Background report

▶ Digitalization in teaching and education in Kenya

Digitalization, the future of work and the teaching profession project

Peter L Barasa

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International Labour Office • Geneva

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▶ Abbreviations

▶ **CPD**   continuous professional development

▶ **FMIS**   Financial Management Information System

▶ **GIZ**   Deutsche Gesellschaft für Internationale Zusammenarbeit

▶ **GPE**   Global Partnership for Education

▶ **ICT**   information and communication technology

▶ **IT**   information technology

▶ **KNUT**   Kenya National Union of Teachers

▶ **KOICA**   Korea International Cooperation Agency

▶ **KUPPET**   Kenya Union of Post Primary Education Teachers

▶ **NEMIS**   National Education Management Information System

▶ **TMIS**   Teacher Management Information System

▶ **TSC**   Teachers Service Commission

▶ **TVET**   technical and vocational education and training

▶ **UNESCO**   United Nations Educational, Scientific and Cultural Organization

▶ **USAID**   United States Agency for International Development
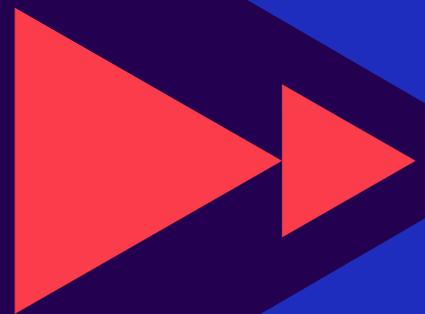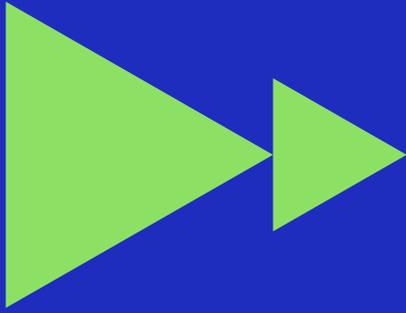
▶ 1. Key findings

The Government of Kenya is prioritizing the use of information and communication technology (ICT) in teaching and learning at both basic and higher education levels, including through collaborations with international agencies and organizations. In response to technological changes, the 2006 National ICT Policy was revised, resulting in the development of the 2019 National ICT Policy, which aims to achieve a knowledge-based society and ensure the availability of accessible, efficient, reliable and affordable ICT services.

The Digital Literacy Programme was initiated in 2016 with the aim to distribute digital devices to primary school students and to train teachers in the delivery of digital learning content. Overall, approximately 81,000 teachers were trained under the programme. The Ministry of Education, Science and Technology and the Teachers Service Commission (TSC) have also targeted teachers for ICT training to provide both basic and enhanced ICT competencies.

Despite the various initiatives, a range of challenges are present, including: inadequate infrastructure, including electricity and internet connectivity; lack of training and continuous professional development (CPD) opportunities on the pedagogical use of digital technologies; multiple data systems in use, leading to a mismatch of teacher, student and school information and data sets; high cost of digital devices; and funding shortfalls and delays in disbursement impacting the operation of programmes and capacity-building of teachers. A digital divide between rural and urban areas continues to perpetuate existing education inequalities.
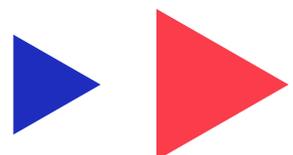
▶ 2. Introduction

Even as digitalization generates opportunities to increase accessibility to education in Kenya, the digital divide has continued to grow larger for groups that have benefited least from the infrastructural development of information and communication technologies (Srinivasan 2006). To counter the digital divide, the Government of Kenya instituted ICT reforms that have seen the introduction of high-speed internet, computers, tablets and other digital tools in schools through projects funded by the Ministry of Education, Science and Technology and through multiple partnerships with agencies and organizations such as the Network Initiative for Computers in Education, Microsoft and Oracle. Technology is seen as a solution to various teacher challenges, including persistent teacher shortages, particularly in rural areas, informal settlements in urban areas, arid and semi-arid lands and areas prone to insecurity (for example due to Somalia border insurgencies, terrorist activities, internal ethnic border conflicts and cattle rustling banditry).

ICT has been a priority area for the Ministry of Education, Science and Technology since the development of the Kenya Education Sector Support Programme in 2005. The 2006 National ICT Strategy for Education and Training included components that would promote the use of technology in education, including formulation of an ICT policy; investment in digital equipment; enhancing connectivity and network infrastructure; facilitating technical support and maintenance; and integrating digital content. These components, among others, aimed to integrate ICT in education, harness emerging technologies and increase access and equity in education. These efforts have made meaningful contributions to digitalization in the education sector.

As the leading ICT innovation hub in sub-Saharan Africa, and second to Madagascar in terms of internet country spread, Kenya is well positioned to digitalize its education sector (World Bank 2019). The 2006 National ICT Policy, which was revised in 2019, set out objectives pertaining to scaling up ICT in education, including through promoting the development of e-learning resources; facilitating public–private partnerships to mobilize resources in order to support e-learning; promoting the development of an integrated e-learning curriculum to support ICT in education; and facilitating sharing of e-learning resources between institutions (Farrell 2007). These efforts, however, have not yet guaranteed sustainable accessibility to education through e-learning, attraction of public investment in ICT education-related areas and development of a teaching workforce qualified to utilize digital technologies.

An assessment prepared by the World Economic Forum (2017) indicates that a growing proportion of jobs in sub-Saharan Africa are becoming ICT intensive. Digitalization within the economy has prompted increased demand for digital literacy skills. As such, digital literacy is becoming a necessary component of the current primary and secondary school education systems in Kenya. As ICT infrastructure is improved and increasingly utilized in teaching and learning, it becomes imperative that teachers acquire the prerequisite ICT skills and that they continue to engage in skills upgrading.

The development in 2006 of the National ICT Strategy for Education and Training by the Government of Kenya, and the policy statement on e-learning, were clear indications that the work of teachers would change, with growing expectations for the acquisition of digital literacy skills. In 2016, Kenya's Ministry of Information, Communication and Technology created the Digital Literacy Programme, which placed emphasis on training teachers in the delivery of digital learning content. In all, approximately 81,000 teachers were trained under the programme.

This study is a review of the changing ICT landscape in Kenya, with a focus on the education sector. It looks at the positive contributions of digital technologies in the education sector, assesses its use for teaching and learning, considers implications of new technologies for teachers and their role in its implementation and reviews existing policies and legislation to examine the extent to which these support digitalization in education.

