SYNTHESIS REPORT

STUDY ON THE USE OF ICT IN EDUCATION AND REMOTE LEARNING DURING CRISES AND THE REQUIRED INVESTMENT IN DIGITAL TRANSFORMATION FOR AFRICAN COUNTRIES

2023

Report produced by:

- Association for the Development of Education in Africa (ADEA)

A study commissioned by:

- Islamic Development Bank (IsDB)
- African Development Bank Group (AfDB)

Ushirika wa Maendeleo ya Elimu Barani Afrika
الرابطة لأجل تطوير التربية في إفريقيا
Association for the Development of Education in Africa
Association pour le développement de l'éducation en Afrique
Associação para o Desenvolvimento da Educação em África

December 2022 / Updated May 2023

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Acknowledgments

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Executive Summary

The COVID-19 pandemic has caused learning disruptions and resulted in learning loss, thereby heavily eroding the quality of education, especially in Africa. The pandemic also exacerbated issues that, traditionally, negatively impacted education in some countries. Despite the efforts of African countries to respond to school closures and ensure continued learning by quickly introducing changes in education policy and practice in response to the pandemic, such as having National Response Plans for remote education, they remain far from resiliently meeting issues of quality, continuity, inclusivity, and equity. Gaps in policy, connectivity, infrastructure, and remote learning systems, among others, have limited the opportunities for the learning environment to fully leverage the potential of digital learning technologies.

A collaborative study conducted by the African Union Commission (AUC) and OECD explored how digital transformation creates quality jobs and greater resilience of African economies to the global recession triggered by the COVID-19 pandemic (OECD, 2021)[1]. The study covers the eastern, central, northern, southern, and western regions of the continent, and it found that the crisis brought about by the pandemic strengthens the role of digitalization in contributing to Africa's productive transformation and in fulfilling Agenda 2063, which encapsulates the continent's developmental vision.

This study, commissioned by the Islamic Development Bank (IsDB) and the African Development Bank (AfDB), aims to assess the status and capacities of 34 African member countries of the IsDB and AfDB on the use of Information & Communication Technologies (ICT) in education and remote learning during the crisis and the required investment in digital transformation. Anchoring the process will be the review of the state of preparation of the study countries in support of ICT use in education. The target countries are at different levels, including political and strategic (the policy and legal environment), pedagogical (curriculum reforms, teacher training and continuing professional development), organizational (structure and governance, ICT, and digital transformation), and ICT expenditure levels. The study covers basic and secondary education, technical and vocational education, and training (TVET), and higher education, providing insights into the investments required to harness the potentials of digital technologies in enhancing learning continuity and to addressing the digital divide of the selected countries in Africa.

The findings reveal that for ICT in Education to be inclusive and accessible beyond the privileged few, there is an urgent need to address electrification and ICT infrastructure issues in countries such as South Sudan, Chad, and Niger. Apart from Tunisia and Mauritius, all other countries in the study need to pursue electrification efforts to reach the 100% target. Overall, the study highlights that despite the progress made, achieving universal access to education remains a far cry due to disparities in infrastructure, access, and financial resources among countries. Consequently, some countries continue to struggle with poor infrastructure access and limited technological penetration, hindering the development of e-resources and ICT use in educational institutions. In countries where ICTs still pose significant challenges, television and radio programs can serve as effective educational alternatives to reach a larger number of children. Furthermore, the study emphasizes the long-standing vision of the study countries for ICT integration in education. However, ongoing workforce training, both during preservice and in-service, is crucial to ensure that educators acquire and

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[1] https://www.oecd.org/dev/africa-development-dynamics-2021-launch.htm

maintain the ability to effectively integrate ICT into the teaching and learning process. Similarly, continuous training for learners and administrators is necessary, as ICT in education impacts the entire system.

With regards to the response to COVID-19 from an educational assessment perspective, there is insufficient evidence to suggest that governments resorted to online examinations for primary and secondary levels. The aim of most emergency remote online teaching was to ensure a continuity of the teaching and learning process, with limited attention given to assessment and examinations as a result, many students lost at least one year of studies due to the pandemic, leading to grade repetition and indicating that remote online teaching was not as effective as anticipated. However, universities adopted various approaches, including open book examinations, assignments as substitutes for examinations, and the utilization of proctored examination tools. Nonetheless, the costs associated with high-end proctoring tools and e-learning platforms pose challenges for the African Universities under study. The countries received support from various local, national, regional, and international partner agencies, as well as donor countries, for the implementation of crucial ICT infrastructure, development of the ICT in Education ecosystem (including policies, connectivity, hardware, software, learning materials, and training) and overall education policy. Additional partners intervened during the COVID-19 pandemic to assist the countries in developing emergency educational response plans. In the post-COVID-19 era, different actors and funding agencies are stepping in to support countries in developing and enhancing the resilience of their education system by leveraging ICT.

Some key strategies for integrating ICTs in the education systems across the continent include building appropriate supporting infrastructure, prioritizing sound pedagogy and training teachers to use ICT effectively to support instruction, in addition to building the overall ICT capacity. The report identifies the following priority areas for investment : (1) electrification in the study countries, with a particular focus on rural households and schools; (2) develop comprehensive digital education strategies; (3) capacity-building of pre-service and in-service teachers in ICTs in Education, accompanied by a revision of teacher training curricula; (4) the development of mass digital literacy programs for citizens of the countries; (5) development of internet infrastructure; (6) implementation of reliable ICT infrastructure in schools; (7) provision of devices to students for accessing digital resources; and (8) encourage digital entrepreneurship and research and development (R&D) in digital domains as catalysts for fostering innovation and efficiency.

Information and communication technologies are often seen as the panacea to society's challenges, from poverty to education and in other areas of concern and interest. This is rightly so to a large extent. However, without a comprehensive ecosystem in place (including for instance gender inclusivity, innovative and sustainable financing models, and social justice policies), the use of ICT is likely to be ineffective and result in a waste of resources. This study reveals that the study countries, in general, have deeper concerns that need to be addressed before they can fully leverage ICT to improve educational services in an equitable manner.

This Synthesis Report provides a comprehensive overview of the utilization of ICT in education across various African nations. It diligently consolidates data and findings from individual country reports to provide a continental perspective on digital educational trends, successes, and challenges. This holistic document serves as a valuable lens through which to understand the broad landscape of ICT in education in Africa, identifying common patterns, unique approaches, and potential solutions. However, the respective country-specific reports provide a more in-depth and nuanced understanding of each country's specific context, challenges, and strategies. These country reports offer a detailed

exploration of ICT usage in education within each individual country, providing valuable insights for policymakers, educators, and other stakeholders.

This report was prepared for the IsDB and AfDB. The opinions, findings, and conclusions stated therein are those of ADEA and do not necessarily reflect those of IsDB, AfDB, Mastercard Foundation neither does IsDB and AfDB guarantee the accuracy of the data in the publication.

List of Abbreviations

BADEA	Arab Bank for Economic Development in Africa
ADEA	Association for the Development of Education in Africa
AfDB	African Development Bank Group
ACTEL	Agency for Telecommunications Commercialization
ASET	Applied science, Engineering and Technology
AUC	African Union Commission
BDIH	Botswana Digital Innovation Hub
BIDPA	Botswana Institute for Development Policy Analysis
BOCRA	Botswana Communications Regulations Authority
BOU	Botswana Open University
BNS	Broadband National Strategy
BWP	Botswana Pula
CAFOP	Pedagogical Animation Centres
CNTE	National Centre of Technology in Education
CS	Computer Studies
COVID-19	COVID-19 Coronavirus Disease 2019
EMIS	Education Management Information System
ESDP	Education Sector Development Programme
ERSP	Education Reform Support Project
ERTP	Economic Recovery and Transformation Plan
ETSSP	Education and Training Sector Strategic Plan
FEC	Federal Executive Council
4IR	Fourth Industrial Revolution
GCRI	Global Conflict Risk Index
GDN	Government Data Network
GDP	Gross Domestic Product
GPE	Global Partnership for Education
HCI	Human Capital Index
HEIs	Higher Education Institutions
ICT	Information and Communications Technologies
IEDA	Institute for Open and Distance Learning
IDA	International Development Association
ICT4E	Information and Communications Technology for Education
ILO	International Labour Organization
IOM	International Organization for Migration

IsDB	Islamic Development Bank
J-PAL	Abdul Latif Jameel Poverty Action Lab
KC	Kitsong Centre
KIIs	Key Informant Interviews
KOICA	South Korean Cooperation Agency
MELSD	Ministry of Employment, Labour and Skills Development
MENFOP	Ministry of National Education and Vocational Training
MIT	Massachusetts Institute of Technology
MoBE	Ministry of Basic Education
MoESD	Ministry of Education and Skills Development
MTR	Mid-Term Review
MoTEST	Ministry of Tertiary Education, Science, Research and Technology
MYSC	Ministry of Youth, Sports and Culture Development
NBS	National Broadband Strategy
NDP	National Development Plan
NEET	Not in Employment, Education or Training
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
NIEPA	National Institute of Educational Planning and Administration
NQF	National Qualifications Framework
NTS	National Transformation Strategy
OECD	Organization for Economic Cooperation and Development
OER	Open Educational Resources
PAQUET	Programme d'Amélioration de la Qualité, de l'Equité et de la Transparence du Secteur de l'Education et de la Formation
QMTS	Quarterly Multi-Topic Survey
REATIC	Renforcement des Enseignements-Apprentissages à travers les TIC
RISE	Reform for Investment and Sustainable Economies
RNCE	Report of the National Commission on Education
RNPE	Revised National Policy on Education
SDG	Sustainable Development Goals
SEACMEQ	Southern and Eastern Africa Consortium for Monitoring Educational Quality
SmartBots	Botswana Digital Transformation Strategy
SME	Small and Medium-sized Enterprises
STEM	Science, Technology, Engineering and Mathematics
TaRL	Teaching at the Right Level
TEELS	Teacher Education E-Learning in Educational Institutions

TFM	Télé Futurs Medias
TVET	Technical and Vocational Education and Training
UAM	Abdou Moumouni University
UBEC	Universal Basic Education Commission
UIS	UNESCO Institute for Statistics
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-CFIT	UNESCO-China Funds in Trust
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
USPF	Universal Service Provision Fund
UTME	Unified Tertiary Matriculation Examination
VDC	Village Development Committee
VEI	Vocational Enterprise Institution
VLE	Virtual Learning Environment
VNR	Voluntary National Review
WFP	World Food Programme
WHO	World Health Organization

Note: The country-specific reports contain comprehensive lists of abbreviations pertaining to each country.

1. Introduction

The COVID-19 pandemic has caused learning disruptions and resulted in learning loss thereby heavily eroding the quality of education, especially in Africa. The pandemic also exacerbated issues that, traditionally, negatively impacted education in some countries (UNICEF, 2021). These include learning losses, inability to provide essential services to students, political crisis, and the large numbers of out-of-school youth. Despite African countries' efforts to respond to school closures and ensure continued learning by quickly introducing changes in education policy and practice in response to the pandemic, such as having National Response Plans for remote education, they remain far from resiliently meeting issues of quality, continuity, inclusivity, and equity. Gaps in policy, connectivity, infrastructure, and remote learning systems, among others, have limited the opportunities for the learning environment to fully tap into the potential of digital learning technologies.

Furthermore, the disruptions were not uniform across different demographics. Girls, for example, were severely affected and are more at risk of not going back to school. Students in rural areas and those with disabilities also encountered unique challenges. In addition to economic precarity, a study carried out in sub-Saharan Africa found that 29% of girls had dropped out of school during COVID-19, half of whom due to pregnancy (Kwauk et al., 2021). According to the same study, the girls experienced high levels of academic anxiety about their learning loss, the amount of remedial learning they will need, and the possibility that they will have to repeat a grade and end up much older than their peers.

In addition, the study observed growing worries and feelings of helplessness among adolescent girls about their own educational futures because of school closings, obstacles to remote learning, economic poverty, food insecurity, gender-based violence, and the health dangers of COVID-19. Similarly, a previous COVID-19 study conducted in Kenya indicated that older adolescent girls (15 - 19 years) had lower rates of distance learning participation, lower levels of confidence in their ability to return to school, and higher rates of depressive symptoms (10-14 years) (UNESCO, 2021).The impact of COVID-19 on the education sector could erode progress already made in gender equality, and increase the risk of adolescent pregnancy, early and forced marriage, and violence.

As part of monitoring the Sustainable Development Goals (SDGs), especially SDG4 "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all", the latest report (UN, 2021) shows that the world was not on track in meeting the targets in reading and mathematics, key proficiency indicators measuring quality learning, even before the COVID-19 pandemic. In sub-Saharan Africa, the proficiency rate was already very low before the pandemic, at 17.5% compared to the global average of 54.5% in 2019. At the end of 2020, the figure dropped further to 14.8 percent, with 6 million children falling below the proficiency threshold, still far much lower than the global figure that also reduced by about nine percentage points, translating to 101 million children[2]. This means that learning losses in sub-Saharan Africa may occur among children who already fell below the minimum level of proficiency. Large disparities in school completion are likely to get worse, especially among poor or vulnerable children. In sub-Saharan Africa, the primary completion rate rose from 57% in 2010 to 64% in 2019, while the secondary rate grew from 26% to 29%, leaving that region furthest behind compared to the worldwide primary completion rate of 92.65 in 2020 and secondary completion rate of 77.01%[3]. The COVID-19 pandemic is expected to further slow or even reverse

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[2] SDG Indicators (un.org)

[3] https://www.theglobaleconomy.com/rankings/Primary_school_completion_rate/

progress in education completion. The UN report (2021) further notes that the region recorded a participation rate of 43 % in early learning in 2019, compared to the global average of 73%. However, the pandemic slowed down this progress as childcare and early education facilities closed in most countries in 2020. The situation is likely to worsen as the report notes that about 65% of low- and lower-middle-income countries have reduced funding for education since the onset of the pandemic.

