouds computing, robotics, 3D printing, the Internet of Things, and advanced wireless technologies, among others—has ushered in a new era of educational expansion with monumental socio-economic consequences for Africa. However, Africa has been left behind during the past industrial revolutions.

The scenario depicted above seems to be different in Africa. Debjani (2018) notes that so far, it does not appear that Africa has yet claimed the 21st century, as it still lags behind in several indicators essential for a successful digital revolution. Improvements in Africa's ICT sector have been largely driven by expanding mobile digital financial services. The region had a large chunk of the global mobile lines in 2018 and will see the fastest growth in mobile line technology by 2025. But artificial intelligence (AI) and block chain are also attracting interest in Africa, as they have the potential to successfully address educational, social and economic challenges there. Interestingly, there are so many other areas in which 4IR technology can be transformational.

The Global Information Technology Report (Sow, 2017) reflects the results of an initiative of the World Economic Forum, which globally assesses education systems. Regarding mathematics and science education, essential for many jobs in the digital economy, Africa ranked 139 out of 151 countries, receiving the lowest global score. ICT solutions for the support of students have been successfully launched in recent years in many first-world economies, but, unfortunately, students in Africa still struggle to find solutions catering for the multi-lingual and multi-cultural challenges in tutoring. The innovative ICT platforms will

help to match African students in need of support with relevantly educated and experienced senior student tutors. African students from various backgrounds will therefore be supported in reaching their academic goals and finding jobs that reflect their talents which can be accentuated by the digitalization prowess.

The last two decades have experienced the explosive global growth of powerful digital technologies that have invaded all parts of the human experience, with profound implications for citizens, societies, economies and for science. Bojanova (2014) reports that this digital revolution and technological capacities that generate its dynamic, form the bedrock on which the globally pervasive fourth industrial revolution (4IR) is built, disrupting pre-existing norms and unleashing an unprecedented new era of innovation. Education systems in Africa, as worldwide, must adapt their working practices to these challenges, create knowledge that can be drawn upon by public and private sectors, and develop individuals with the high-level skills and competencies to develop the entrepreneurial agents that all dynamic societies need.

Meaning of Digital Revolution

Digital revolution as a relatively novel technological discourse may not be very strange to many people in this computer age. According to Krauß (2018), the Digital Revolution (also known as the Fourth Industrial Revolution) is the shift from mechanical and analogue electronic technology to digital electronics which began in the latter half of the 20th century, with the adoption and proliferation of digital computers and digital record-keeping, that continues to the present day. Implicitly, the term also refers to the sweeping changes brought about by digital computing and communication technology during this period. Central to this revolution is the mass production and widespread use of digital logic, MOSFETs (MOS transistors), and integrated circuit (IC) chips, and their derived technologies, including computers, microprocessors, digital cellular phones, and the Internet. These technological innovations have transformed traditional production and business techniques.

Areas of Digitalization

According to Heywang and Zaininger, (2018), the following are the areas of digitalization which provides necessary skills for survival.

Basic Skills

Basic Digital Skills are “entry-level functional skills required to make rudimentary use of digital devices and applications. With basic digital skills, users are typically able to operate devices like computers and smartphones, access and store information from online resources, and set up online accounts and profiles. Ability to access and use digital technologies to perform basic tasks such as: Functional use of digital devices, online communication via emails and finding, managing and storing digital information and content.

Intermediate Digital Skills

Intermediate Digital Skills enable individuals to use digital tools for more significant task-oriented purposes. Intermediate skills are the skills that enable an individual to make substantive and beneficial use of online applications and services, while Yamakin (2019) defines them as a set of generic information and communication technology skills that can be utilized to complete tasks. They are often required for professional growth and are applicable to a range of job profile requirements. Ability to use technology to perform work-related tasks

such as using professional software for presentations, analytics, accounting, project management, digital marketing, social media analytics and web design as well as graphic design.

Advanced Digital Skills

Advanced Digital Skills allow people to use technology in transformative ways. UNESCO defines these as “the group of skills that form the basis of specialist [information and communication technology] occupations and professions.” These occupations include, but are not limited to, computer programmers, artificial intelligence experts, and data scientists. Ability to perform specialist tasks in professions in the information and communication technology industry such as computer language programming, cloud computing, network management, artificial intelligence, data science, big data analytics, cyber security and web development as well as search engine development.