▶ 3. Methodology

This study is based on a comprehensive document analysis and key informant interviews. The main focus of the study is on digitalization and the changing nature of work as applied to the teaching profession in primary and secondary schools and technical and vocational education and training (TVET) institutions. Research for the study largely employed a content analysis approach through a literature review of existing sectoral statistics and reports, national policy reports and material produced by stakeholders in the education sector.

A review of literature on ICT national policy development and reports on the progress of development of ICT infrastructure in Kenya, particularly in the education sector, was undertaken. Reports of the Ministry of Education, Science and Technology were reviewed, including those of the TSC and other education-related bodies, such as the Kenya Institute of Curriculum Development, the Kenya National Examinations Council and the Kenya Education Management Institute. The study also critically reviewed media reports on ICT and the changing work environment and needs of teachers in Kenya.

Interviews were scheduled with key informants in the Ministry of Education, Science and Technology on ICT policy, implementation of ICT in schools, teacher training and development, terms and conditions of employment for teachers, capacity for innovation, creativity and collaboration in teaching, the changing context of learning, pressures faced within education systems (such as ensuring adequate funding) and implications for inclusion and equity. Interviews were also undertaken with TSC key informants on teacher shortages, teacher recruitment and digitalization of teacher management. In addition, interviews were carried out with teachers' unions in Kenya, specifically the Kenya National Union of Teachers (KNUT) and the Kenya Union of Post Primary Education Teachers (KUPPET). TVET managers and GIZ representatives were also useful in providing vital information on digitalization in Kenya. The selection of interviewees was purposive. The study adopted a qualitative approach and was mainly guided by two principles in selecting key informants: practicality and expertise.
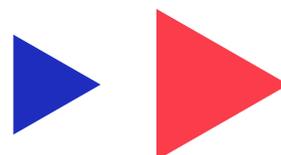
▶ 4. Brief overview of the education sector

The Kenyan education sector comes under the aegis of the Ministry of Education, Science and Technology, the role of which is to provide quality education to all Kenyans. It hosts the State Department of Basic Education, which has responsibility for basic education[1], and the Department of Science and Technology, which is mandated to formulate, promote and implement higher education policies and strategies. TVET resides in the Department of Science and Technology.

The national education system has historically used an 8–4–4 structure: eight years in primary education, four years in secondary education and four years in university. Pre-primary education, comprising 4–5-year-olds, is included in the structure, but is managed by county governments. The TVET system absorbs youth that do not enrol in the mainstream education system at primary, secondary or university levels. A number of Kenyan students are also enrolled in international systems of education, such as the International General Certificate of Secondary Education (Cambridge syllabus).

The TSC is an independent constitutional agency mandated by the Government of Kenya to register and employ trained teachers in public schools or institutions. It also has the mandate to recruit, assign to schools, promote, transfer, discipline and terminate the employment of teachers.

4.1 Teacher data

It is difficult to establish the number of teachers in the country, including the projected required number, due to fluctuations in the figures from different sources. According to the TSC Strategic Plan 2019–2023, the TSC had 317,069 teachers on its payroll in 30,892 schools as of June 2018 (table 1).

▶ Table 1. Public schools, students and teachers in Kenya

Level of public school	No. of schools	No. of students	No. of teachers	No. teachers required	Teacher shortage	Student–teacher ratio
Primary	22 263	8 071 662	217 291	255 345	38 054	37
Post-primary	8 629	2 761 769	99 778	158 069	58 291	28
Total	30 892	10 833 431	317 069	413 414	96 345	32 (av.)

The TSC estimates an overall teacher shortage of 96,345, of which 38,054 are at the primary school level and 58,291 are at the post-primary level (public secondary schools and middle-level certificate and diploma colleges serviced by the TSC). Due to funding shortfalls, the TSC has not been able to promote qualified and deserving teachers, including those that have attained higher academic qualifications. The promotion of teachers by the TSC entails a salary increment, a new job group or grade, or a more senior position; or a combination of a salary increment and a new grade; or a salary increment, new grade and a more senior position. According to KNUT, by 2020, 257 teachers with master's degrees, 6,370 with undergraduate degrees and 5,453 with diplomas have submitted requests for promotion.[2]

Teacher shortages introduce staffing challenges, especially as the Government of Kenya targets 100 per cent transition of students from primary to secondary school. The situation is made worse by teacher attrition and low replacement and recruitment trends. Teachers are now taking on a greater workload than the recommended 28 lessons per week. Classes are congested, with a high student–teacher ratio in primary

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1   In Kenya, basic education comprises early childhood education and primary and secondary education.

2   Most of the 30,000 teachers who have attained higher qualifications since 2014 have yet to receive acknowledgement letters from the TSC to enable them to seek promotions.

schools (56:1) and in secondary schools (41:1).[3] Some national schools register even higher student–teacher ratios of 50:1 and 70:1 due to teacher and facility shortages. High student-teacher ratios impact the quality of education and erode confidence in public schools.

In 2018, the TSC received parliamentary approval to hire 88,000 teachers with a budget of 27 billion Kenyan shillings over the three-year period 2018 to 2020 (Wanzala 2018). However, the TSC requires 82 billion Kenyan shillings in order to recruit teachers over a five-year period to address existing teacher shortages, which is close to 100,000 (figure 1). Projections of the TSC Strategic Plan 2019–2023 indicate that the short-age could reach 119,419 teachers by 2023, of which 84,478 will be in secondary schools, if the number of teachers recruited does not increase. Teacher shortages worsened in 2019 with the government's emphasis on a 100 per cent transition of learners from primary to secondary education. Due to shortages, schools have had to employ their own teachers, normally referred to as board of management teachers. They are paid directly by funds raised by the schools' boards of management, usually through levies on parents, resulting in additional financial burdens for parents. These teachers are sourced from the pool of trained and qualified teachers who have not yet been absorbed by the TSC.

In the private school sector, accurate data on teacher shortages are difficult to locate. This is because school ownership varies greatly, encompassing schools owned by religious groups or other faith-based organizations, schools owned by non-governmental organizations and other associations, international schools and individual- or group-owned schools (for example, Nova Pioneer, Woodcreek and Makini schools). In most private schools, especially those that are group-owned or faith-based, class sizes are low compared to public schools. These private schools generally have adequate numbers of teachers (Nishimura and Yamano 2012).