A collaborative study by the African Union Commission (AUC) and OECD explored how digital transformation creates quality jobs and greater resilience of African economies to the global recession triggered by the COVID-19 pandemic. Covering the eastern, central, northern, southern, and western regions of the continent, the study found that the crisis brought about by the pandemic strengthens the role of digitalization in contributing to Africa's productive transformation and in fulfilling Agenda 2063, which encapsulates the continent's developmental vision. But this requires governments to promote the dissemination of digital innovations beyond large cities through place-based policies. Africa's workforce also needs to be prepared to embrace digital transformation and guarantee social protection. As part of encouraging smaller firms to compete in the digital age, governments should also remove barriers to innovation. Partnership and collaboration are central to the success of these recommended actions. It is therefore important to deepen regional and continental co-operation for digital transformation (AUC/OECD, 2021).

The current project aims to assess the status and capacities of 34 African member countries[4] of the Islamic Development Bank and African Development Bank on ICT in education and remote learning. Anchoring the process will be the review of the state of preparation of the study countries in support of ICT use in education. The target countries are at different levels, including political and strategic (the policy and legal environment), pedagogical (curriculum reforms, teacher training and continuing professional development), organizational (structure and governance, Information & Communication Technologies (ICT), and digital transformation), and ICT expenditure levels. The study will inform the level of, and target for, investments required to address the digital divide of the selected countries in Africa. The study outcome is also expected to inform the improvements needed for the education sectors' resilience in the 34 countries, improve quality, and increase equity and access to learning. Covering basic and secondary education, TVET and higher education, the study provides actionable recommendations for the needed investment in digital infrastructure and curriculum reforms in the 24 African countries based on the good practices shared and lessons learned.

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[4] Angola, Benin, Botswana, Burkina Faso, Cameroon, Chad, Comoros, Cote d'Ivoire, Djbouti, Ethopia, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Madagascar, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Tanzania, Tunisia, Uganda, Zambia and Zimbabwe

2. A Framework for ICTs in Education

Some key strategies for integrating ICT in the education across the continent include building appropriate supporting infrastructure, prioritizing sound pedagogy and training teachers to use ICT effectively to support instruction and related assessment, in addition to building the overall ICT capacity. The transformative approach departs from the primary focus on ICT and puts education at the center, with ICT becoming an enabler within the African educational ecosystem. This calls for clear guidelines and dimensions, as well as integrative strategies to clarify the various focus areas of ICT in education and the role of various players in the integration process (Barakabitze et al., 2019) as follows:

- **Vision, policy, strategy, planning and implementation:** A national ICT policy helps to articulate the vision and strategy, and creates an enabling system, for the advancement of ICT research, development, and innovation (RDI) within the context of education.

- **Teacher professional development and pedagogy:** Teacher professional development should prioritize programs that prepare pre- and in-service teachers to integrate ICT into their classrooms. On pedagogy, training and awareness are required to ensure a phased approach in ICT integration in support of pedagogy, and both teachers and learners are guided to use ICT in support of teaching and learning.

- **Curriculum planning:** The ICT curriculum planning and development should pay attention to the 'education-centered' transformation, ensuring the ICT curriculum clearly states the role of ICTs in the educational domain.

- **Assessment:** With the increasing adoption of ICT in Africa's education systems, the use of ICTs in assessment should be included as an objective and incorporated into teacher development.

- **Connectivity:** On ICT and connectivity, the introduction of ICT tools should align with education standards and ICT policies, while laying greater emphasis on user commitment and ongoing support in terms of training and device replacement.

- **Management and administration:** Effective management and administration of ICT integration in education necessitates adequate and consistent support to new and ongoing initiatives or projects for greater uptake and deploying appropriate M&E processes to justify the return on investment.

- **Change management and sharing research:** Change management should be a key enabler across all levels of the education system, coupled with sharing good educational research to inform policymakers on the goings-on in the classroom and other learning environments.

Education technologies (EdTech) can have a positive impact on learning if countries harness the efforts of multiple actors and integrate EdTech into the broader education system policy and practices. This requires a comprehensive approach. The pandemic is a wake-up call to re-examine education models to address issues of resilience, access, quality, and relevance with EdTech. Countries need to leverage EdTech in reforming education in terms of access, skills, teachers, assessment, content, data, and community engagement (World Bank, 2020). EdTech policies and projects need to be developed with a clear purpose, strategy, and vision of the desired educational change. The design of EdTech initiatives should be flexible and user-centered, with an emphasis on equity and inclusion, to realize scale and sustainability for all. There should also be a path for collaboration and integration

of proven Edtech solutions developed by the stakeholders (public and private sectors) into education systems at scale.

Teacher empowerment is central, and technology should also enhance teacher engagement with learners through improved access to content, data, and networks. This helps the teachers to better support the learners. Education systems should take a whole-of-government and multi-stakeholder approach to engage a broad set of actors to support learning, as part of the ecosystem approach. Evidence-based decision making within cultures of learning, evaluation, and experimentation, enabled by EdTech, leads to more impactful, responsible, transparent, and equitable uses of data and in particular learning outcomes data. Therefore, interventions in EdTech should be data driven. The World Bank (2022) is developing a composite EdTech Readiness Index to help orient (frameworks) and inform (guiding instruments and good practices) existing EdTech policies and strengthen the measurement of the impact of ICT in education in terms of understanding the outcomes, quality of practices, policies driving practices, and the political capacity. Identifying where EdTech practices can be strengthened and monitoring progress and the status of implementation as countries act. The EdTech Readiness Index tool relies on six pillars as shown in the figure below:

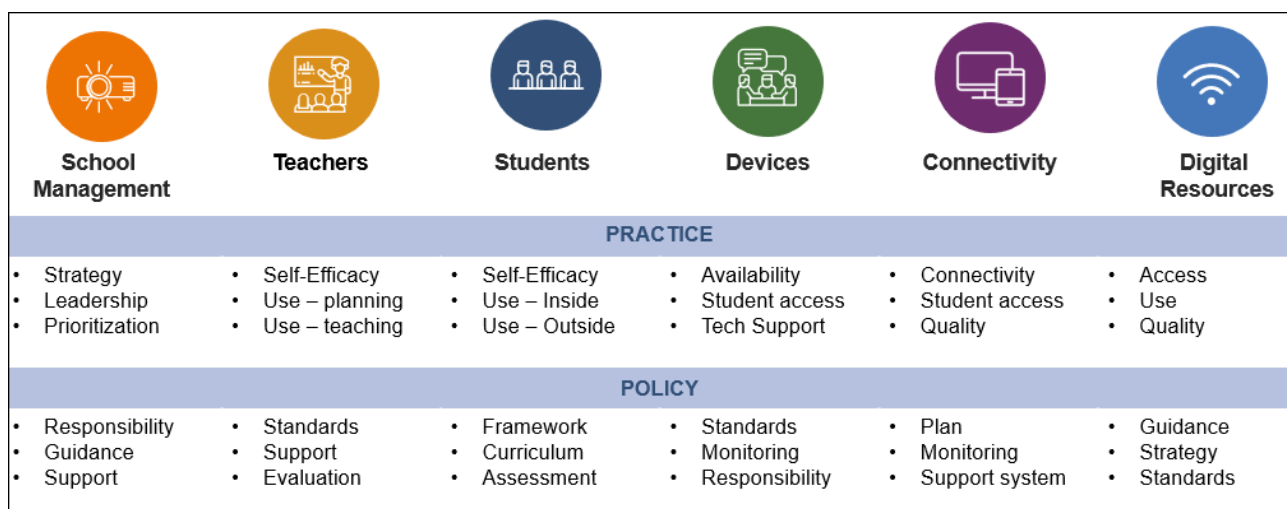| School Management	Teachers	Students	Devices	Connectivity	Digital Resources
PRACTICE					
• Strategy • Leadership • Prioritization	• Self-Efficacy • Use – planning • Use – teaching	• Self-Efficacy • Use – Inside • Use – Outside	• Availability • Student access • Tech Support	• Connectivity • Student access • Quality	• Access • Use • Quality
POLICY					
• Responsibility • Guidance • Support	• Standards • Support • Evaluation	• Framework • Curriculum • Assessment	• Standards • Monitoring • Responsibility	• Plan • Monitoring • Support system	• Guidance • Strategy • Standards

Figure 1: The six anchor pillars of the EdTech Readiness Index tool. (Source: World Bank, 2022)

3. Methodology

This work was first initiated with the development of 24 selected African country reports[5] (from an initial list of 30 countries) on the "use of ICT in Education and Remote Learning during crises and the required investment in Digital Transformation for African countries." This was followed by a second level focusing on an additional 10 countries[6], bringing the total to 34 countries. The methodological approach was two-fold namely (i) for the 34 selected country reports, and (ii) for the synthesis report.

3.1 Country reports

The study entailed a critical review of secondary documents gathered from a range of sources including public government items dealing with the countries' economic and social, legal framework, ICT infrastructure, the availability of ICT tools within the country's education sector, system strategies as well as teachers and students' capabilities. It also focused extensively on how much the countries under study deployed ICT to mitigate learning losses. The country studies which form the basis of this report used a mixed-methods approach which was conducted in two phases.

The first phase entailed a desk review and analysis of the relevant literature from government and institutional websites. The desk study also considered national and international studies that reviewed changes across the schooling and post-schooling sectors before and after the onset of the pandemic. The second phase involved the administration of questionnaires to a predefined sample. The investigation followed a "concurrent mixed" or "multi-methodological" approach, gathering and mixing qualitative and quantitative data and integrating these to offer a more nuanced understanding of the integration of ICT into the education sector in the target country. The two phases of the study were conducted to better understand the impact of the pandemic on learning, enabling to explain the interaction between situational conditions, education policy and how these impacted the usage of ICT in education before, during, and after the COVID-19 pandemic period.

In the study, data regarding the use of ICT in education in selected African countries before, during and after COVID-19 pandemic period were collected and analyzed and covered basic education, TVET and higher education focusing on: (1) the level of digital divide; (2) existence and breadth of ICT policies and strategies; (3) availability and utilization of ICT infrastructure in learning facilities; (4) the level of the workforce's digital competence; (5) the availability of electronic systems for learning and examination; (6) the existence of generic and country-specific e-education materials; (7) partners engaged in supporting the use of digital technology in education; (8) the existence of cross-country e-education programs; (9) challenges related to implementing e-education; and examples of success stories and good practices.

The gathered data were analyzed based on the following thematic areas: (1) common SWOT (Strength, Weaknesses, Opportunities and Threats) analysis on the use of ICT in education and remote learning; (2) required enabling factors to support the strong national resilience to future crisis; (3) the current status of the harmonization of online and hybrid higher education standards; (4) the key gaps concerning ICT infrastructure, e-learning systems, the ICT literacy of both teachers and

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[5] Botswana, Cameroon, Chad, Comoros, Côte d'Ivoire, Djibouti, Ethiopia, Gambia, Guinea Bissau, Kenya, Madagascar, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Sudan, Tanzania and Uganda.

[6] Angola, Benin, Burkina Faso, Ghana, Guinea, Mali, South Africa, Tunisia, Zambia and Zimbabwe

students, and e-curricula; (5) opportunities for initiating and enhancing regional programs for e-education; (6) key partners and stakeholders currently engaged in supporting the use of digital technology in education, area of support they are engaged in; and (7) Specific best practices that can be replicated.

The study covered 34 countries[7] in Africa (Benin, Burkina Faso, Botswana, Cameroon, Chad, Comoros, Côte d'Ivoire, Ethiopia, Djibouti, The Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Madagascar, Mali, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Sudan, South Africa, Tanzania, Tunisia, Uganda, Zimbabwe, and Zambia) and all levels of education (basic and secondary education, TVET and tertiary education). The study participants included policymakers, education ministry officials and technicians, ICT in education partners, telecoms companies, curriculum developers, developers of digital technologies applied to education providers, students and TVET institutions.

3.2 Synthesis report

For this synthesis, a systematic review of the 34 country profile reports was carried out and the general findings are presented using specific good examples, initiatives and success stories from the countries and recommendations for investment and actions are made accordingly. Most of the recommendations, actions and required areas of investment are generic to all countries while specific recommendations for any country are present in the country reports.

3.3 Limitations of the research

The non-focus countries have obvious limitations as they are based on the use of secondary data. While the researchers tried to be as comprehensive as possible, it is impossible to refer to all studies sources published before, during and after the COVID-19 pandemic. Moreover, existent data sources are themselves limited and those available might be incomplete and not current.

The focus-study countries reports were validated with the data through primary data, key informant interviews and focus group discussions with the partners which have minimized these limitations.

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[7] We initially targeted 30 selected countries in sub-Saharan Africa (Benin, Botswana, Burkina Faso, Cameroon, Chad, Comoros, Cote d'Ivoire, Ethiopia, Djibouti, Gabon, Gambia, Guinea, Guinea Bissau, Kenya, Madagascar, Mauritius, Mauritania, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Tanzania, Togo and Uganda). Due to varying circumstances, the number was pruned down to 24 for the first phase. The second phase subsequently added 10 countries.

4. Level of Digital Divide in Education Across Selected Countries

A reliable ICT infrastructure comprising of electricity, connectivity, devices, software, and e-materials at the national, institutional (school) and individual levels coupled with the appropriate training and support are of paramount importance for the successful integration of ICT in Education. Unavailability of any component would compromise the full benefit of the use of ICT in Education.