Importance of Digitalization

Digitalization has permeated almost every facet of human endeavour. It has applicability in the following areas among others.

Online Business

Businesses are able to design products and trade online, and individuals are able to operate financial services and payments for shopping and investments. Williams, (2017) observes that the government is also migrating to online platforms to conveniently provide public services. Other 4IR technologies are also having impact. For example, in West Africa and Kenya, block chain has enabled efficient verification of property records and transactions, and expanded access to credit in some previously informal sectors of the economy.

Modernizing Agriculture and Agro-Industries

Africa has yet to harness the full potential of its agricultural sector, and 4IR technologies provide an opportunity to do so. Williams reports also that, farming alone accounts for 60 percent of total employment in Africa, and the food system is projected to add more jobs than the rest of the economy between 2010 and 2025. Information on competitive pricing, monitored crop information, disease prevention tips, and disaster mitigation support through digitalization has the potential to transform the agriculture sector to improve income, production, and demand throughout the continent.

Improving Health Care and Human Capital

African countries face numerous health challenges exacerbated by climate change, limited physical infrastructure, and a lack of qualified professionals. According to Wang (2010), 4IR technology can help mitigate these threats and build sustainable health care systems, especially in fragile states. Mobile technology has become a platform for improving medical data and service delivery. Rwanda became the first country to incorporate drones into its health care system, using autonomous air vehicles to deliver blood transfusions to remote regions.

Improving Disaster Response—Technology has also improved disaster response. For example, during the West African Ebola outbreak in 2014 and the global COVID-19 pandemic,

WhatsApp became an easy method of dispersing information, checking symptoms, and communicating under quarantine, (Abdi, 2018).

Digital Skills are Essential to the Future Workforce in Africa, with Basic Skills Most Critical. Digital skills are central to questions about preparing children and young people for an evolving workforce. The concept of twenty-first century skills has gained traction over the past decades and denotes a range of skills, abilities, behaviors, and attitudes that are required for success in the twenty-first century. Digital skills are core to most twenty-first century frameworks and, in this study, refer to skills related to the use of technology, (Abdi, 2018)..

Without Growth in Digital Skills, Africa's Economies Will Falter. Limited access to digital talent despite an anticipated increase in demand for digital skills would have serious consequences for Africa's employers, especially with an existing supply gap. Yamakin (2019) laments those informal sector companies, which comprise a majority of African employers, are even more likely to struggle to hire qualified workers, as they typically do not have the option of looking overseas. They might fail to keep pace with technology, compromising their viability and productivity.

Failure to Recognize and Capitalize on 4IR Opportunities, Conversely, will Impose Considerable Risks on African Stakeholders: Without attempts to move beyond existing models of innovation, entrepreneurship, and digital growth on the continent, African businesses risk falling further behind, exacerbating the global "digital divide" and lowering their global competitiveness (Wolf, 2018).

Fighting Poverty and Inequality—the spread of digital technologies can empower the poor with access to information, job opportunities, and services that improve their standard of living. According to Wolf (2018), AI, the Internet of Things (IoT), and block chain can enhance opportunities for data gathering and analysis for more targeted and effective poverty reduction strategies. Already, we have witnessed the transformational power of formal financial services through mobile phones, such as M-Pesa, reaching the underserved, including women, who are important drivers for sustainable poverty eradication. These financial services allow households to save in secure instruments to enlarge their asset base and escape cycles of poverty.

Reinventing Labor, Skills, and Production—it is estimated that by 2030, Africa's potential workforce will be among the world's largest, and so, paired with the needed infrastructure and skills for innovation and technology use, the 4IR represents a massive opportunity for growth. According to Heywang and Zaininger, (2018), indeed, the 4IR is dramatically changing global systems of labor and production, requiring that job seekers cultivate the skills and capabilities necessary for adapting rapidly to the needs of African firms and automation more broadly. Already, Africa's working population is becoming better educated and prepared to seize the opportunities provided by the 4IR: For example, the share of workers with at least a secondary education is set to increase from 36 percent in 2010 to 52 percent in 2030.