▶ **Figure 1: Teacher shortage projections 2020–2023**
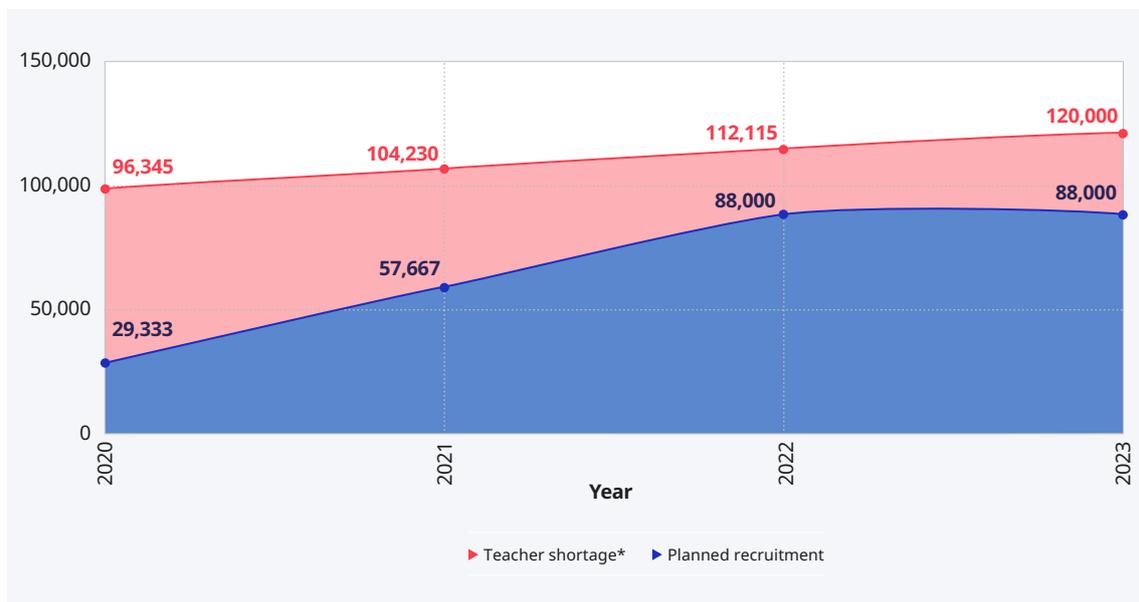
Notes: Annual shortage growth rate = 7,885, estimated by linearly extrapolating from 96,345 in 2020 to the projected 120,000 shortage in 2023.

Annual planned recruitment rate is calculated by averaging the three-year recruitment plan of 88,000 teachers over the three years between 2020 and 2023 (inclusive).

No recruitment is currently planned beyond 2022. That is why the "planned recruitment" number for 2023 is the same as that for 2022.

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3   The primary net enrolment rate rose from less than 60 per cent during the pre-2003 period to about 91.2 per cent in 2017 (Government of Kenya 2018a). Increasing enrolments in primary school have generated challenges of high student–teacher ratios and increases in teachers' workload.

The existing data and literature suggest that teacher attrition in Kenya is determined by both individual and institutional factors. The reasons for leaving the teaching profession include lack of good housing, inadequate water, inadequate social amenities (common in rural areas, arid and semi-arid lands and informal settlements in urban areas), excess workload, poor remuneration and better opportunities elsewhere. Attrition in the teaching profession is also experienced through death and retirement of teachers. Research on teacher attrition in a Kenyan county indicated that: "The pull and push factors were greatly affected by government policies regarding transfer, remuneration, departmental transfers, motivation and generally the welfare of the teacher. … [T]eacher attrition can be controlled and the losses minimized by improving teachers' working conditions, pay and motivation among other things" (Mulei et al. 2016).

Between 1987 and 2016, 22,961 deceased teachers were removed from the TSC employment roll. The country lost an average of 791 teachers per year due to death, translating to two teachers per day.

4.2 Teacher training and professional development

Kenya has embraced the three conventional teacher education processes: pre-service, in-service and CPD. The government is committed to producing a qualified teaching workforce that is able to carry out a well-developed teaching and learning agenda. The strategic objectives of the National Education Sector Plan are to enhance the equity, quality and relevance of education; to enhance training at all levels; to undertake quality assurance; and to review standards of education and training at all levels (Government of Kenya 2016). Teacher education is offered at three levels of qualification: certificate, diploma and degree. It is carried out in teacher training colleges, technical training colleges and universities. Teacher education programmes are offered as follows.

▶ **Early childhood development and education.** Teacher training is provided through in-service courses in district centres for early childhood education and is run by the National Centre for Early Childhood Education, which is mandated to develop the curriculum, to train supervisors and trainers and to conduct monitoring and evaluation processes.

▶ **Primary teacher education.** Training is offered in 30 public and private certificate-level colleges and technical institutes through a two-year residential programme.

▶ **Secondary teacher education.** Teachers are trained in teacher training colleges and universities, graduating with diplomas and degrees respectively.

▶ **Technical teacher education.** Training is provided at the Kenya Technical Trainers College, where teachers for secondary schools, technical training institutes, primary teachers' colleges, institutes of technology and vocational polytechnics are trained at diploma level.

▶ **Special needs teacher education.** Training is provided to professionally qualified practising teachers through a two-year diploma programme at the Kenya Institute of Special Education.

The expansion of primary and secondary education as a result of the government's policy of free primary and secondary education, and its commitment to 100 per cent primary to secondary transition, have necessitated the training of more teachers. There are currently four public diploma teacher training colleges in the country (Kagumo, Kibabii, Lugari and Moiben) (Government of Kenya 2016, 21).

According to the National Education Sector Strategic Plan 2018–2022, education is undergoing key reforms, including a shift to a competency-based curriculum and competency-based assessment at the basic education level, and a shift to competency-based education and training at the TVET level. This presents opportunities for reforms in pre-service teacher preparation to produce teachers with the requisite skills to implement the competency-based curriculum and align pre-service teacher education to competency-based education (Government of Kenya 2018a). A report of the Kenya Institute of Curriculum Development identified the following shortcomings of teacher education programmes: lack of adequate knowledge of content; inadequate professional skills, values and attitudes; and need for mentoring. The report recommended that teacher education in Kenya be organized at three levels – early years teacher education, middle school

teacher education and secondary school teacher education – and that it be operationalized in six teacher education programmes (KICD 2016):

▶ early years teacher education;

▶ middle school teacher education;

▶ postgraduate diploma and Bachelor of Education in secondary teacher education;

▶ post diploma in technical teacher education;

▶ post diploma in special needs teacher education;

▶ continuous professional teacher development.