4.1 Electrification

Hundreds of millions of people now have dependable and affordable access to electricity, and large-scale electricity networks have been in place for more than a century, but many households in the 34 African countries are experiencing a low level of electrification. Many social and economic advantages are anticipated from electrification, including expanded access to communication technology, increased security thanks to street lighting, and improved outcomes in areas where public services are provided, such as health and education. The graph below reports on the status of electrification from the study countries:
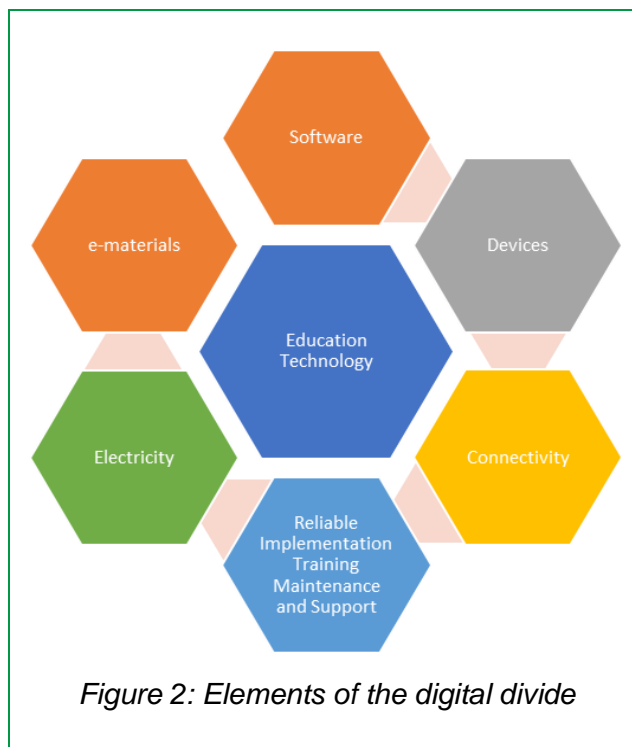
Figure 2: Elements of the digital divide

ACCESS TO ELECTRICITY
(% POPULATION) 2020

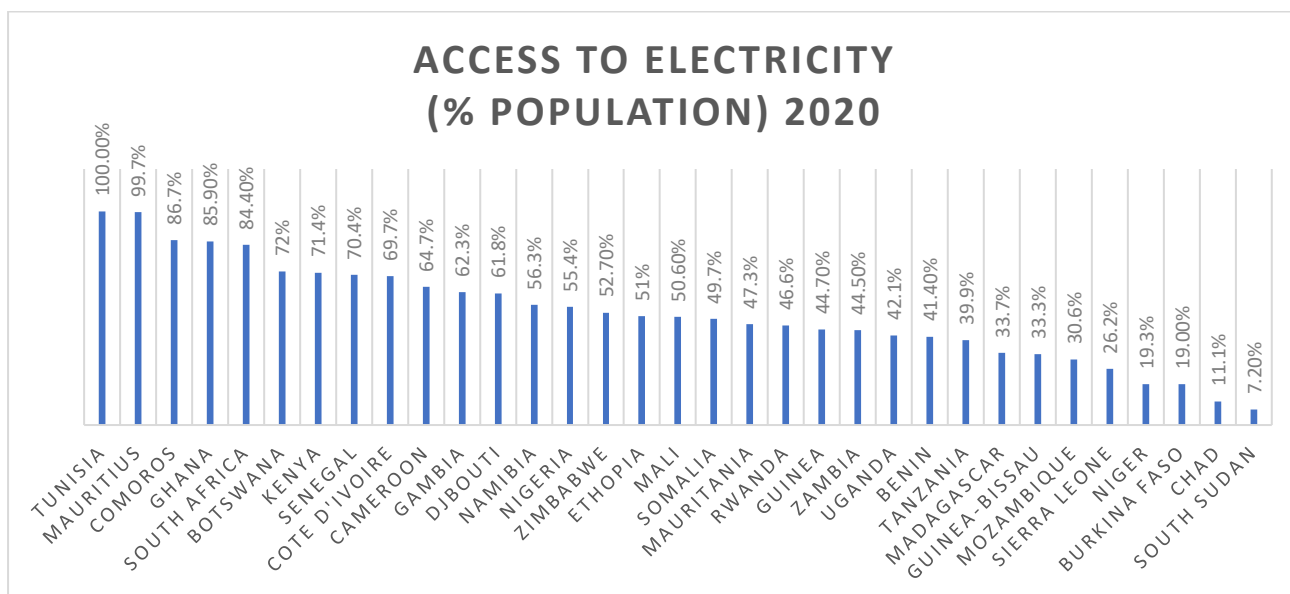| Country	Value
TUNISIA	100.00%
MAURITIUS	99.7%
COMOROS	86.7%
GHANA	85.90%
SOUTH AFRICA	84.40%
BOTSWANA	72%
KENYA	71.4%
SENEGAL	70.4%
COTE D'IVOIRE	69.7%
CAMEROON	64.7%
GAMBIA	62.3%
DJIBOUTI	61.8%
NAMIBIA	56.3%
NIGERIA	55.4%
ZIMBABWE	52.70%
ETHIOPIA	51%
MALI	50.60%
SOMALIA	49.7%
MAURITANIA	47.3%
RWANDA	46.6%
GUINEA	44.70%
ZAMBIA	44.50%
UGANDA	42.1%
BENIN	41.40%
TANZANIA	39.9%
MADAGASCAR	33.7%
GUINEA-BISSAU	33.3%
MOZAMBIQUE	30.6%
SIERRA LEONE	26.2%
NIGER	19.3%
BURKINA FASO	19.00%
CHAD	11.1%
SOUTH SUDAN	7.20%

Figure 3: Access to electricity in target countries (Source of data: ITU and World Bank)

The graph clearly highlights the urgency to address electrification issues in countries such as South Sudan, Chad and Burkina Faso amongst others, else ICTs in Education will not be inclusive, and will remain accessible to a privileged few. Except for Tunisia and Mauritius, all other study countries need to pursue electrification efforts to reach the 100% target. This is the basis for any ICT initiatives to prosper, including ICT in Education.

4.2 Computers, TV, and Radio Penetration

Countries have initiated a series of initiatives to implement and boost the use of ICT in the education system. Educational technology refers to the creation, use, and promotion of information and communication technologies but also other tools that can be used to increase access to education. Computers, television, and radio are technologies that can be put to work in the service of education, especially during pandemic times. Although the number of computers has increased significantly in some countries, the ownership of a computer still appears a luxury for households with a higher level of income. The graph below gives an indication about the percentage of households that own television sets and radio units, across the African countries surveyed. For Mauritania and Guinea Bissau, the radio penetration rate has not been reported in country reports.
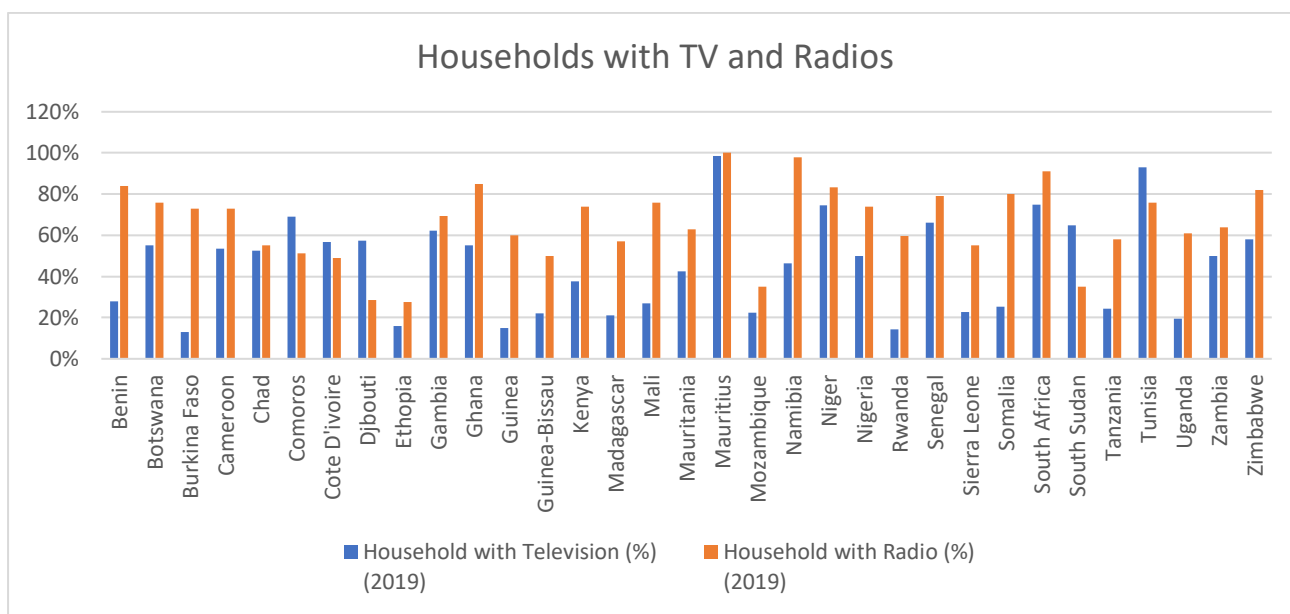
Figure 4: Households Television and Radio penetration in target countries

In general, the study shows that despite the progress made, universal access to education remains a far cry given that not all countries can have the same infrastructure, access, and financial means. As such, some countries continue to suffer from poor access to infrastructure and low levels of technological penetration that prevent the development of e-resources and ICT use in the learning institutions. In countries where ICTs are still a major challenge, television and radio programmes can be an effective educational alternative to reach out to more children.

In Africa, internet use jumped by 24% between 2019 and 2021. The share of internet users in urban areas was 50% in 2020, more than three times that in the rural areas at 15%. There is also a

generational gap, with 40% of the region's population aged 15-24 using the internet, compared with 27% of all other age groups. In terms of gender, 35% of men are using the internet compared with 24% of women. While the digital gender divide has been narrowing across all regions, women remain digitally marginalized in many of the poorest countries, where online access could potentially have its most powerful effect (ITU, 2020 & 2021).

Figure 4 illustrates the households with a computer and those with internet access in the target countries. Countries like Uganda, Tanzania, Guinea Bissau, Comoros, Chad, and South Sudan do not report any household with internet access while very few households own a personal computer. It is interesting to note that in other countries there are more households having access to the Internet than households having access to a PC. This is clearly because mobile broadband is readily available and less costly than having a PC with fixed internet connection. However, it is also interesting to note that even in countries like Mauritius and Botswana, the number of households with a PC does not exceed the 50% mark.

There is a need for further probing, as this may mean:

i.   Either households have alternative devices like tablet PC and laptops which are not reported as being personal computers; or

ii. There is still a significant level of digital divide in these countries as well when it comes to individual households owning a personal computing device.

In the latter case, this would explain why emergency remote and online teaching was not as effective despite the infrastructure, policy environment and human capital that exists in these countries. The lack of internet connectivity at home is a barrier for students to access online learning platforms and materials anywhere and anytime.
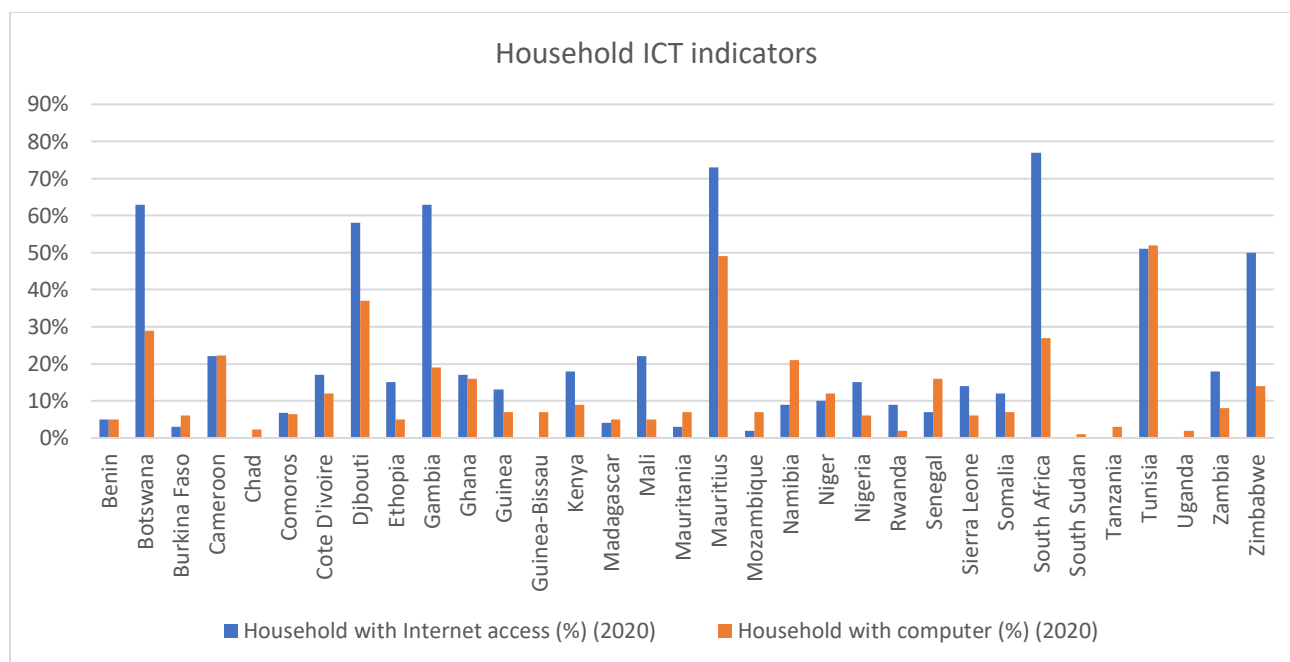

Figure 5: Households with a computer and Internet access in target countries

4.3 Mobile and Broadband

4G and 3G mobile networks cover about half and one third of the African population respectively, with 2G covering only 7% of the population. In the rural population, 18% has no mobile network coverage, and another 11% has only 2G coverage. 4G covers about one fifth of the rural population, with 3G and 2G being accessed by half and 11% of this population, respectively. This is quite low when compared to the coverage in urban areas, standing at 88% for 4G and 11% for 3G (ITU, 2021).