Increasing Financial Services and Investment—Digitization has impacted economic growth through inclusive finance, enabling the unbanked to enter formality through retail electronic

payments platforms and virtual savings and credit supply technological platforms. More broadly, digitization is enabling entrepreneurs and businesses to rethink business models that are more impactful, sustainable, and connected to other sectors of the economy. For example, with fintech, digitization has gone beyond the financial sector to affect the real sector and households, transforming product designs and business models across market segments.

Reasons for Re-Inventing the Curriculum in Africa

Owing to the global impact of digitalization, there is a dire need for rethinking the African educational curriculum so as to catch with the rapid pace development occasioned by the fourth industrial revolution brought about by digitalization.

First and foremost, the pace of technological change is faster than ever. It took ten years for Thomas Newcomen to improve his engine before he showed it to the world in 1712 and its impact on the hand industries was not felt for another sixty years. Yusuf (2020) observes that today change can come in ten months, ten weeks and even ten days – a three year old iPhone is obsolete. The rate of change in education is also accelerating. It has been estimated that nearly 50% of subject knowledge acquired during the first year of a four year technical degree is outdated by the time the student graduate.

Again, the agents of the Digital Revolution are proliferating. According to Abdi (2018), The list is long, and already includes artificial intelligence (AI); Big Data; mobile internet; cloud technology; robots in industry and the home; the internet of things; driverless cars, lorries and taxis; drones; 3D printers; nanotechnology; virtual reality, software-based digital therapies and machine learning. The implication is that by next year – maybe next month – the list will be longer still.

Furthermore, millions of people across the globe have access to huge databases and so experimentation and innovation are not only made in research centres. Significant changes can be made by talented individuals in their homes, offices and factories. Yamakin (2019) notes that the ability of small teams of people to devise new uses, new products and new services has never been greater in the world's history than now. In the same vein, very large investments, amounting to billions of dollars, are being made by companies in Europe, Asia and America to develop and implement these agents of change. There is no shortage of capital for this industrial revolution, and one consequence will be a massive reduction in the need for labour.

Similarly, a transition in the global economy is underway that will disrupt the landscape for jobs and work. According to Bai, Pan, Hirumi, and Kebritchi (2018), about 65 percent of children entering primary school today, according to one estimate, will end up working in a job that doesn't yet exist. The World Bank Group's Human Capital Project emphasizes the need for economies to invest in human capital—particularly digital skills—or risk falling behind in the rapidly changing landscape for jobs and skills. Automation is challenging the traditional boundaries of firms and expanding global supply chains, which may enable rural clusters to emerge that connect small and medium-sized enterprises to opportunities worldwide. Online platforms are enabling entirely new industries and redefining interactions with customers and employees. Automation is changing the demand for labor as

technological advancement makes it possible for machines to do the jobs once performed by people.

It is unarguable that, digitalization makes learning new skills imperative. Different skill sets are needed for the future, with socio-behavioral skills and digital skills the most critical for success. Employers anticipate more than 40 percent of skills required for the workforce will change before 2022, with more than half of employees needing to learn different or more advanced skills. This will include shifts in the types of skills valued and the emergence of new skills sets, as well as a greater focus on existing skills sets that increase in importance.

Focus of Educational Curriculum Change for the Incorporation of Digital Revolution

The focus of African educational curriculum should be its reinvigoration to incorporate digitalization to fast track educational development and be in line with global technological advancements. The aims of inclusion of digital knowledge into African education as:

- a) to adopt common policies for access and use of data;
- b) to create data repositories, as well as research data management and software services, to enable scientists and other stakeholders to utilize modern data resources in innovative and creative ways;
- c) to improve the infrastructure and communication networks, together with high performance computing centres and cloud computing capacities that enable stakeholders to undertake state of the art data analyses;
- d) to improve the circulation of educational knowledge through open access publishing that serves Africa's needs, best done by working in collaboration with the international scientific community, for which the current dysfunctional model of scientific publishing is a major concern;
- e) to create programmes of research on major issues of specific relevance for Africa that will drive the use of these infrastructures and stimulate scientists and other stakeholders to create economic and societal benefits;
- f) to create state-of-the-art capacity in artificial intelligence, particularly in machine learning, in ways that are able to inspire and support data-intensive science and innovation;
- g) to develop the individual skills and competencies required to progress data-intensive science and to realize its potential for socio-economic benefit, Yusuf (2020, 54-55).