The role of the TSC was focused on teacher recruitment, and it was only recently that it became actively involved in CPD. That involvement stemmed from the 2016 report of the Kenya Institute of Curriculum Development, which identified low subject mastery and insufficient pedagogical skills as factors that negatively impacted quality in schools. It called for the initiation of CPD programmes for those already employed via in-service education and training and teacher professional development modules. The TSC would continue to ensure institution-based quality assurance and standards of the programmes (Government of Kenya 2016). The National Education Sector Strategic Plan 2018–2022 report outlines the government's plan to align the skills, attitudes and competencies developed through teacher professional development programmes with the National Qualifications Framework and to link them to professional progression pathways (Government of Kenya 2018a).

The Ministry of Education, Science and Technology, working with the TSC, supports science-oriented teachers with paid leave if they want to return to college for further education and qualifications. This is not the case for arts-based subject teachers. The net effect has been an increase in the number of students pursuing Bachelor of Education programmes at university in science subjects. A shortage of teachers in arts subjects is now being witnessed. Also, any funding for in-service training is focused on programmes such as Strengthening Mathematics and Science Subjects (SMASS), while arts-based subjects have no specific programme for in-service teacher development.

Finally, cascaded in-service training, which characterizes most Ministry of Education, Science and Technology initiatives, allows only a few selected teachers to attend the training with the hope that they will train their colleagues on return to their work stations. This system has not been successful, as the selection process in some schools can lead to disagreement among colleagues, reducing the likelihood of teachers passing on training on their return to school.

In 2019, a strong conversation ensued among education stakeholders with regard to how to equip teachers for the future. This included a proposal to eliminate the traditional Bachelor of Education training introduced in 1972 by separating subject and pedagogical content. Specifically, students would first be required to complete an undergraduate basic degree in either science or arts in two subjects that they wanted to teach, followed by one-year specialized postgraduate diploma training in education.

4.3 Financing

According to UNESCO Institute for Statistics data, expenditure on education as a share of total government expenditure in Kenya has been declining for over a decade to below the Global Partnership for Education (GPE) target of 20 per cent. Education funding in Kenya comes from the central government, the National Government Constituencies Development Fund, county governments, households (parents), non-governmental organizations, religious bodies or faith-based organizations, the private sector and individual companies, external loans and grants and internally generated funds (KIPPRA 2019).

The Ministry of Education, Science and Technology allocates the larger share of its annual budget to fund the free primary and secondary school education. In the 2019/20 financial year the ministry received 473.3 billion Kenyan shillings out of a total budget of 3.08 trillion Kenyan shillings. The largest share of expenditure goes to primary school education, where the student population is highest.

While education expenditure as a percentage of total government expenditure may have declined across all education levels, the total expenditure per student (US$ purchasing power parity) rose from US$254 in 2012 to US$313 in 2015 (UNESCO Institute for Statistics data). This indicates inadequate progress in government funding of the education sector. According to the Education Sector Report of 2016, in Kenya the overall education sector budget and projected resource allocations showed an increase from 339,924 million Kenyan shillings in 2016/17 to 349,861 million Kenyan shillings in 2017/18. Allocations to basic education increased from 56,246 million Kenyan shillings in 2013/14 to 67,106 million Kenyan shillings in 2015/16, while total budgetary allocations to the TSC increased from 165,683 million Kenyan shillings in 2013/14 to 186,586 million Kenyan shillings in 2015/16.

The 2016 Education Sector Report noted that the key priority areas to be financed include teacher resource management (recruitment of 5,000 additional teachers and promotion of the existing workforce), free primary education, free secondary education, university education, TVET infrastructure and science and technology research. An additional allocation was provided for the establishment of seven new universities.

In 2018/19, the Government of Kenya spent 3.9 per cent of the national budget on early learning and primary education, which was a 48 per cent increase in the allocation from 2017/18. Despite this increase, allocations to primary education declined by 4.1 per cent, and have been declining since 2015/16. The free primary education programme, which accounts for 87.5 per cent of the primary education budget, is facing a funding deficit of 3.4 billion Kenyan shillings. An analysis of Kenya's 2018/19 budget estimates states that the reduction in funding does not respond to the government's commitment to achieve universal primary education and may have negative implications for achieving the programme's targets for 2018/19, such as the planned increase in beneficiaries by 100,000 students (Government of Kenya 2020).

4.4 Terms and conditions of employment

Teachers in public schools are not allowed to hold any other jobs, as it is expected that their entire working time be committed to the schools to which they are posted. However, teachers are allowed to venture into business; in rural areas, for example, they may be involved in agriculture on both a subsistence and a commercial basis, while in urban areas they may run retail shops or taxi cab businesses. Having a business "on the side" is common among both public and private teachers, in both primary and secondary schools.

Public school teachers in Kenya are represented by two main unions: KNUT for primary school teachers, and KUPPET for secondary schools and middle-level colleges offering certificates and diplomas with TSC tutors. Once a teacher is recruited by the TSC they are automatically enrolled in one of the unions – KNUT or KUPPET, as appropriate. Teachers in private schools do not have a national private teachers' union.

4.5 Existing policy frameworks

Major educational reforms have taken place in Kenya since 2010, with a number of frameworks and policies being developed outlining the principles and long-term goals to guide planning in the Ministry of Education, Science and Technology. Such reforms take place within the context of Kenya's commitment to implementing a number of national and international instruments, including the 2030 Agenda for Sustainable Development, Education for Sustainable Development, the African Union Agenda 2063, the Kenya Vision 2030, the 2010 Constitution of Kenya and the Big Four Agenda. The Big Four Agenda is centred on the Government of Kenya's priorities for 2019/20, namely universal health care, affordable housing, manufacturing and food security. These are prioritized in the Third Medium Term Plan of the Kenya Vision 2030.

Policy documents that aim to promote innovative transformation and guide the future direction of the Kenyan education sector include the National Education Sector Strategic Plan, 2018–2022, and the Policy Framework for Reforming Education and Training for Sustainable Development in Kenya, 2019 (Government of Kenya 2019a). Through the National Education Sector Strategic Plan, 2018–2022, "Kenya strives to provide quality and inclusive education, training and research for sustainable development … realized through providing, promoting and coordinating competency based equitable learner centred education, training and research that is relevant to the labour market. [It] purposes to increase access and participation, raise the

quality and relevance and improve governance and accountability in education, training and research with an emphasis on Science, Technology and Innovation" (Government of Kenya 2018a, xii). Complementary to that, the Policy Framework for Reforming Education and Training for Sustainable Development in Kenya, 2019, "provides the framework for delivery of inclusive, equitable, quality and relevant education, training and research that promotes lifelong learning opportunities for all" (Government of Kenya 2019a, 20). A summary of policies and frameworks developed within this period is outlined in table 2.