Despite the uncertainty caused by the COVID-19 pandemic, service providers continue to switch to 5G and more than 160 of them, including those in Africa, have launched commercial 5G services. By the end of 2021, 5G subscriptions were expected to reach 580 million, and further projected to be 3.5 billion by 2026. Mobile broadband subscriptions continue to rise, standing at 8 billion in 2021.

Smartphone penetration is also growing, and subscriptions associated with smartphones account for about 76 percent of all mobile phone subscriptions (Ericsson, 2021). For sub-Saharan Africa, mobile subscriptions will continue to grow over the forecast period as mobile penetration is less than the global average. In the first quarter of 2021, more than 20 percent of the global net additions were recorded in Africa. The figure below demonstrates the level of mobile penetration in the 24 study countries in 2020.
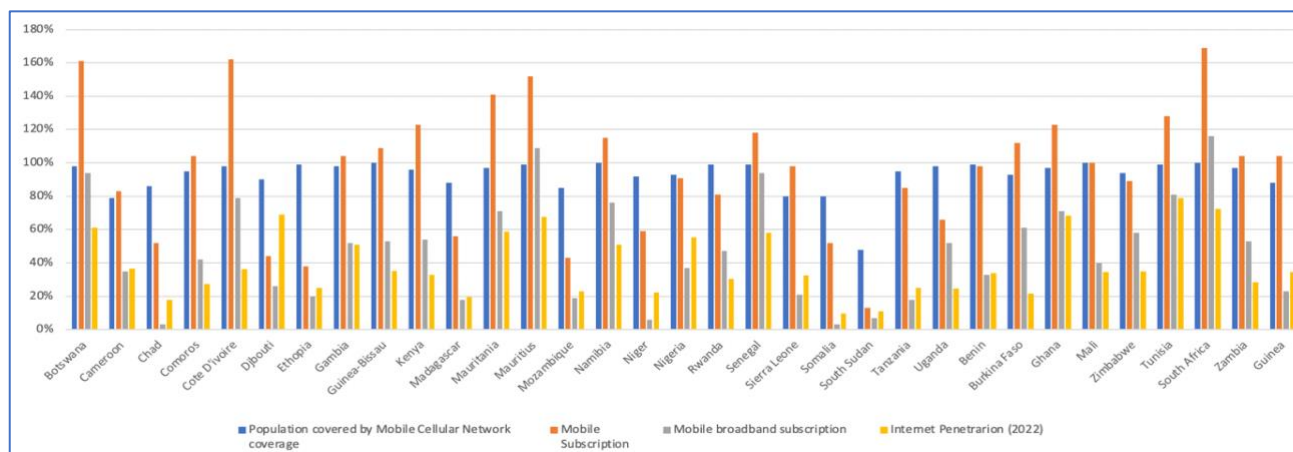
Figure 6: Mobile indicators in target countries (Source: datareportal.com, World Bank, ITU)

For sub-Saharan Africa, mobile subscriptions will continue to grow over the forecast period (2020 - 2025) as mobile penetration is less than the global average. In the first quarter of 2021, more than 20 percent of the global net additions were recorded in Africa. Over the forecast period (2020 - 2025) mobile broadband subscriptions are predicted to increase, reaching 76 percent of mobile subscriptions (Eriksson, 2021).

The driving factors behind the growth of mobile broadband subscriptions in Africa include a young, growing population with increasing digital skills and more affordable smartphones. In many countries, mobile internet is rapidly overtaking fixed internet by overcoming key obstacles to fixed internet access (Figures 5 & 7).
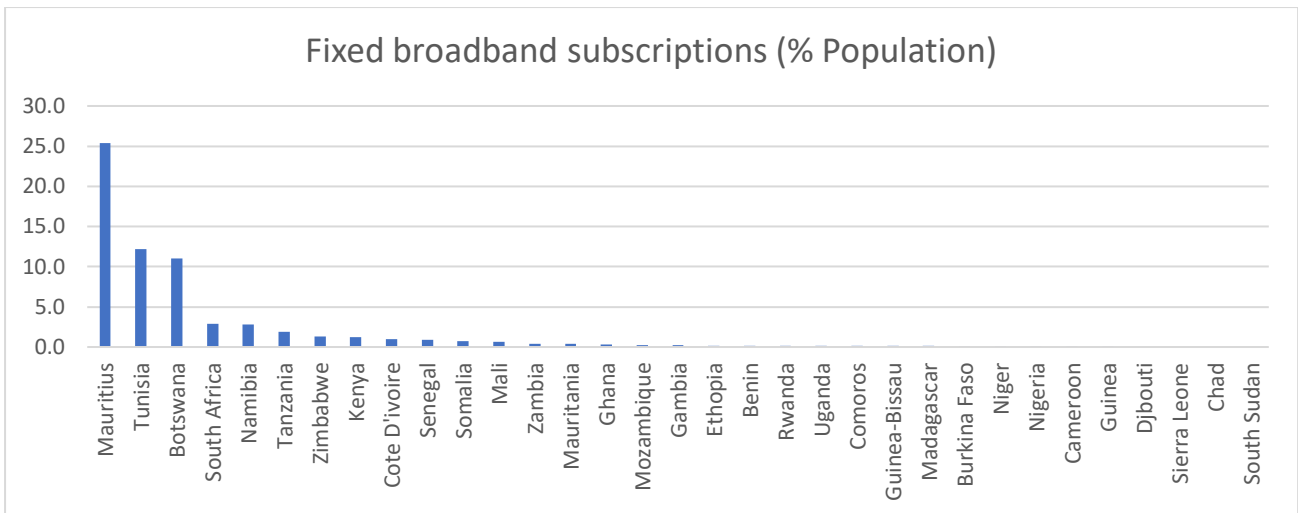
Figure 7: Households with fixed internet access in target countries

Mobile internet requires fewer ICT skills than are required to operate a computer, hardware costs are less, it is available as prepaid, and it does not rely solely on electricity at home, something most African households still struggle to access. This makes mobile technology an important technology to consider for supporting online learning. Nevertheless, the cost of mobile data is high in African countries, which impacts the affordability of the technology. In 2020, the median price of 1GB of mobile data in Africa was more than $5 compared to almost $7 in 2018, a drop of 28%. In the European Union (EU), on the other hand, the price was $3.5 per GB in 2020 ($4.1 in 2018). While there has been a significant decline in average broadband data prices, there are still notable differences in prices between countries.[8]

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[8] https://www.theafricareport.com/107259/africa-which-countries-charge-the-most-for-internet-data/

5. Existence and Breadth of ICT Policies and Strategies

The COVID-19 pandemic crisis illustrated the importance of having an education system that is resilient, inclusive, and equitable. Governments recognize the importance of the use of ICT in education for improving their nation's educational system to optimize learning opportunities and to improve student performance, promote inclusion, improve education management, expand the reach of education, and optimize teaching and learning practices and assessment.

The successful integration of ICT into any educational system depends on a supportive policy environment and framework built at the national level. In general, national ICT in education policy provides directives pertaining to the utilization of ICT in education and differ from country to country depending upon political stability, national priorities, the country's level of development, the extent of ICT infrastructure, and demographics.

Table 1: Policy mapping for countries

Country	Education	ICT	ICT in Education
Botswana[9], Comoros, Côte d'Ivoire, Djibouti, Ethiopia, The Gambia, Guinea Bissau, Guinea, Kenya, Mauritius, Namibia, Niger, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Benin, Burkina Faso, Ghana, Zambia, Mali, Zimbabwe, Tunisia, South Africa	√	√	√
Cameroon, Madagascar, Mauritania, Sierra Leone, South Sudan	√	√	✕
Chad, Mozambique	√	√	! [10]
Somalia	√	✕	✕

An analysis of the country reports shows that:

- All the countries have established policies on education.

- All the countries except Somalia have defined policies on ICT.

- Many countries do not have specific policies on the use of ICT in Education. However, this component is covered to certain extent in either their Education or ICT policy or both.

- Despite the existence of the policies, in general, countries were not able to engage in a smooth transition to inclusive digital learning for all stakeholders during the COVID-19 pandemic. This ability to adapt to emergencies to ensure continuity of learning is a litmus test for a resilient education system. For instance, in Mauritius, students at primary and secondary level had to repeat a year post-pandemic.

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[9] Dates to 2007 and 2011 respectively. There is a need to review and come up with a new ICT in Education Strategy

[10] Covered briefly in the Education Strategy

6. Availability and Utilization of ICT Infrastructure in Learning Facilities

Information and Communication Technology is one of the main drivers of a knowledge-based economy and enhances access, quality, and equity in education. There have been various initiatives for ICT integration in education by both the government and other partners. Most countries have implemented programs aimed at equipping schools with ICT infrastructure and connectivity in view of providing ICT learning resources and guidelines for integrating ICT into learning. In general, ICT infrastructure at the schools is not up-to-date and almost nonexistent in certain schools. As a result, in most cases, the use of ICT in teaching and learning remains poor across schools. Internet connectivity remains a challenge for schools and teachers need to have their capacity enhanced.

6.1 Internet Connectivity in Schools

There is still a challenge for school connectivity to the internet. Some countries like Senegal, Botswana, and Namibia, still do not have broadband infrastructure in schools. In 2018, 25.7% of primary schools were connected to the Internet 25.7% nationwide. In major urban cities, like Dakar, the rate is above 80%, while it falls to 8% in rural areas such as Kedougou in Senegal. However, secondary schools in Addis Ababa were the most connected to the internet (76%) during the 2018/19 academic year, as well as Harar and Dire Dawa (as opposed to national coverage which was only 21.5% of total secondary schools). In Benin, there has been slow progress in terms of the 2016-2022 plans for providing Internet connectivity in schools. Chad faces a challenge related to the lack of digital equipment throughout the education system and the administration in general, which means that the coverage rate is relatively low with enormous difficulties related to its acquisition and use of ICT in Education.

The Mauritius Case

Internet connectivity in Mauritius, under Infrastructure and Connectivity, has been enhanced in secondary schools from 2 Mbps to 10 Mbps and wireless connectivity has been extended in 160 secondary schools (State and Private). A total of 276 primary schools were planned to be connected to high-speed broadband internet. In line with the eGovernment Strategy 2013-2017, several eGovernment projects have been implemented including e-Education with the introduction of interactive projectors in primary schools through the Sankore project.

Through SchoolNet II, Internet links and wireless connectivity were deployed in more than 150 sites in Mauritius and Rodrigues comprising Secondary State Schools, Grant-aided Secondary Schools, and Public Libraries among others (November 2017). Whereas to support the Early Digital Learning Programme and to modernize teaching and learning using ICT tools, tablet computers distribution to Grade I and II students and educators started as from October 2017.

The cost of broadband access remains a major barrier in countries like Burkina Faso and Bissau-Guinea. While broadband internet penetration in Guinea-Bissau stands at 37 percent as of June 2021, matters are worse within the education sector: only 17 percent of Bissau-Guinean schools have regular access to electricity, much less access to the internet, although this percentage varies

significantly across the country. One reason for this is the high cost of connectivity in Guinea-Bissau as well as, for instance, the country's irregular terrain that makes it hard to establish the hardware (network equipment) required for such infrastructure to function effectively. One way of addressing this is scaling up existing efforts to install solar panels at schools but also making sure that school staff is trained in simple maintenance (for instance, dusting off the panels) (World Bank, 2022).