Strategies of Curriculum Change for the Incorporation of Digitalization in African Education

Curriculum changes emanate from societal needs and or changes, learner's interest and aptitudes and contemporary phenomena. Education system in Africa needs to change what, how, and when people learn in order to fit into the digital scenario. Bai, Pan, Hirumi, and Kebritchi (2018) aver that education systems in Africa are not adequately prepared for the pace or scale of change required to address the current technological shifts. Investments in human capital are essential, but how those investments are made will be as important as the capital deployed. Then economic and education systems need to reform in order to provide learners with skills for the future. Foundational lessons should include digital skills and begin early in life. There are shifts required in three areas:

What People Learn—to bring knowledge in line with technological changes, there is a gap between what skills education systems offer versus what economies need. Only 50 percent of countries in Africa have computer skills in the curriculum, compared with 85 percent globally. **How people learn** – given that traditional pedagogical methods and infrastructure are not geared toward twenty-first century skills, schools tend to teach digital skills by focusing on specific subjects, so digital skills should be taught as a computer course rather than embedded in the wider curriculum. **When people learn** – with lifelong lessons required instead of the current model of education at the start of a career, learners need to upgrade their skills in line with global best practices. Education providers still focus on traditional age groups rather than adapting to the innovative learning styles occasioned by technological innovations.

Curriculum adaptation, flexibility and contextualization should address elements such as the prioritization of learning objectives and content that enables an appropriate inculcation of digital knowledge into the students to enable them fit adequately in a constantly changing global scenario threatened by pandemics and economic recession. To achieve this, Wang (2010), Bai, Pan, Hirumi, and Kebritchi (2018) and Yusuf, (2020) note that the following strategies can be employed:

Adapt Education to Lifelong Learning Models—structured education can no longer end after leaving school or college. Education must become a lifelong endeavour, and sources for education need to evolve to provide those opportunities. Attributes such as creativity, curiosity, and design-thinking will be essential for the future workforce. People will no longer start a career path and only grow with one role, so nurturing competent lifelong learners becomes essential in a society promoting multitasking.

Change in higher education—from how long degrees take to forging stronger ties between institutions of higher learning and industry; changes will need to be made to our post-secondary education learning to prepare students for the 4th Industrial Revolution adequately. During the 4th industrial revolution, post-secondary education qualifications will become shorter and more focused, and tertiary institutions will have to provide more life-long education with modular post-graduate qualifications throughout the working lives of individuals. This will also impact how earlier education levels will need to modify their preparatory classes. For example, it is essential that the seeds for this type of learning are set in pre-tertiary schools by offering students the opportunity to learn topics beyond their core curriculum and develop a love for learning.

Educational Gaming—Educational gaming offers a promising model to enhance students' learning in Science STEM education, not just improving content knowledge, but also motivation and thinking and creativity skills. Educators and policy makers should consider using it to enhance STEM learning outcomes and problem-solving skills and motivation. Designing games appears to lead to even deeper learning than just using them for educational purposes. Educational gaming may promote learning by doing, student's vital learning, student's engagement and motivation and students' thinking skills.

Online Laboratories—Online laboratories, whether remote or virtual, are another promising innovation intended to enhance technology-supported teaching and learning. Virtual online laboratories allow students to simulate scientific experiments while remote ones allow

students to use real laboratory equipment from a distance through the Internet. Educators and policy makers should consider online laboratories as a promising way of increasing access to a wide range of experimental learning. Using online laboratories only requires access to the Internet and allows teachers and students to access more experimental equipment than a single school can generally provide. While remote laboratories can give students' access to expensive equipment, virtual laboratories can allow them to vary the conditions for the experiments.