▶ **Table 2. Policies and frameworks in the education sector in Kenya**

No.	Policies and frameworks
1.	National Education Sector Strategic Plan, 2018–2022
2.	Third Medium Term Plan 2018–2022: Transforming Lives: Advancing Socio-economic Development through the Big Four, 2018
3.	Education Sector Disaster Management Policy, 2018
4.	Sessional Paper No. 1 of 2019: A Policy Framework for Reforming Education and Training for Sustainable Development in Kenya, 2019
5.	Mentorship Policy for Early Learning and Basic Education, 2019
6.	Policy Framework for Nomadic Education in Kenya, 2019
7.	National Pre-Primary Policy Standards Guidelines, 2018
8.	Competency Based Education and Training Policy Framework, 2018
9.	Sector Policy for Learners and Trainees with Disabilities, 2018
10.	Implementation Guidelines: Sector Policy for Learners and Trainees with Disabilities, 2018
11.	National Pre-Primary Education Policy, 2017
12.	Basic Education Framework, 2017
13.	Education for Sustainable Development Policy for the Education Sector, 2017
14.	National Education Sector Plan, Volume Two: Operational Plan, 2017/18–2019/20 (Education Sector Report, 2016)
15.	National Education Sector Plan, Volume One: Basic Education Programme Rationale and Approach, 2015
16.	Education and Training Sector Gender Policy, 2015
17.	Basic Education Act No. 14, 2013
18.	Science Technology and Innovation Act No. 28, 2013
19.	Technical and Vocational Education and Training Act No. 29, 2013
20.	Policy Framework for Science, Technology and Innovation, 2012
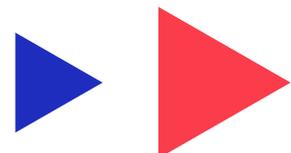
▶ 5. Technology and teacher management

The National Education Sector Plan articulates the government's commitment to integrating ICT in teaching and learning, including through developing new knowledge and technologies and promoting and coordinating the development of science and technology. In relation to teacher management, the sector aims to enhance quality teaching, professionalism and teacher integrity in all educational institutions, and to recruit and ensure sufficient teaching staff for public primary and secondary institutions (Government of Kenya, 2016).

The TSC is mandated to manage the teaching service for basic education. Its mandate and function are to register, recruit, maintain and provide teacher support in the implementation of the curriculum (Government of Kenya 2018b). The TSC reviews education standards and the training of persons entering the teaching service, and advises the national government on matters related to the teaching profession (Government of Kenya 2016). In this respect, the TSC manages the Teacher Management Information System (TMIS).

In addition to the TMIS, the National Education Management Information System (NEMIS) and the Financial Management Information System (FMIS) are used for management of data in the education sector in Kenya. NEMIS, TMIS and FMIS were funded in 2018 through education sector programme implementation grants sourced from the GPE (GPE 2019a). The GPE is supporting Kenya's efforts to adopt new technologies to strengthen the collection of data for education planning and decision-making (GPE 2019b).

5.1 Teacher Management Information System

In Kenya, the TSC is mandated as the body fully in charge of all matters pertaining to teacher management. However, no data are collected on teacher management in private schools by the TSC. To assist the TSC in effectively accomplishing its mandate, in 2015–16 the TMIS was developed to enhance efficiency in the management of teachers' data (Government of Kenya 2016). The TMIS is administered at the TSC head office and is utilized in ensuring effective teacher management through centralized and up-to-date data. There is harmonized and timely access to teacher information at all administrative units and at national, district and education institution levels. The data are updated on a termly basis and capture teachers' information, school details and student enrolment, among other information. Schools are expected to provide and update basic school-level information and provide data on student enrolment and teaching workload. Schools generally comply with these requirements and the TSC has put in place mechanisms to ensure that data are submitted on time.

In an effort to improve service delivery, the TSC is in the process of providing a multichannel mobile technology platform to improve interaction with its teachers (Government of Kenya 2016, 38). This is intended to facilitate capture of real-time data by the TSC, enabling it to respond quickly to any matters that need to be addressed. This is an improvement on the previous system of collecting data in hard copy.

It is observed in the National Education Sector Strategic Plan, 2018–2022, that the existing data management practices in the sector do not support the generation of evidence-based, timely, reliable and correct data. Institutions within the education sector tend to operate in silos and use different data systems that do not talk to each other, occasioning mismatch of information and data sets. Currently, there are overlapping school-level data maintained by the TSC, the Kenya National Examinations Council and the Ministry of Education, Science and Technology. Each of these institutions maintains separate data sets with separate school codes for the same school, causing challenges in harmonization of the data sets (Government of Kenya 2018a). Besides, as revealed through key informant interviews, schools and teachers face challenges arising from a lack of reliable internet connectivity, leading to slow online collection and submission of data.

5.2 National Education Management Information System

Data and information are critical in presenting and managing issues in the education sector (Government of Kenya 2017a). These issues include accessibility and participation of learners, quality and equity of education

and internal efficiency. The education sector needs to facilitate the production of timely, accurate and reliable data from institutions of learning. In order to provide quality, reliable and timely education statistics to enrich education planning, the Ministry of Education, Science and Technology designed and developed NEMIS, a web-based data management system that collects data and information on schools, teachers and learners from education institutions. The heads of institutions periodically provide data to ministry officials. NEMIS is located in the Ministry of Education, Science and Technology, and ministry staff are charged with updating information and maintaining the system.

A key feature of the system is the issuance of unique identification markers to schools, learners and all staff members in learning institutions. Through this system, the Ministry of Education, Science and Technology can track each stage of a learner's education and ensure the registration and legitimacy of schools and education institutions. The data collected are intended to aid decision-making and planning, including effective resource allocation and data-driven policy development and implementation. The information generated is also designed to assist with monitoring and evaluating education sector performance and outcomes in order to assess quality and efficiency and guide future decision-making (box 1).

The report of the National Education Sector Plan, 2013–2018 (Government of Kenya 2015a), notes several challenges when it comes to implementing NEMIS: data sets are incomplete due to poor response rates, particularly from private schools; in most cases, the data are captured manually through hard copy question-naires or summaries submitted by subcounty education officers; ICT has not been fully utilized to improve data flows due to lack of continuous connectivity between the districts and the Department of Education (charged with basic education at the Ministry of Education, Science and Technology), compromising data capture and real-time transfer at the lower levels; and various directorates, semi-autonomous government agencies and the TSC are collecting similar data at different times, producing different statistics for different users, leading to conflicting policy decisions.