6.2 Devices

In general, there is a lack of ICT infrastructure and resources at the level of schools. The SEACMEQ Namibia report (2019) mentions that to a large extent, education had to rely on low-tech ICT such as radios. They point out that the use of the radio has played an important role in learning during the COVID-19 pandemic. NAMCOL's distance learning materials were used during the pandemic for senior secondary school learners.
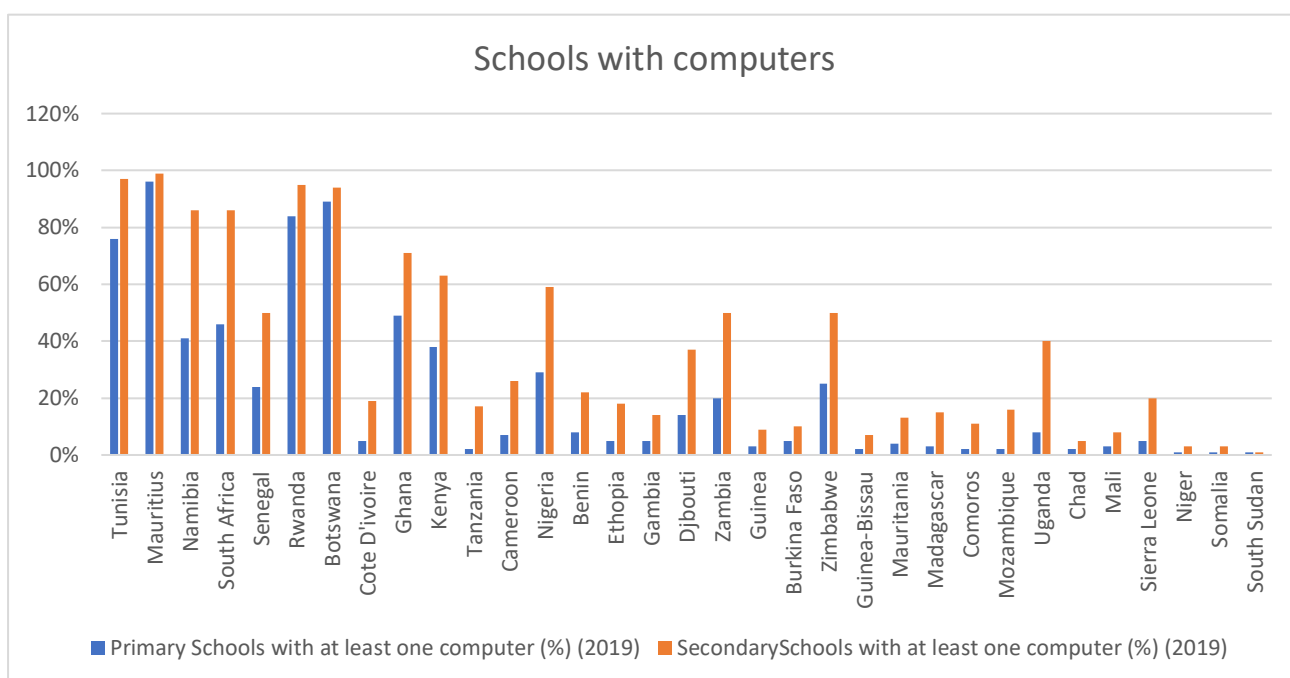
Figure 8: Computers in schools

Analysis of country reports has shown that despite the huge potential of ICT in education, during the COVID-19 period, all the countries had to resort to the use of Radio and TV to provide education to the students during the lockdown and this approach is far from what leaders in the education sectors would recommend in the 21st century. Consequently, strategies must be put in place to address the challenges encountered due to the lack of devices both in schools and in households.

7. Level of the Workforce's Digital Competence

Much progress has been made over the last decade and countries have invested extensively in infrastructure to support their vision for digital learning. However, it has been observed from the country reports that the implementation of digital teaching and learning during the pandemic was highly impeded by a lack of connectivity, access to digital facilities and to the state of readiness for the rapid transition to remote learning. Thus, an appropriately trained and engaged educator workforce can be an important driver of an effective competency-based education system. In some cases, there has indeed been a notable transformation in the education workforce, especially in capacity-building and competency development.

> **Success Story – Botswana Capacity Building of Teachers**
>
> Botswana's allocation of teachers across the country's schools contributes to an equitable education system. This has been demonstrated by a high correlation between learner enrolments and the numbers of teachers employed – despite the shortage of classrooms. Within a population of more than 15,000 educators, less than 1% were listed as being under-qualified.
>
> *World Bank (2019)*

The quality of teachers is an emerging concern and has a direct impact on the learning of the students. For this reason, in Djibouti, the current priorities of the Ministry of National Education and Vocational Training (MENFOP) concern the evaluation and improvement of teaching staff, the incorporation of ICT into classrooms, and the strengthening of technical and vocational education systems. To achieve these goals, 24% of the national budget was allocated to education in 2018, while the country continues to host refugee and migrants' populations, offering them social services, such as accommodation, school, and health care. The objective of MENFOP is to set up a digital policy for effective control of the education system and optimal integration of new technologies into the learning-teaching process. In 2020, MENFOP launched a Strategic Plan for Strengthening Teaching-Learning through ICT (REATIC). The REATIC Strategic Plan promotes a transformative reform of the education system from 2020-2035 to allow for planning and budgeting. The objectives of this strategy, using ICT, were to strengthen student performance, optimize teaching practices and assessment of teaching-learning, and ensure better management of the education system with a focus on inclusion. Moreover, there is also the Catalyst to Development (C2D) who is giving support for the development of the skills' referential for teachers and pedagogical advisers. This mission is for the benefit of MENFOP. It allows beneficiaries to improve their educational practices and the accomplishment of their missions to have the best impact on the quality of teaching and learning.

In Mali, the Ministry of National Education developed and adopted an initial and ongoing teacher training policy in 2003. This policy sees distance education and the integration of ICT into education as alternatives to professional teacher training in a relatively short time and at lower costs. As a result, various partners have launched experimental projects at the institutional level. They include Interactive Radio Teacher Training Program (FIER) with the support of USAID (United States Agency for International Development) in 2004 and the Cyber_Edu project in 2006 resulting from a partnership agreement between UNCTAD (UN Conference on Trade and Development), the Canton of Geneva,

and the Ministry of Communication and New Technologies (MCNT) acting on behalf of the Mali government.

The teacher education curriculum in Burkina Faso includes a technology course, called "Education Technology in Curriculum," which is taught as a computer lecture. The Ministry of Education, in conjunction with teacher education institutes, is working to improve the content of the technology course in the pre-service teachers' education curriculum. The Francophone Initiative for Distance Education of Teachers (IFADEM) is a hybrid approach for the face-to-face and distance training of inexperienced teachers. It was set up in collaboration with the International Organization of La Francophonie (OIF). Its ambition is to enable each teacher, while remaining at their post, to train in didactic and pedagogical plans, but also to strengthen their capacities in the use of ICT in Education.

In Ethiopia, the implementation of the Education Sector Development Programme (ESDP) has contributed to much progress, including decentralizing education administration, the teacher development policy, and a programme of career pathing for educators as well as policies for inclusion in education. As far back as 2007, Ethiopia's Science, Technology, and Innovation Policy (2007) stressed the importance of ensuring human resource development as central for the country's ICT strategy, stating that the national effort for rapid and sustainable socio-economic development was contingent on the quality and quantity ICT skills among the government and the public at large. Likewise, the Ethiopian Government also acknowledges education and training as central for socio-economic development and specifically for the development of education that will enable a knowledge and information society and acknowledges the importance of digital technology for educational development, particularly highlighting the enhancement of educator capacity through the training and development of teachers in ICT pedagogies. Ethiopia has also embarked on several digital technology initiatives in teacher preparation, such as the EthERNet for tertiary education, SchoolNet for basic education, including pre-service ICT capacity developing in Teacher training college programmes. Meanwhile, Mauritania has embarked on the Tamkeen project for Mauritanian Youth Development using the Medrassety.net platform, while Mauritius has opted for the Universal ICT education programme which includes the impressive Digital Youth Engagement Programme Project - Coding in Cyber Caravans for development of the workforce capacity.

Similarly, in Zimbabwe, the Teacher Capacity Development Program (TCDP) was launched in 2018 by the Ministry of Primary and Secondary Education to strengthen teacher training in Zimbabwe. The program provides in-service training to teachers in the country, with a particular focus on improving the quality of education in disadvantaged communities. The TCDP offers a range of training programs, including workshops, seminars, and online courses. The use of ICT has been integrated into the program to facilitate distance learning and to enhance the accessibility of training to teachers in remote areas. According to the Ministry of Primary and Secondary Education, the program has trained over 40,000 teachers since its inception in 2011. However, there is limited data on the actual impact of the program on student outcomes.

No matter how good pre-service training for teachers is, it cannot be expected to prepare them for all the challenges they will face throughout their careers and therefore the study recommends ongoing ICT training as part of the continuing professional development of teachers. There are different practices in different countries, but in most of them, there is no established framework for the continuous professional development of teachers/educators. For example, in Guinea Bissau, the teacher professional development opportunities are ad hoc, only provided in a subset of schools, and led by donors.

However, there are some challenges when it comes to investment in educator capacity in poorer countries. Madagascar is one of the poorest countries in the world and one of the least invested in, with the least investment in the education sector, which was only 3.23% of GDP in 2018 (as per World Bank, 2020) that was spent on its education system, compared with just over 5% for similar countries in Africa. Although, there has been limited use of ICT as a tool for complementing and enhancing teacher professional development in Mozambique, a Nordic private training company called the Soprano Plc pioneering global online education with an AI-powered learning environment and JAMK University of Applied Sciences launched a Finnish led teacher professional development programme, with the Universidad Pedagogica as the local partner. The project was piloted in 2019, to provide training for 200,000 teachers onsite, remote, and online. The parties plan to jointly develop Mozambique's education system and the quality of teaching through Finnish pedagogy and management skills, using the latest online technology to increase the number of qualified teachers and improve learning outcomes. UNICEF established a partnership with the National Institute for Open and Distance Learning (IEDA) in Mozambique to improve the equipment and capacity of Distance Training Tutorial and Resource Centres at teacher training colleges as well as at Distance Training Tutorial and Resource Centres in selected schools at the district level. Some of the centers have received materials and equipment from UNICEF, including computers, printers, tablets, manuals, and various stationary supplies to facilitate on-the-job and distance training of teachers.

The different country reports reveal that, in general, before the pandemic, online learning has been used primarily in universities, whereby the main gaps are the lack of technology-enabled policies, limited practitioner skills and competencies, as well as the resistance to embrace new technologies. Therefore capacity-building of higher education practitioners is a key aspect to promote distance e-learning, technology-enabled learning, and integration of ICT in the higher education landscape. In Niger, the Abdou Moumouni University (UAM) had defined "Innovative Pedagogies and Digital Learning" as one of the key thrusts of its 2017-2021 Strategic Plan. The Programme d'Amélioration de la Qualité, de l'Equité et de la Transparence du Secteur de l'Education et de la Formation (PAQUET-EF) in Senegal includes the integration of ICT for improved governance of the sector as well as better learning and teaching while promoting innovation. The training of all stakeholders within the education sector to use devices, digital curriculum, and assessment focus on the training of the trainer who will then cascade training to other players in the education sector as well as the promotion of new education platforms.

Other governments in the study countries are also doing their part to advance education throughout the nation, in all spheres and at all levels. One of the initiatives of the Government of Sierra Leone is to provide subsidies to schools and support teachers' training. On the other hand, teacher training policy is relatively new in Somalia and schools may be unaware that secondary teachers must have a bachelor's degree to be considered qualified, or that many of these teachers were in post before the policy was implemented and have not been given the opportunity to increase their level of qualification. Given that some of the lowest rates of qualified teachers are found in public secondary schools, a greater emphasis could be placed on upskilling underqualified teachers, particularly those with teacher training certificates, as well as training the substantial proportion of unqualified teachers. As such, all teachers were required to take a Teacher Proficiency Testing (TPT) in 2019/2020 as part of the MoECHE's efforts to standardize and improve teacher training. The findings of this test highlight the disparity between qualifications and teacher performance in Somalia. Low knowledge levels are evident among both secondary and primary school teachers, with secondary teachers performing

better across most subjects. For both primary and secondary teachers, pedagogy is regarded as their weakest area of knowledge.

The priority for ICT deployment by the Ministry of Education and Vocational Training in Tanzania has been in the teacher training colleges with this promoting the use of ICT in schools as trained educators are deployed to classrooms. In 2017, the Tanzanian government adopted the Primary Teacher Deployment Strategy and the National Framework for Continuous Professional Development for Practicing Teachers (NFCPDPT, 2017) to address the shortage of teachers and improve the competencies, including the ICT competences, of educators. In 2017, the Government of Canada and the Government of Tanzania launched the Teacher Education Support Project (TESP) to strengthen the teacher education system. It provided teacher colleges (TCs) with facilities, materials, and equipment as well as improved college infrastructure, including rehabilitation of science and ICT laboratories. The TESP, five-year project (ending 2021). The deliverables for this project are also aimed at developing teachers' digital competences and therefore improving access and use of ICT in teaching and learning.

 ICT in education and remote learning was identified early in Côte d'Ivoire as a solution to mitigate the various challenges of access, quality, and equity. In 2012, the MENETFP (Ministry of National Education, Technical Education and Vocational Training) launched the UNESCO-CFIT (UNESCO-China Funds in Trust), a project completed in 2018 that aimed at improving the continuous training of teachers through the development of an online training system as well as digital teaching resources. The project was implemented in 10 localities: Abidjan, Bassam, Bondoukou, Bouaké, Daloa, Korhogo, Man, Daoukro, San Pedro and Yamoussoukro. The program contributed to strengthen the capacities of the APFCs (Antenne de la Pédagogie et de la Formation Continue) in instructional technology, to introduce ICTs in teacher training colleges (CAFOPs-Centres d'animation et de formation pédagogique), as well as enable self-pace learning of in-service teachers in primary and secondary schools. This program reached about 6,000 teachers and CAFOP students. In 2015, the MENETFP also launched the "Mobile Learning Côte d'Ivoire" project in partnership with the AUF (Agence universitaire de la Francophonie). It was a 2-year pilot program, engaging 400 primary school teachers and 600 middle school teachers in 5 cities: Agboville, Divo, Bouna, Boundiali and Séguéla. The project enabled offline self-paced teacher training through the distribution of tablets, pre-loaded with the training material.

Several policies provide for teacher development aimed at improving the quality of Teacher Education. For instance, Uganda recognizes that education is crucial for both, building human empowerment and delivering economic progress. The Ministry of Education and Sports (MoES) received support from UNESCO through their Capacity Building in Education (CapED) programme which was also supported by the Islamic World Educational, Scientific and Cultural Organization (ICESCO). The project supported the establishment of Teacher Education E-Learning in Educational Institutions (TEELS). These institutions were equipped with ICT toolkits: 18 tutors were given comprehensive and pedagogical training in technological skills and competencies for delivering effective teaching.