Collaboration through Technology—Collaboration through technology can enhance students' interaction, engagement, learning and thinking skills, in addition to increasing the flexibility and diversity of their educational experience. Technology-supported collaboration can enhance students' awareness of global challenges and develop their understanding of other cultures. Educators and policy makers should consider technology as a way to increase collaborative learning – including over long distances and between different cultures. Policy makers could facilitate this process by creating platforms for international collaboration among schools, classes, teachers and students.

Aligning a Skills-Based Curriculum with Technology—Using technology to align with skills-based curricula can promote more accurate assessment of the variety of skills included in education curricula and standards. While it is becoming increasingly common to develop these kinds of skills-based curricula, Debjani, (2018) notes that their eventual impact on actual teaching and learning also depend on the availability of adequately aligned support systems which is the responsibility of government and education policy planners.

E-learning—E-learning can be viewed as computer assisted learning, and as pedagogy for student-centered and collaborative learning. Early developments in e-learning focused on computer assisted learning, where part or all of the learning content is delivered digitally. More recently the pedagogical dimension of e-learning has become prominent. According to Wang (2010), e-learning comprises all forms of electronically supported learning and teaching. The information and communication systems, whether networked learning or not, serve as specific media to implement the learning process. E-learning according to Yamakin (2019) can be defined as a learning process created by interaction with digitally delivered content, network-based services and tutoring support. E-learning is any technologically mediated learning using computers whether from a distance or in face to face classroom setting (computer assisted learning). It is a shift from traditional education or training to ICT-based personalized, flexible, individual, self-organized, collaborative learning based on a community of learners, teachers, facilitators and experts. Its inclusion in curriculum change will enhance digitalization of the African continent and beyond.

Online Instruction Media--Online instruction is used across most programs to increase flexibility, provide students with multiple ways to access course content, and track progress in real-time. Udacity is an example of an exclusively online learning platform that uses a range of student tracking and feedback systems to ensure success which can be incorporated in the African educational curricula.

Emphasis on Self-led Learning—Self-led learning offers students an opportunity to develop proactive habits and independent thinking. This can include content-delivery media that keep

users engaged while providing personalized performance-based learning. According to Abraham (2018), Anudip uses its learning management system to deliver gamified course content to learners, who compete for high scores across the platform. Its basic courses—digital literacy, workplace readiness, and English—are typically offered through self-led learning. Microsoft's Interns4Afrika participants are recruited locally for sales, marketing, or technical support roles with high ICT intensity for six months. Incorporated such an innovation into African education curricula will facilitate digitalization.

Redefining the Purpose of Education—Throughout time, the purpose of education has evolved based on the needs of society during that period. Currently, education serves to prepare people to take on the tasks of a job or discipline to “do” something worthwhile for earning a living. As we move farther into the future through digitalization, Abdi (2018) observes that education will need to support children to develop the skill set and mindset to do anything in their future rather than a particular “something.”

Improve STEM Education—STEM (science, tech, engineering, and maths) education needs to improve across the board regardless of income levels, age, or gender. There's no doubt every worker in the future will need some technical skills and improvement in STEM education is warranted, but it's important to note that we shouldn't adopt an either/or mentality. The educational system still need to help students understand the values that will help them learn how to use this new technology ethically and morally; therefore, humanities training and professionals will still be essential, (Yusuf, 2020).

Develop Human Potential—Even though machines are mastering many tasks typically performed by humans, people are still more adept at creative endeavours, imagination, critical thinking, social interaction, and physical dexterity. The educational system of the future needs to develop these inherent abilities in humans, so they are equipped to partner with machines in the future rather than compete with them in the production lines as well as service delivery.

Online Courses—In addition to transforming classroom practices, digital technologies open up opportunities for self-directed learning and continuous professional development. In particular, massive open online courses (MOOCs) appear to be well-suited to enabling people to update their competencies over their lifetimes by overcoming time and resource constraints. Online resources can thus offer a partial solution to the challenges of developing, activating and effectively using skills. In the last five years, online education has found its peak moment with the emergence of MOOCs. MOOCs are fully fledged courses of lectures available on line to serve a wide variety of purposes. With MOOCs, the term “massive” clearly implies a significant scale. Coursera, one of the leading educational platforms has now reached approximately 17 million people while enrolments in Edx peaked at 5.3 million in June 2014, (Wolf, 2018). All these approaches need to be adopted in the African context to facilitate digital growth.