Regarding online student registration, to date primary and secondary school learners have been registered on NEMIS. Going forward, the system needs to be expanded to include learners from other subsectors, including the pre-primary, TVET and university subsectors (Government of Kenya 2018a).

▶ **Box 1. NEMIS modules**

Institution module. This module captures data on registration and physical aspects of schools and education institutions. It has six submodules: institutional registration; school infrastructure; school utilities; co-curricular activities; teaching and learning material; and emergency reporting.

Learner module. This module captures data on the performance, progression and transition of learners in the education system from the time of their registration. It has five submodules: unique personal identifier; learner registration; student mobility; performance progression; and learner talent.

Staff module. This module captures data on teaching and non-teaching staff from the beginning of their appointment. It has five submodules: teaching and non-teaching staff registration; teacher mobility; teaching subject areas; study areas; and teachers' responsibilities.

Finance module. This module tracks income and expenditure at all education institutions. It has five submodules: fees; capitation; income returns; development funds; and expenditure returns.

5.3 Financial Management Information System

The FMIS was developed in order to consolidate and extend financial management processes consistent with the National ICT Master Plan, 2013/14, and the government's financial management regulations and practices. The FMIS resides in the Ministry of Education, Science and Technology. Utilization of the FMIS was to be expanded to county and institution levels in support of financial management and administration in devolved decision-making, though technical and skilled human resources presented challenges. Timely and

accurate financial reporting by schools makes it easier for the Ministry of Education, Science and Technology, the TSC and the Kenya Institute of Curriculum Development to share information through NEMIS, TMIS and FMIS (Government of Kenya 2015b).

Strategies and actions in the National ICT Master Plan were designed to strengthen the capacity of operational management and the FMIS in the education sector. The FMIS was implemented over a three-year period jointly by the National Treasury, the Ministry of Education, Science and Technology and the TSC, with a focus on:

▶ formulation and implementation of a medium-term organizational development plan that will deal with issues such as staffing, budgeting, information technology (IT) hardware, software development and networking and communication infrastructure;

▶ introduction of a nationwide unified school financial record-keeping system via the revision of the unified school record-keeping and administration guidelines (as consistent with the FMIS), training all school principals and clerks on unified record keeping and formulation by the Ministry of Education, Science and Technology of policy and regulatory guidelines on school financial reporting as an obligatory function through the FMIS.
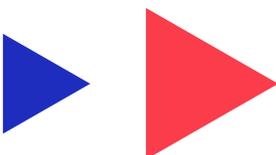
▶ 6. Digital skills training and development for teachers

In order to promote digitalization of teacher education, the Ministry of Education, Science and Technology has facilitated identification of the required ICT competencies for teachers, school managers and education managers; ensured that educational managers at all levels have the requisite skills for ICT leadership; reviewed the teacher training curriculum at pre-service level to equip them with the relevant ICT skills, knowledge and competencies for effective teaching and learning; developed an in-service ICT teacher training curriculum across all levels of education; and ensured that all teachers and teacher educators at all levels of the education system are facilitated to acquire their own ICT equipment under a one-device per teacher policy (Government of Kenya 2019a, 140).

Kenya is committed to lifelong training and education for supporting the creation of a globally competitive and adaptive workforce to meet the requirements of a rapidly industrializing economy. Among the flagship education and training projects for 2012 were plans to establish a teachers' recruitment programme to employ 28,000 more teachers for improving quality and ensuring that all schools had adequate numbers of teachers, and establishing a computer supply programme that would equip students with modern IT skills (Government of Kenya 2007, 12). These targets were not fully achieved. The computer supply programme, involving assembly of computers in local facilities in Kenya, could not meet its targets. The challenges came from the fact that the prerequisite infrastructure, including electricity and internet connectivity, was lacking.

The provision of a skilled workforce, the promotion of research and development and the integration of ICT into teaching and learning are expected to contribute to the government's development agenda. The Government of Kenya, through the Ministry of Education, Science and Technology, initiated a Teacher Education and Professional Development Programme in partnership with the United States Agency for International Development (USAID) and the private sector between 2007 and 2013. The programme targeted in-service teachers in all public primary schools and diploma teacher training colleges with the aim of improving the quality of instruction at public teacher training colleges to better prepare trainees for the classroom, including integrating ICT into teaching and learning (Management Systems International 2013).

The USAID/Kenya (2013) report shows that towards the end of the project in March 2013 over 8,000 tutors and educators and 32,000 teachers and teacher trainees had been trained on various aspects of improving educational quality. Twenty colleges had launched professional development centres that used action research to continually improve teachers' skills. More than 290 teachers used ICT tools in the classroom after going through the Teacher Education and Professional Development Programme. Teacher support teams were developed in North Eastern, Coast and Central Provinces to support teachers in integrating new technologies in lessons and teaching methods. More than 4,600 primary and 270 secondary school learners had benefited from the computer and communications equipment (USAID/Kenya 2013; Management Systems International 2013).

In order to support the Teacher Education and Professional Development Programme, capacity-building for primary school teachers became a priority. In accordance with the Teachers Service Commission Act of 2012, the TSC prepared a harmonized curriculum for ICT integration and embarked on capacity-building for teachers and education managers to effectively lead the utilization of ICT in education. The main objective was to have "all or most of the teachers trained in the integration of ICT in education by 2016" (TSC 2013, iv). The capacity-building was also meant to support the implementation of the School Laptop Project, which was launched in 2013–14 with the aim of equipping students beginning their primary education with a laptop in order to develop their digital literacy skills.

Furthermore, in 2015, a sensitization workshop was held by the Ministry of Education, Science and Technology for training teachers on the application of ICT for teaching, learning and management (Government of Kenya 2016). Since 2016, through the Digital Literacy Programme, efforts have been made to enhance the digital skills of teachers at primary school level, with a total of 80,980 teachers being trained. Furthermore, as part of the teacher education reform programme, the ICT skills of teachers were enriched

through a teacher professional development programme (KICD 2016) that aimed to build the capacity of TSC field officers on ICT integration in teacher performance appraisal and development processes, and introduce ICT-enabled teaching and learning support materials for early grade mathematics (Government of Kenya 2018a).