This study shows that ICT has long been part of the vision of the study countries. However, there is a need for ongoing workforce training, both during preservice and in-service for educators to acquire and maintain the ability to integrate ICT into their classrooms. Similarly, training for learners and administrators needs to be ongoing since ICT in education affects the entire system.

8. e-Education Initiatives and Availability of Electronic Systems for Learning and Examinations

The COVID-19 pandemic spurred on the need for the availability of ICT for learning, including systems for authenticating examinations, e-education materials, and data analytics to monitor teaching and learning. There have been several initiatives across different countries. Botswana's Maitlamo ICT strategy and implementation placed the country in an advantageous position. At the onset of the pandemic, the education system had both curricula for teaching computer skills and educators with the pedagogical skills to use ICT in teaching other subject areas. Already in 2002, Botswana ensured that all secondary schools were equipped with computer infrastructure and internet connectivity, to learn basic computer skills. The Maitlamo strategy ensured the early integration of ICT into primary and secondary curricula advancing the development of digital literacy skills among learners across the education spectrum and beyond. UNESCO commended Botswana for its early integration of ICT in education, pointing out that the development of computer skills in primary and secondary education plays a critical role in national development particularly for learners who come from homes and communities which lack ICT infrastructure (UNESCO Institute for Statistics, 2015).

In Tunisia, *Madrassati* is part of a digital solution for all. The National Centre of Technology in Education (CNTE) has planned to deploy digital school services through technological platforms taking into consideration all the information needs of all actors related to the school (student, parents, teachers, school management, external actors). It is an innovative tool that provides real-time access to data and evaluation reports for pedagogical and administrative staff, students, and parents. It can also be used to transfer any type of data that has an importance and impact on the quality of school life. Eventually, this system should reach all the schools in the country. The technological platform allows parents to receive and access online up-to-date information on their children's work, progress, attendance, and behavior. As for the teaching and administrative staff, the technological platform allows them to analyze student evaluation data, monitor student progress between two points in time, and easily identify students who are in the process of absenteeism and dropping out of school quickly and easily.

In April 2023, the Tunisian Association Innocence introduced "*My training protects me - Takwini Yahmini,*" an innovative platform designed to cater to individuals seeking vocational training. Serving as the first electronic platform of its kind, it focuses on engaging with and addressing the needs of those who have discontinued their education or express interest in vocational training. The platform offers a comprehensive directory of both public and private vocational training centers, accompanied by informative videos introducing each center's offerings. By providing timely updates on vocational training advancements, the platform simplifies registration and enrollment procedures for both students and trainers involved in the Technical and Vocational Education and Training (TVET) field. Furthermore, the platform facilitates the identification of conditions faced by children experiencing school dropout and economic exploitation, contributing to their well-being and protection.

The 'Digital Training Pilot' project in Chad aimed to train and bring digital reinforcement. The 'Renforcement des Enseignements-Apprentissages à travers les TIC (REATIC)' was an initiative aiming to promote equity, improve quality, and advance educational reform. The 'Emergency Project to Reinforce Education and Literacy' in Chad (PURÉAT) aimed at building long-term capacity to support education in emergencies and providing equitable access to an improved quality of education.

The 'Education and Training in Liaison with Employment' (EFE) is also Chad's initiative involving training and continued education through ICT.

In Djibouti, the Ministry had initiated a project entitled 'DJIBOUTI NUMERIQUE' whose objectives was to disseminate televised courses for all grades, ensuring continuity of course courses through radio programs, giving access to e-Learning platforms for secondary students and pre-service teacher training as well as distributing booklets and paper materials to the marginalized and remote areas. Similarly, in Madagascar the MENETP (Ministère de l'Education Nationale et de l'Enseignement Technique et Professionnel) aimed at reaching as many learners as possible by broadcasting educational programs for all classes on the core subjects in the school curricula via radio and television. On the other hand, Ethiopia, which had low digital readiness for the continuity of education, managed to embark on an emergency response initiative by using e-Learning platforms for secondary education, multi-media TV channels and radio programs to disseminate primary education resources.

A success story unique to Burkina Faso

An alternative option is to turn to ICTs that do not require an internet connection and use nano-servers to access digital content offline, for instance. The EDbox in Burkina Faso (below) allow computers/ tablets/ smartphones to be connected to digital content on local storage, without internet access. ICT and inclusive education programs must be developed coherently to ensure that everything required to access educational content is provided by the programme (or is already available in the schools).

Figure 1: EDbox nano server in Burkina Faso

Source: https://www.hi.org/sn_uploads/document/Inclusive-ICT-report_1.pdf

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In South Africa, the Thutong portal serves as the online gateway to a vast collection of free educational materials, policy details, and interactive services pertaining to every facet of the South African educational system. It will offer pertinent data and services on teacher development, school administration, and management in South Africa. Furthermore, the Department of Education established the Dinaledi Schools Project to significantly improve performance and increase participation in Mathematics, Life Sciences, and Physical Sciences. The schools were provided with the resources and support to improve teaching and learning.

To boost digital education activities for the development of the digital education ecosystem, Mauritania has the Medrassety.net platform which was an initiative put in place to help parents and teachers in maintaining their children's learning, as well as assisting them in raising their concerns to regional education authorities. Its first digital learning program, the 'Akelius Digital French Course,' was offered to enable out-of-school children and young people to improve acquisition of the French language, and

to acquire a sufficient level of French to enter formal schooling. This initiative also strengthens innovative teaching practices such as use of ICT and blended approaches.

In May 2022, the Centre for National Distance Learning and Open Schooling, in Ghana officially launched five ultra-modern studios aimed at promoting e-learning and the digitization of manual content at all levels of education. The studios are part of CENDLOS' aim to make ICT in education effective, efficient, accessible, and inexpensive to all students. Centre for National Distance Learning and Open Schooling (CENDLOS), which was founded in 2002, has generated interactive, appealing, relevant, and approved instructional content to enhance teaching and learning. The centre also has the IBOX system, which is an offline solution for students at the senior high school level in the remote areas, and the ICAMPUS GH which is the online version of the IBOX.

Mauritania's first digital learning program: Akelius Digital French Course

Since 2000, Mauritania has been under a modern bilingual education system, with all children being taught in both French and Arabic. Although expected to teach in both languages, a significant percentage of teachers face challenges with the second language which is most often French.

The Akelius Digital French Course is an innovative digital learning application that works online and offline which aims to:

- Enable out-of-school children and young people to improve acquisition of the French language, and to acquire a sufficient level of French to enter formal schooling.

- Strengthen innovative teaching practices such as use of ICT and blended approaches.

Since June 2019, over 1,100 adolescents and young adults (49 per cent girls and 51 per cent boys) have strengthened their skills in French using the Akelius digital learning application.

UNICEF (2021)

While digital competencies and skills are important, lifelong development of competencies and skills to participate in social life is equally fundamental. As such, the Tamkeen project aims to teach the Mauritanian youth leadership and life skills that will enable them to support themselves independently. The objective is to boost young Mauritanians' self-esteem and encourage them to participate in the community, local government, and home decision-making processes.

These educational initiatives realize the potential of information and communication technology (ICT) in education and do make a difference in education by ensuring that students learn with understanding. For example, in Mauritius, there are the Universal ICT Education Programme, Digital Youth Engagement Programme, Community Empowerment Programme, Cyber Caravan Project, and the Community Web Portal, which are all initiatives that helped learners from all education levels. In Tanzania, we have several policies and initiatives that encourage the integration of ICT in education such as the National ICT Policy, ICT Policy for Basic Education, and the reviewed National ICT policy. 'iKnowledge' is a project led by Avanti Communications brings digital classrooms to schools in Tanzania through the deployment of high-speed satellite broadband connectivity. The project

provides ICT equipment as well as digital skills training for teachers. Students have access to the computer labs to learn basic ICT skills and access eLearning platforms. The schools are also equipped with additional laptops and projectors for teachers to access eLearning and educational content for use in the classrooms.

The use of online learning platforms to support blended learning in Cameroon at University level was positive overall, given that students find online learning platforms easier to access information since they receive instant updates on their mobile phones. The underlying rationale for using Google Classroom as a platform in teaching and learning is that such technology optimally allows students to collaborate and co-construct knowledge according to social constructivist principles. Similarly, remote learning in higher education was also implemented for the continuation of their students' studies. For the learning management system, the University of Buea decided on Google Classroom and WhatsApp as a complementary communication tool, except for the Faculty of Education and the Higher Teacher's Training College, where Moodle was preferred.

The UVCI (Université Virtuelle de Côte d'Ivoire), launched in 2015 by the government, aims to boost distance education and mitigate the challenges of overcrowded universities. This is a fully online university where students can access lessons from anywhere. Teachers work from classrooms which are set up as studios, where lessons are recorded and broadcasted and streamed via a MOOC (Massive Open Online Courses) platform. The University is also equipped with a modern FabLab where students can build their projects. These are equipped with advanced computers, 3D printers, robotics machines and applications for code development. By 2019 the University had a total of 4742 registered students.

On another note, there is no evidence to suggest that governments had recourse to online examinations for primary and secondary levels. The aim of most emergency remote online teaching was to ensure continuity in teaching and learning without much focus on assessment and examinations. Most students lost one year of studies after the pandemic which they had to repeat – suggesting that remote online teaching was not as effective as expected. However, universities adopted different approaches shifting to open book examinations, assignments in lieu of examinations and the use of proctored examination tools. Despite this, the costs of deploying high-end proctoring tools and e-learning platforms were a challenge for African universities in the study countries.

9. Digital Learning Materials

Since the start of the COVID-19 pandemic, emergency programs have been put in place by the governments, with support from technical and financial partners, to address the most urgent needs for sustaining education. The three most used approaches are the provision of radio and TV programs, handing out self-learning booklets and the use of digital tools and the internet. Tertiary education institutions, being more autonomous, strategize their own approach whereby Learning Management systems such as Moodle, Google Classroom, Blackboard, and Canvas were used to host online learning materials and platforms like Zoom, Teams and Meet were utilized for synchronous sessions with students.

While platforms and systems were readily available, countries were not necessarily ready in terms of the available of appropriately designed content, adapted to the new teaching and learning modalities. From the country reports, there have been different digital education initiatives undertaken both prior to and during the pandemic as emergency responses. However, none of these initiatives, that existed prior to COVID-19 had really scaled up to be embedded within the mainstream curriculum frameworks and were designed with the resilience of the education system in mind.

9.1 Existence of generic and country-specific learning materials

In the higher education sector, institutions, except the open and distance learning ones, do not usually engage in the development of self-instructional content or explicit student manuals as most teaching are done face-to-face. During the pandemic, in many universities, lecturers were required to convert their lecture notes into PowerPoint presentations while the supporting reading materials were distributed in portable document format (PDF) either via e-learning platforms, Google websites or email. Such notes were then complemented with audio explanations.

In general, there are many online repositories of free learning resources for all educational levels such as Enuma, Khan Academy, Curriki, and OpenLearn just to name a few. However, the main issue and constraint is access to these resources, the contextual relevance, appropriate guidance from educators, who themselves need to have appropriate training and competencies to be able to effectively use these platforms and their resources to teach. On the other hand, teachers can take advantage of the TESSA network of teachers and teacher educators stretching across Sub-Saharan Africa. At the heart of the network is a bank of open educational resources (OER), linked to the school curriculum and designed to support teachers and teacher educators in developing active approaches to learning.

In Mauritius, the Government launched in 2017 the Early Digital Literacy Programme (EDLP) with the support of the Indian Government, as part of the ongoing educational reforms to promote ICT mediated pedagogy at school level and is in line with the strategy stated in Budget Speech 2016/2017 "Moving Towards a Fully-Fledged Digital Society." The aim was to digitize curriculum content that would be available for deployment on tablets for lower primary grades. The issue when COVID-19 forced the closure of the schools, was that the students no longer had access to the tablets and e-content as these were kept at the schools. Therefore, the Government resorted to an emergency response plan to invite educators to use their acquired education technology skills to develop PowerPoint based lessons with voice-overs, converted to video format and aired on the national

television channels. For lower secondary students, an online platform called the Student Support Programme (SSP) was designed since 2018, to contain curriculum related digital materials in the form of documents and instructional videos for different subjects. This platform was used during COVID-19 lockdown and school closures. However, the digital divide in terms of internet access and availability of computers in households meant that there was no equitable access to these resources.

In Benin, the Ministry of Education developed an online platform called "My Class at Home" that provided access to digital educational resources and materials for both teachers and students. The e-learning platform (https://elearning.etudiant.bj/) launched in the context of the COVID-19 health crisis displays more than 35,000 course videos and at least 2,500 other online teaching materials. These digital solutions have made it possible to ensure the continuity of courses, despite the restrictions and – essential – to encourage students to validate their school year. The digitalization of training courses has made the lives of many students easier amidst the COVID-19 pandemic. (SOS Children's Villages, n.d.).

Senegal recently launched PROMET (Projet du Ministère de l'Éducation pour le Développement du Télé Enseignement), similar initiative to the SSP programme of Mauritius. PROMET is a sectoral plan to ensure continuity of education in partnership with UNICEF. The project included several initiatives enabling online platforms, digital lessons, radio, and TV education programs for remote learning which are adapted to the local context.

Senegal's Virtual University (UVS)

UVS is a public digital university, which aims to provide Senegalese youth with equitable access to higher education. UVS takes into consideration the rapid trends in ICT, which will require new ways of equipping students in an era of a digital age. Learning at UVS combines traditional classroom teaching with online training. In this approach, the traditional classroom teaching component decreases as the students advance in their curriculum. UVS was established in September 2013, by presidential decree. The university started with an initial student registration of around 2,050. By 2018, the number of students associated with UVS has grown to more than 28,000. The first cohort of students graduated in 2018.