Lifelong Education—Lifelong learning is the “life-long, life-wide and life-deep”; “ongoing, voluntary, and “self-motivated” pursuit of knowledge for either personal or professional reasons. Therefore, it does not only enhances social inclusion, active citizenship and personal development, but also competitiveness and employability. Wolf (2018) observes

that the term recognizes that learning is not confined to childhood or the classroom but takes place throughout life and in a range of situations. Lifelong learning means self-directed growth. It means understanding yourself and the world. It means acquiring new skills and powers- the only true wealth which you can never lose. It means investment in yourself. Lifelong learning means the joy of discovering how something really works, the delight of becoming aware of some new beauty in the world, the fun of creating something, alone or with other people. African educational curriculum needs to be remodeled along life-long learning lines.

Matters arising

The following are the matters arising in the inclusion of digitalization in the African educational system.

- i. *Limited access to digitally shared information.* The digital divide describes “unequal patterns of material access to, usage capabilities of, benefits from computer-based information and communication technologies that are caused by society. It is still more accentuated in African countries as they lack a broad access to information distribution systems.
- ii. New “digital” practices are also onerous, including provision of IT infrastructure, policies, incentives, methods and standards for data sharing, security against malign interventions, policing of ethical standards, and systems and software needed by high-level analytic and AI procedures; such that no individual and few organizations or states in Africa could hope to provide them alone.
- iii. Poor Development of Foundational Skills—**Skills** acquired early in life to cement the foundation for learning that occurs into adulthood; skills beget skills. The provision of such skills to learners is a position that African education is grossly lacking.
- iv. Unavailability and Quality of Resources in the Education system. This include teacher training, ongoing support and professional development, the resources teachers can access, and the materials students use to learn—are collectively referred to as “structured pedagogy.” Educational success rests on the ability to supply classrooms with high quality teachers and learning resources. Unfortunately for the African education, this ability is in short supply as government seems unconcerned about the quality of education provided to the citizenry.
- v. Short Supply of trained teachers. Teachers have an outsized influence on education outcomes. However, Africa struggles to source teachers who meet even minimum teaching standards, and qualified candidates are in short supply. Africa is the only region globally where student-teacher ratios in primary schools have worsened since 1970. This is a minus for digitalization.
- vi. Shortage of Quality Learning Resources: Many students in Africa lack access to basic learning materials. The current pupil-to-textbook ratio is about 20:1 with a target of 1:1. Digital skills improvement relies on students’ access to both these basic and additional technology-based learning materials which are unavoidably inadequate in Africa (Abraham, 2018:77-78).

Conclusion

It is unarguably true that the African education system is lagging behind in catching up with the ever metamorphosing technological and educational scenario as a result of low level of digitalization in the educational system. As the ugly phenomenon is unfolding, the African continent is concomitantly lagging behind in many aspects of human development. This calls

for concerted efforts to re-engineer African educational curriculum so that recipients of the educational services will be adequately groomed to compete favourably in the fast changing digital world.

Recommendations

To achieve full digitalization of the African educational system, the following recommendations are made to be put in place by the management of educational institutions as well as other agencies to facilitate digitalization of African education:

- i. African governments should synergize with management of educational institutions and embark on rapid provision of digital infrastructure in the educational system.
- ii. At the institutional management, national and international level in Africa, there should be scaling up the effort to develop well-managed, integrated digital services and open, sharing practices in the educational system.
- iii. Non-governmental organizations can act as powerful and persuasive collective force in unity with the management of educational institutions in developing an African open education area with a platform of potential synergies with the African Continental at large.
- iv. The management of educational institutions should encourage the adoption of ICTs by businesses and SMEs in particular, with a focus on key sectors such as healthcare, transportation and education.
- v. Management of educational institutions should alter educator training—Rather than teachers distilling information to students that they then memorize, teachers should be trained to become guides to help students facilitate their own learning and lines of inquiry through digital infrastructure.

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