Albeit at low levels, in all training institutions teachers are exposed to digital facilities within the training process, especially when learning how to develop teaching and learning content. Not all teacher trainers, however, have undertaken training in digital technology and may lack the needed digital skills. CPD is necessary to develop a skilled and innovative teacher workforce that can integrate ICT for student learning.
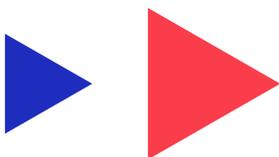
▶ 7. Pedagogical uses of technology

One of the strategic goals of the education sector is to promote open and distance learning and integrate ICT in curriculum delivery at all levels of education and training (Government of Kenya 2016). During 2013–14, the Ministry of Education, Science and Technology initiated the School Laptop Project with the intention of equipping every student beginning their primary education with digital technology skills to prepare them for work in the twenty-first century (TSC 2013). In anticipation of the project, the Kenya Institute of Curriculum Development, which is mandated to develop curriculum under the Kenya Institute of Curriculum Development Act, 2013, developed digital content for teaching and learning.

Efforts towards affordable production of digital devices through local assemblage, as revealed through key informant interviews, did not materialize, as device parts, including the plastic covers, needed to be imported. Locally assembled devices are subject to tariffs on imported parts, making the final product less affordable. Other challenges included lack of readiness of digital content, leading to a delayed launch and government budgetary constraints. A report by the Kenya Human Rights Commission observes that criticism of the project "focused on whether laptops are a priority and especially in schools that are under-resourced and lack electricity, in particular those in marginalized areas. ... there is need for putting out a clear strategy outlining how the program will be rolled out including some of the threats to the programme. Further, it should endeavour to get the marginalized children connected" (KHRC 2014, 44).

According to a 2019 newspaper article, five years after the projected launch of the School Laptop Project the government openly recognized that the project was not viable. The article noted that the project was poorly conceptualized and planned (The Standard 2019). Instead, the Ministry of Education, Science and Technology planned to set up one computer laboratory for each of the 25,000 public primary schools across Kenya, which is thought to be more feasible than a laptop per child in public primary schools. According to another article, the laptop project failed due to a lack of funds, electricity, teacher training, storage and digital devices to run the digital programme in schools (Nyaundi 2019).

The Ministry of Education, Science and Technology has an ICT directorate run by a deputy director for the digitalization of education to support teachers in integrating ICT. The Digital Literacy Programme, which was launched in 2016 by the Ministry of Information, Communication and Technology for training teachers in delivery of digital learning content, envisages integration of ICT in schools through the following means:

▶ digital content: to be developed by the Kenya Institute of Curriculum Development, which is responsible for also vetting private entities for content approval for basic education;

▶ policy frameworks: includes the National ICT Policy of 2006, revised in 2019, and the draft ICT Integration in Education for Basic Education Policy;

▶ ICT infrastructure: developing an environment for ICT integration, including access to power supply and electricity in all public institutions by solar power or national grid;

▶ capacity-building: providing the requisite knowledge and skills to administrators and education managers (head teachers, school boards of management, Ministry of Education, Science and Technology officers at national, county and subcounty levels) and teachers on the use of ICT for teaching and learning.

At its inception, the purpose of the Digital Literacy Programme was to integrate ICT into the education curriculum in order to enhance effective delivery of learning materials in all public primary schools in Kenya (Government of Kenya 2016). The programme pilot was successfully carried out in 150 public primary schools: three schools from each of the 47 counties and nine special needs schools. Under the programme, more than 12,000 digital devices were distributed. Phase 1, which ended in June 2019, was themed "Learning to Use" and focused on exposing teachers and students to user-friendly technology. Phase 2, which was initiated in July 2019, was themed "Using to Learn" and focused on setting up shared digital learning resource centres in schools with appropriate infrastructure and tools. Phase 3, yet to be initiated, is themed

"Using to Produce", and will focus on making use of technology for employment creation and mentoring learners for development at the tertiary level.

In the early stages of the programme, 150 public primary schools were supplied with digital devices; over 63,550 teachers were trained on ICT integration; and over 1.2 billion Kenyan shillings was disbursed for infrastructure (Government of Kenya 2016). Further, in the implementation of the Second Medium Term Plan, 2018–2022, under the Digital Literacy Programme a total of 882,765 learner digital devices, 43,777 teacher digital devices, 21,133 content access points and 19,409 projectors were supplied to primary schools to support the integration of ICT into teaching and learning. Moreover, 91,526 education professionals were trained to support the programme for integration of ICT and assistive technology for learners with special needs (Government of Kenya 2018b, 81).

The Ministry of Education, Science and Technology is also aiming to implement the Laptops and Assistive Technology Plan for Learners with Special Needs through the Digital Literacy Programme. The plan will include provision of assistive technology and specialized laptops to assist visually impaired and physically disabled students in their learning; provision of laptops for visually impaired learners in secondary schools, TVET institutions and universities; and adaptation of digital content materials for learners with special needs (Government of Kenya 2018b, 83).

To support the Digital Literacy Programme, identifying, acquiring and setting up a reliable and robust technology and ICT infrastructure is required, including teacher digital devices (laptops, scanners and printers); learner digital devices (laptops and tablets); projectors; Digital Literacy Programme content servers; digital wireless routers; power supply for grid or solar power; device storage and charging; and assistive and specialized technology for students with special needs.

In the implementation of the Digital Literacy Programme, benefits at primary school level have been realized. In the classroom, teachers have observed change in the learning of their students, with digital devices increasing student attentiveness and allowing them to experience learning in practical and fun ways. It has also reduced absenteeism and increased admissions in schools. In addition, the development of teacher capacity in the use of ICT has led to collateral enhancement of ICT capacity in communities.

In terms of ICT infrastructure, several challenges to its implementation have been recorded: battery failure for those relying on solar power; high power bills; need for technical maintenance of facilities and provision of first-line support; lack of internet connectivity; lack of data on connectivity (making it difficult to map out areas with connectivity needs); inconsistent connectivity (weak signal); destruction of telecommunication installations in areas prone to internal conflicts and border insurgencies; theft of tablets and computers; and lack of secure storage for ICT equipment. The Ministry of Education, Science and Technology has requested assistance from UNESCO and Safaricom, the largest telecommunications provider in Kenya, to assist with the issue of lack of internet connectivity. There are variations in internet coverage available to schools, with those in urban and peri-urban areas receiving better coverage. The cost of integrating ICT in some counties is supported by donors.

In 2015, the Ministry of Education, Science and Technology and the Korean International Cooperation Agency (KOICA) launched the Primary Schools Environment and Capacity-Building Project in Nairobi, Kenya. It aimed to digitalize and improve the quality of public school education, including by enhancing the capacity of ICT-based primary education and providing necessary technology and knowledge to teacher trainees and dispatching experts from the Republic of Korea to assist in technical support.