The UVS slogan in Wolof, "foo nekk foffu la" means literally "where you are, is where it happens". This is significant in that UVS aims to embed education within local communities, emphasizing that students are local agents for change within the societies where they live. UVS takes education to people where they live, making it possible for youth, women with young babies, and people with disabilities, to study at their choice of location and their preferred pace. The societal change has been huge, as demonstrated by the rise in the number of students. The UVS example has inspired other countries, including Burkina Faso and Cote d' Ivoire, signifying the important contribution of UVS to the broader African higher education ecosystem.

https://www.tipconsortium.net/

Furthermore, another recent post-pandemic initiative UCUSAF (Uganda Communications Universal Service and Access Fund) was a pilot Holistic eLearning Platform for four Secondary Schools based on Moodle in Uganda. The Research and Education Network for Uganda (RENU) platform aims to carry out capacity building for quality teaching and learning using technology. RENU is a provider of internet and cloud services. The primary focus is on building infrastructure and capacity. In recognition

of eLearning as the future of pedagogy and with the objective of using this modality for the delivery of 30% of the curriculum, more content is being developed and uploaded on the platform.

In Tunisia, the BACWEB project aims to make available to students' national baccalaureate exam subjects to accompany them during their revisions. Among the services offered by BACWEB for the benefit of students, a bank of national exam subjects and their answers for all sections and all subjects since 1994 is put online with a printable version of the current year. This space is annually updated to allow for the identification and publication of subjects and their answers, which allows for the daily provision of necessary and official resources.

> **So Kalan – Mali's first e-Learning platform**
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> "So Kalan" is the first e-learning platform designed and implemented in Mali. In partnership with a school in Bamako, Ada Ouologuem and her team created 20-minute didactic modules on exam subjects. Through these short videos, So Kalan gradually gives access to an increasing range of learning opportunities: courses in mathematics, French, physics & chemistry, biology, history, and geography.
>
> The emergence of COVID-19 and its consequences on students' learning needs prompted the young enterprise to refine and strengthen its educational programme. So Kalan took advantage of this opportunity to make young people aware of protective measures against COVID-19. The "video capsules" are broadcasted on its own online platform and on the Africable TV channel. "So Kalan" also introduces video conferencing software, facilitating interactive communication between students and teachers. In other words, students can ask questions and teachers get a chance to question their students.
>
> In just a few months, more than 500 students have logged in and are taking the courses online. Beyond Mali, the broadcasting of these video clips on the television channel Africable allows students from Senegal, Côte d'Ivoire, and Niger to tune in.

9.2 The existence of cross-country e-learning programs

Analysis of the country reports did not explicitly reveal the existence of cross-country e-learning programs, and many of the e-learning initiatives, especially during the COVID-19 pandemic, have been mainly country-specific with each country reacting to its local issues and adapting to the constraints encountered. On the other hand, some projects led by common regional/international partners in the African region spanned over different participant countries.

For instance, prior to COVID-19, the Sankoré project launched in 2011 was a Franco-British partnership which aimed to educate some 16 million African children from Anglophone and Francophone countries. It aimed to assist Africa in achieving the Education for All (EFA) goals through digital empowerment. The initial partners in the project were Mauritius, Madagascar, Mali, Burkina Faso, Mauritania, and Senegal. However, there was no necessary coupling between the countries at the curriculum level, despite the deployment of the same equipment and technologies in these countries.

Similarly, during the COVID-19 pandemic, the Global Partnership for Education (GPE) mobilized funding to support several African countries in developing emergency response plans to address effects of school closures and ensure continuity of learning. However, there is limited evidence to suggest that the development of these response plans was undertaken in a concerted and coordinated manner across countries.

APPRENDRE is a program being implemented by the AUF and financed by the AFD to the tune of €20 million, over the period from June 2018 to June 2024. APPRENDRE is a provider of expertise and networking of actors in charge of education (practitioners, educational managers, academics, and researchers). The program provides technical support to the Ministries of National Education of the 26 eligible African countries to provide services, tools, and expertise in the pedagogical, didactic and university fields, at the request of partner countries.

The West and Central African Research and Education Network (WACREN) and the Research Institute for Development (Institut de Recherche pour le Développement, or IRD) have jointly launched the ADC, an e-learning project that spans two years. This initiative has been piloted at two universities: the National Higher Institute of Industrial Technology of Lokossa in Benin and the Virtual University of Burkina Faso. The ADC project has been financed by the French Development Agency, with funds delegated by the European Union. It is part of a larger program aimed at improving connectivity and digital solutions in the education, health, and micro, small, and medium enterprises sectors in member states of the Organisation of African, Caribbean and Pacific States.

In November 2021, Airtel Africa and UNICEF announced a five-year pan-African partnership to help accelerate the roll-out of digital learning through connecting schools to the internet and ensuring free access to learning platforms across 13 countries. By providing equal access to quality digital learning, particularly for the most vulnerable children, the partnership will help to ensure that every child reaches their full potential. The Airtel Africa and UNICEF pan-African partnership will benefit learners in Chad, Congo, Democratic Republic of the Congo, Gabon, Kenya, Madagascar, Malawi, Niger, Nigeria, Rwanda, Tanzania, Uganda, and Zambia[11].

AFIMEGQ Project

The project AFIMEGQ "Africa For Innovation, Mobility, Exchange, Globalization and Quality" is a cooperation and mobility programme in the area of Higher Education, implemented by the Education, Audiovisual and Culture Executive Agency (EACEA) of the European Union (EU).

The project is designed to facilitate the movement of Masters students, PhD students and Staff between selected national Universities in the African regions as a means of building capacity and encouraging socioeconomic development in each region.

The project focuses on postgraduate education and research as a means of strategic capacity development by making available a wider variety of postgraduate degrees and research opportunities to students from each region and country.

The AFIMEGQ partnership is composed of 10 African partner institutions as well as 12 associate institutions from all over the world. The main holder of the project was the University of Yaoundé (Cameroon) and the National Engineering School of Tunis (ENIT) intervened as an associated partner.

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[11] https://www.unicef.org/press-releases/airtel-africa-and-unicef-announce-multi-million-dollar-partnership-scale-digital

Partnership Members in AFIMEGQ:

University	Name	Country
UY1	Université de Yaoundé I **Coordinating Institution**	Cameroon
UNDT	Université de Ndjamena	Chad
UNIKIN	Université de Kinshasa	Democratic Republic of the Congo
EiABC	University of Addis Ababa	Ethiopia
UONBI	University of Nairobi	Kenya
UMP	Université Mohammed 1er, Oujda	Morocco
UCAD	Université Cheik Anta Diop, Dakar	Senegal
SUN	University of Stellenbosch	South Africa
ENIT	Université El Manar, Tunis	Tunisia
CBU	Copperbelt University, Ndola	Zambia

Source: https://www.afimegq.org

10. COVID-19 Responses and Challenges Related to Implementing e-Learning

The COVID-19 pandemic spurred the need for ICT for learning, including systems for authenticating examinations, e-education materials, and data analytics to monitor teaching and learning. Since the start of the crisis, emergency programs have been put in place by the governments, with support from technical and financial partners, to address the most urgent needs for sustaining education. The three most used approaches are the provision of radio and TV programs, handing out self-learning booklets and the use of digital tools and the internet. Tertiary education institutions, being more autonomous, strategize their own approach whereby Learning Management Systems (LMS) such as Moodle, Google Classroom, Blackboard, Canvas were used to host online learning materials and platforms like Zoom, Teams and Google Meet were utilized for synchronous sessions with students.

Botswana's challenges during COVID-19

In Botswana, despite the early adoption of ICT, only a small number of learners of its school-going population benefited from the country's remote learning plans that, in this case, needed to rely on households for its implementation. In responding to the COVID-19 pandemic, the country's education policy and practices were found to be beneficial as was it's the introduction of new online and offline learning tools and platforms. However, the implementation of digital teaching during the pandemic was limited by access to internet connectivity and electricity and the state of readiness for the rapid transition to remote learning. There were large disparities among households, particularly across Botswana's vast geographic area, with many challenges when the pandemic required the transition to online teaching, learning and assessment. Moreover, the inequalities in access to education technology meant that even the lessons presented using radio and TV were difficult to deliver and monitor due to the lack of infrastructure, particularly among households located in the regions away from Gaborone.

Public-private partnerships play a crucial role during emergencies such as the COVID-19 pandemic. The private sector has undertaken noteworthy initiatives to tackle the impact of this crisis on education, some initiatives are as follows:

- To enable the digitalization of teaching materials for both teachers and students, the ICT infrastructure and internet costs need to be comparably affordable and accessible, especially in low-income countries. Rwanda, through its telco providers MTN and AirTel for instance, adopted the social corporate services implementation, where the internet for educational resources was zero rated. In Cote d'Ivoire, the provision of free online learning environments allowed the Ministry of National Education, Technical Education, and Vocational Training to deliver online courses to the learners who were stuck at home (ADEA, 2020)

- In Senegal, partnerships were established with the media, whereby programs like "Salle des Profs" on TFM and "e-school" on the e-TV channel were supported by private television networks.

- In Burkina Faso, like in other countries in Africa and the Middle East where Orange is established, the pupils who benefit from the Digital Schools programme are in classes CE1, CE2, CM1 and CM2 (equivalent of UK Years 3 to 6) and attend disadvantaged primary

schools. These schools are generally located on the outskirts of large cities and in rural areas of Burkina Faso.

- The Orange Foundation and the Tunisian Ministry of Education have signed a memorandum of understanding for the implementation of the *"Digital Education"* program in public primary and secondary schools in Tunisia. The objective is to provide free educational content to primary and secondary school students in the form of a digital kit comprising two Raspberry Pi servers and 50 tablets.

Private firms are significant drivers of jobs, training, local revenue, local value creation and solution providers to local problems in many emerging nations. Their initiatives also aided in reducing the pandemic's negative social and economic effects. Some businesses were even able to capitalize on the crisis and emerge from it stronger than before during the COVID-19 pandemic. The Kenya-based Edtech business PataTutor[12] seeks to match students with capable private or online teachers. The firm intends to make it simple for parents to hire in-person or online tutors for their kids. Since the COVID-19 pandemic started, the use of online tutors and classrooms has grown significantly. With the help of these online lessons, students and learners can study in the comfort of their own homes.

The Mastercard Foundation's Centre for Innovative Teaching and Learning in ICT (CITL)[13], based in Rwanda, further supports entrepreneurs, and scale up technology innovations to improve teaching and learning in secondary education. The Centre drives the innovative use of technology to close the gap in access to quality education; build evidence of what works in ICT for education; and create an active network of ICT leaders in secondary education to advance the integration of technology in education policies and practices across Africa.

In general, governments established a three-fold approach: to ensure the continuity of learning, to prepare for the reopening of schools, and to strengthen the education system's capacity to respond to crises. Countries have been limited in leveraging digital technologies in their response to the pandemic, as they do not possess the core foundations necessary to leverage the digital economy.

The study countries encountered several challenges in ensuring the continuity of education during the crisis, including:

- Limited electrification infrastructure, impeding reliable access to power sources.

- Scarcity of devices both in households and schools, hampering access to digital learning opportunities.

- Inadequate network coverage, bandwidth constraints, and exorbitant costs of internet connectivity, constraining effective online learning.

- Student resistance and suboptimal engagement towards remote learning methodologies.

- Insufficiency of e-materials and adapted curriculum resources for alternative media channels such as radio and television.

- Conflict-ridden regions exacerbating difficulties in accessing schools and functional ICT infrastructure.

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[12] Five African edtech startups innovating learning methods - Ventureburn

[13] https://mastercardfdn.org/all/centre-for-innovative-teaching-and-learning-in-ict/

- Absence of comprehensive Learning Management Systems (LMS) to facilitate efficient remote learning platforms.

- Lack of Education Management Information Systems (EMIS) for streamlined data management and educational administration.

- Knowledge and skills gap among educators and students pertaining to proficient utilization of ICT tools.

- Absence of legislative frameworks supporting the provision of distance education in certain countries.

- Inadequate logistical and technical infrastructure, limiting the provision of equitable digital learning opportunities for all students.

These challenges highlight the diverse barriers faced by the study countries in achieving equitable and sustainable educational continuity during crisis situations.

The World Bank (2021)[14] highlights some lessons learned globally that are relevant to Gabon's context:

- First, **the availability of technology is a necessary but insufficient condition for effective remote learning**. Gabon needs to address the challenges of limited internet connectivity and digital devices, particularly in rural areas, to ensure the effective use of EdTech.

- Second, **teachers play a critical role in facilitating effective remote learning**. The Gabonese government needs to provide regular and effective pre-service and on-going teacher professional development to enhance teachers' digital and pedagogical skills.

- Third, **remote learning needs to allow for meaningful two-way interaction between students and their teachers**. Gabon needs to adopt appropriate technology solutions that enable interaction between teachers and students.

- Fourth, **parents' involvement can mitigate some of the limitations of remote learning**. Gabon should prioritize strategies that provide guidance to parents and equip them with the tools required to help them support students.

- Lastly, the **Gabonese government needs to work closely with other entities working in education**, including multilateral, public, private, and academic entities, to secure the quality of the overall learning experience.

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[14] https://www.icbl.hw.ac.uk/media/10700/ijet2021_paper19.pdf

11. Partners Engaged in Supporting the Use of Digital Technology in Education

The selected African countries were supported by different local, national, regional, and international partner agencies and donor countries for the implementation of key ICT infrastructure, ICT in Education ecosystem development (policy, connectivity, hardware, software, learning materials, training) and education policy in general. Other partners stepped in during COVID-19 to help the countries develop emergency educational response plans and post-COVID 19, there are different actors and funding agencies moving in to support countries develop and improve the resilience of their education system with ICTs.

There are different high-level multi-stakeholder initiatives based on regional and international partnerships and collaborations as highlighted in the table below.[15]

Table 2: Regional Players and Cross-Country Projects

Region	Project Name	Project Brief
East Africa Community (EAC)	East African Community Broadband ICT Infrastructure Network	The aim of this project is to establish and operate a cross-border broadband infrastructure network within the EAC.
	Analogue-to-Digital Broadcast Migration (ADBM)	ADBM requires government interventions on several areas including policy and regulatory regime, technology standardization, spectrum plans and business and consumer preparations. To that effect, the EAC Secretariat is working with the International Telecommunications Union and the European Union to support a programme for harmonizing ADBM among EAC Partner States.
	ICT Policy and Harmonization Framework	In this project, two reference instruments have been developed: a Regional Framework for Harmonization of National ICT Policies and a Study on the EAC Communications Regime. Both documents provide recommendations on harmonizing the ICT policies and regulations of Partner States.
Southern African Development Community (SADC)	Infrastructure Development	The SADC is committed to ensure broadband connections with open-access fibers exist between all SADC Member States and their major cities, along with at least one Internet exchange point in each Member State. It further aims to ensuring that the public has affordable,

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[15] https://www.eac.int/infrastructure/communications-sector/ongoing-projects

		high-speed Internet access, potentially through terrestrial wireless or satellite technology in remote areas, amongst others.
Economic Community of Western African States (ECOWAS)	Integrated ICT Infrastructure development	ECOWAS Secretariat has set up an integrated ICT Policy working in close collaboration with its 15 member states. The implementation of the Policy is being done by the ECOWAS Infrastructure projects preparation and development Unit (PPDU). ECOWAS has also mobilized key multilateral partners to provide technical and financial support. The key ones include the AfDB and the WBG.
Central African States Economic Community (CEEAC)	integrated Infrastructure Master Plan	The Heads of States members of the "CEEAC" have endorsed a new integrated Infrastructure Master Plan that include regional projects with focus on Transport, Electricity, and ICT. Several multilateral partners including the European Commission and African Development Bank are currently supporting the CEEAC Secretariat to prepare for regional ICT Policy and Plan with a specific focus on Broadband networks and human capacity development as well.
Smart Africa Initiative	Single Digital Market for Africa	The initiative currently has 32 African member states from across the whole regions. One of the key priorities for the Smart Africa Secretariat hosted by the Government of the Republic of Rwanda is ICT Skills development and Capacity.

From the table, we observe that the key areas of focus are ICT Infrastructure specifically expanding broadband networks taking advantage of the various submarine cables especially in SADC, ECOWAS and EAC and supporting landlocked countries to benefit from the submarine cables by extending fiber optic networks. This is a critical milestone towards facilitating access to sustainable and cost-effective connectivity for schools at all levels. The issue of access to electricity is also tackled in specific regions such as ECOWAS, EAC and SADC by promoting regional cross border power pools like the Eastern Africa Power Pool (EAPP) which is a collaborative effort by eleven countries in Eastern Africa to interconnect their electricity grids and take advantage of excess capacity within the network and facilitate trade of electric power between the members.

This is also critical for the education systems in the concerned countries to be able to use and integrate digital technologies in the classes and households. Several multilateral and bilateral partners are providing technical and financial support including the WBG, AfDB, EU, BMZ and others.

However, the two key elements behind all these supported initiatives are sustainability and impact. If the initiatives supported by the partners are not sustainable financially and logistically over time, they may have neither impact nor positive outcomes in terms of the objectives to be achieved. For instance, the one laptop per child (OLPC) project launched in 2005 in Africa was not sustainable and necessarily impactful in terms of learning outcomes.

12. Recommendations and Investment Priorities

12.1 Policy and Implementation

1. Governments are urged to develop comprehensive digital education strategies outlining clear objectives, targets, and timelines for the adoption of ed-tech and digital learning in education.

2. ICT integration policies and implementation strategies should be clearly defined using an inclusive and participatory approach with all stakeholders (policy makers, practitioners, administrators) to help address the challenges of translating policy into practice arising from a lack of resources and an enabling infrastructure.

3. Policies need to be accompanied by clear implementation plans, and key result areas with appropriate monitoring. This is in addition to ensuring policy coherence.

12.2 Workforce Competence

1. Teachers in the study countries lack the appropriate training and digital competencies. It is widely postulated that in the 21st Century, the "bricks-and-mortar" institutions of teacher training will not be sufficient to address the training needs of in-service and pre-service educators. There is a need to mount a common capacity-building programme for educators and school administrators in Africa on digital learning design and teaching with technology. Such a programme can be built on micro-credentials, on a flexible open and blended modality offered by a consortium of partners online with face-to-face sessions carried out in their respective regions.

   Teachers often adopt teaching methods similar to the ones they experienced as students. Hence, it is crucial to provide pre-service teachers with ICT training and opportunities to incorporate these techniques into their learning activities during their time in school. This ensures that they will utilize these skills to enhance their teaching practices once they enter the profession. Therefore, institutes responsible for teacher training need to thoroughly reassess their curricula to align them with the requirements of 21st-century teaching and learning.   Investment in the development of human capital is as important as the investment in the development of ICT Infrastructure.

2. Develop a high quality professional Digital Leadership Development programme for the heads of educational institutions to create an enabling environment visioning, coherent policy making and driving the educational transformation at school level.

3. To ensure the successful implementation of digital initiatives, it is recommended to establish comprehensive mass digital literacy programs. These programs aim to equip the general public with essential ICT literacy skills, empowering them to effectively engage with digital services and adapt to new media for educational purposes. Without a digitally literate and empowered target audience, the potential for success in digital initiatives is limited.

12.3 ICT Integration in Teaching and Learning

1. It is highly recommended to integrate ICT into teaching and learning practices. By doing so, educators can create dynamic and engaging learning environments that cater to the diverse needs of students. This integration should involve the use of digital tools, software applications, and online resources that align with the curriculum and are relevant to the students' context. It is crucial to invest in the development of a comprehensive ICT infrastructure and provide necessary training and support to teachers to ensure effective integration. This will enable students to access a wide range of information, collaborate with their peers, and develop essential skills for the digital era. Moreover, it is essential to regularly evaluate and update the ICT integration strategies to keep pace with advancements in technology and educational practices. By embracing ICT integration in teaching and learning, educational institutions can prepare students for the challenges and opportunities of the digital age, empowering them to thrive in a technology-driven world.

2. Ensure the provision of quality content that aligns with the specific needs and cultural context of a country is of paramount importance. It is crucial to establish a sustainable e-content development strategy, supported by adequate investment, to expedite the complete digitization of curricula within a shorter timeframe.

3. Redesign and adapt curriculum to 21st century digital teaching and learning and review modes of student evaluation by replacing knowledge-based tests with alternative modes of assessments that focus on achievement of learning outcomes.

12.4 Partnerships for ICT projects in Education

1. The sole responsibility of ICT projects cannot be borne by the State, on the other hand, excessive reliance on external funding agencies raises concerns about project sustainability. Therefore, while Governments should consistently allocate funds for ICT development projects, it is imperative for the local private sector to actively participate and support the initiatives undertaken by the Government. By doing so, they contribute to the improvement of the country's education system, ultimately leading to the formation of a skilled workforce.

2. As the continent is now focused on continental and regional integration through the African Continental Free Trade Area (ACfTA) that implies movement of labor in addition to products and services, it is imperative for regional organizations to support and facilitate regional projects aiming at expanding access, use and integration of digital technologies in education and training.

3. It is equally important to find ways of promoting regional cooperation in developing online learning and library platforms especially in support of continuous teachers' professional development, harmonization of ICT related curriculum and professional training programs amongst others.

4. In some countries, Governments need to explore innovative project financing models (crowd funding and microfinance for instance) in collaboration with partners such as the private sector to improve the edtech situation.

12.5 Basic Facilities and Infrastructure

1. If there is no electricity, there are no ICTs and by extension no integration of ICTs in Education. Electrification is the number 1 priority for most of the African countries in this study, especially for the rural areas. Investment is required in green and renewal energy and solar energy should be explored for remote population and schools.

2. For most of those with electricity, Internet access is still an expensive commodity and Internet bandwidth is limited.

3. Further the investment to equip schools that already have access to electricity with computers and tablets to bridge the digital divide and promote technology-enabled pedagogies.

4. Improve and upgrade existing infrastructure as short-term solution, in lieu of engaging in ambitious projects that are not realistic and sustainable.

5. Further investment in the expansion of coverage and penetration of television and radio to households for educational TV and radio programs for remote areas. This must be done in phase with the electrification projects.

6. It is therefore important to bring partners listed in table 2 on board while addressing ICT for Education at national levels to make sure that the economy of scale is taken care of in some of the key required investments such as Internet infrastructure, access and connectivity, costs of devices, and computing facilities in schools.

12.6 Country-Specific Intervention Matrix

With the primary and secondary level data analysis from the target research countries, the potential areas of support from the AfDB and IsDB are marked with "x" in the following table 3.

Table 3: Potential areas of support for target countries

Countries	Policies and strategies	Capacity Building	E-Learning initiatives and e-content	ICT Systems & Infrastructure
Benin		X	X	X
Burkina Faso	X	X	X	X
Botswana		X	X	
Cameroon	X	X	X	X
Chad	X	X	X	X
Comoros		X	X	X
Côte d'Ivoire		X	X	X

Djibouti		X	X	X
Ethiopia			X	X
The Gambia		X	X	X
Ghana		X	X	X
Guinea		X	X	X
Guinea- Bissau	X	X	X	X
Kenya		X	X	X
Madagascar	X	X	X	X
Mali	X	X	X	X
Mauritania	X	X	X	X
Mauritius		X	X	
Mozambique	X	X	X	X
Namibia		X	X	X
Niger	X	X	X	X
Nigeria		X	X	
Rwanda		X	X	X
Senegal		X	X	
Sierra Leone	X	X	X	X
Somalia	X	X	X	X
South Sudan	X	X	X	X
South Africa		X		X
Tanzania	X	X	X	X
Tunisia		X		X
Uganda		X	X	X
Zambia		X	X	X
Zimbabwe		X	X	X

The highlighted cells *denote the priority area for potential investment. As mentioned in the other sections, infrastructure is the backbone for ICTs in Education.*

13. Conclusion

COVID-19 has exposed the weaknesses of education systems globally and did not spare even the developed countries who were much better equipped and prepared than the developing world. Africa, being, the continent that hosts some of the poorest countries of the globe and others with different challenges such as conflicts, terrorism and extreme climatic conditions cannot hope for a better future and progress if its already fragile education ecosystems further collapse. To a significant extent, and rightly so, ICTs are often seen as the panacea to society's challenges from poverty to education and in other areas of concern and interest.

The use of ICT in education has emerged as a powerful tool in transforming teaching and learning practices across Africa. It can bridge educational gaps, enhance access to quality education, and prepare students for the demands of the digital age. However, while ICT offers numerous opportunities, it also brings forth a set of challenges that need to be addressed to ensure its effective implementation.

First, infrastructure and connectivity remain significant obstacles in harnessing the full potential of ICT in education. Many regions in Africa still lack reliable electricity supply and internet connectivity, making it difficult for schools to adopt ICT-based approaches. Efforts must be made to improve infrastructure, expand internet coverage, and provide necessary resources to schools, particularly in remote and underserved areas.

Additionally, the shortage of skilled teachers who can effectively integrate ICT into their pedagogical practices poses a significant challenge. Teacher training programs should focus on equipping educators with the necessary ICT skills and knowledge to effectively integrate technology into the curriculum. Continuous professional development initiatives and supportive policies should be implemented to encourage and empower teachers to embrace ICT tools and methodologies.

Digital literacy among students and teachers is another crucial challenge that needs attention. Many learners and educators lack basic digital skills, hindering their ability to fully utilize ICT for educational purposes. It is imperative to prioritize digital literacy programs and provide training opportunities to enhance the digital competence of both students and teachers. This will enable them to navigate digital platforms, critically evaluate online information, and utilize digital resources effectively.

Furthermore, the affordability and accessibility of ICT devices and software remain a significant concern. Excessive costs of computers, tablets, and software licenses make it challenging for schools and families to afford them. Governments, educational institutions, and private sector stakeholders should collaborate to make ICT devices and software more affordable and accessible, ensuring equitable access for all students.

Lastly, while ICT can enhance educational experiences, there is a need to ensure that it complements traditional teaching methodologies rather than replacing them entirely. A balanced approach that combines ICT with effective pedagogy is essential to maximize the benefits of technology in education. Teachers should be encouraged to use ICT as a tool to support and enrich classroom interactions and engage students in active learning.

The use of ICT in education holds immense potential for transforming the African educational landscape. However, addressing the challenges of infrastructure, teacher training, digital literacy, affordability, and pedagogical integration are vital for the successful implementation of ICT initiatives in education. The issue of empowerment of populations in rural and remote areas is a matter of significant importance. It is crucial to recognize that addressing extreme poverty and hunger is equally essential as ensuring electrification. These actions must be undertaken coherently and in parallel, considering them as interconnected goals. With concerted efforts from governments, educational institutions, and stakeholders, Africa can harness the power of ICT to provide inclusive, quality education that prepares students for the future.

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