During 3–14 December 2018, the third training for ICT capacity-building for primary school teachers under KOICA was conducted with the objectives of providing capacity-building for teachers, setting up ICT innovation centres and providing equipment to two primary schools in Nairobi County. As a result of the training, it was expected that teachers would achieve learning goals effectively and efficiently by developing their ICT utilization abilities and applying them in schools; develop teaching materials using ICT to motivate students to join class activities; and manage sustainable capacity-building in teachers programmes through their experience in instructional design with lesson plans utilizing ICT.

The training was carried out through micro-teaching, which involved utilizing smart phones and ICT applications for teaching and learning. The teachers were also taught to use PowerPoint and techniques

such as importing videos, photos and other learning aids into the lesson plans. The training provided a 177-page manual to support trainees during the course with engaging activities. In 2019, Pusan National University and Dong-Eui University, Republic of Korea, with the support of KOICA, developed a master plan for operating ICT innovation centres in Kenya that can be accessed by both teachers and learners.

In terms of TVET, eight technical institutions have started offering Cisco Networking Academy programmes, which aim to provide trainees with industry-valued certification in skills to repair and maintain computers. To facilitate this, 40 TVET institutions have been connected to the internet through the fibre optic cable (Government of Kenya 2016).

GIZ has an ongoing project to provide support to TVET institutions in Kenya. The project has involved companies such as DT Dobie and Toyota Kenya working with three TVET institutions to make them centres of excellence through ICT integration in the training of young people. GIZ is piloting a blended learning model for the three TVET institutions, which will include modules that will enable simulation of engineering lessons for off-site students. The institutions are expected to adopt the cooperative training approach/dual system, which has both industrial and school-based components.

GIZ is in the process of developing comprehensive management learning modules. The focus on trainers has a three-model approach: pedagogical training and curriculum orientation; technical training; and internship with companies for trainees. The project will have a continuous training design that will create an online platform for trainees as they continue with their learning. In support of cooperative training, it will also include a collaborative platform with institutions in Germany, including the Federal Institute for Vocational Training (BIVT). The trainees are expected to master foundational knowledge in relevant digital technologies in areas such as development of ICT systems.
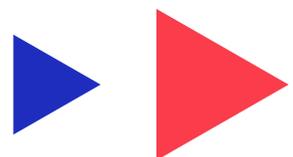
▶ 8. Teaching ethical and critical use of digital technology

Teacher training in digital technology espouses ethical practices in ICT-related activities, including research. It is expected that ethical standards acquired by teachers will be passed down to the students.

Cyber security is one of the challenges experienced with regard to the use and integration of digital technologies in education in Kenya. An interview with a high school teacher of computer studies revealed the following concerns (Serianu 2018):

▶ lack of training and preparation to safeguard against cyber attacks;

▶ absence of regulations that require teachers to acquire cyber security-based training to safeguard their personal, school and student data;

▶ insufficient preparation to respond to student technology-related questions;

▶ lack of full integration of ICT and cyber security skills in the school curriculum;

▶ limited information sharing, as teachers are sometimes reluctant to share cyber security-based issues that affect them due to a lack of knowledge or lack of access to industry specialists who can help advise on issues.

As the country embraces digital technologies, cyber security concerns and challenges have to be addressed, including through responsive policy and legislative frameworks.
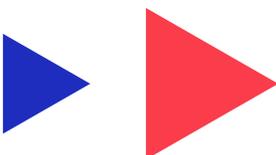
▶ 9. Relevant regulatory or policy frameworks in relation to digitalization and education

9.1 Status of legislation

This section highlights some of the key national legislative instruments that relate to regulation of the use of ICT and digitalization in education in Kenya.

▶ The Cyber Security and Protection Bill, 2016, provides for increased security in cyberspace and the prohibition of certain acts in the use of computers. Other closely related legislation includes the Computer and Cybercrimes Bill, 2017, and the Computer Misuse and Cybercrimes Act, 2018, which provide a framework for prosecuting cybercrime in Kenya. Another relevant bill is the Data Protection Bill, 2018, which provides for the protection of personal data. These legislative instruments can assist with data collection and management as well as security and protection in the integration of ICT in schools.

▶ The Science, Technology and Innovation Act No. 28 of 2013 provides the legal framework upon which the initiation and management of information technology in all sectors is governed. The aim of the act, according to the National Education Sector Strategic Plan, 2018–2022, is "to facilitate the promotion, co-ordination and regulation of the progress of science, technology and innovation of the country; to assign priority to the development of science, technology and innovation; and to entrench science, technology and innovation in the national production system" (Government of Kenya 2018a, 14).

▶ The Information Communication Technology Practitioners Bill, 2016, provides for the establishment of an ICT Practitioners Institute and a Council to govern it, as well as registration and licensing of ICT practitioners.

9.2 Status of relevant policies

Kenya's Ministry of Information, Communication and Technology is responsible for all matters related to communication, including formulating and implementing government policies related to communication and the internet, such as the 2006 National ICT Policy, revised in 2019. It works towards achieving a knowledge-based society for which education plays a key role. The National ICT Policy and e-Government Strategy provide guidelines for transforming Kenya into a digital society. The government "will make education a platform for equipping the nation with ICT skills in order to create dynamic and sustainable economic growth" (Mariga et al. 2017, 4–5).

The National ICT Policy was formulated in 2006 with the aim of improving the livelihoods of Kenyans by ensuring the availability of accessible, efficient, reliable and affordable ICT services. Several reviews have taken place since 2006. The National ICT Policy, 2019, was "necessitated by the rapid changes and developments since 2006 in order to keep abreast with development of emerging technologies" (Government of Kenya 2019b, 9).

Prior to 2006, Kenya did not have a well-established ICT policy to drive the educational agenda on digitalization. In a review of pathways towards digitalization in education, the authors observed that "the existing education policy on ICT is imbedded in three documents, namely: e-Government Strategy, National ICT Policy and Sessional Paper No. 1 of 2005 which is a Policy Framework for Education, Training and Research. There is a need therefore to consolidate these documents into one" (Mariga et al. 2017, 1). A consolidated document would provide a concrete foundation for digitalization in education.

The Kenya Vision 2030 is the country's development blueprint for the period 2008–2030. It is the master plan upon which the country's national development strategy rests (Government of Kenya 2007). The Kenya Vision 2030 is anchored by three main pillars: economic, social and political. The education and training sector is one of the eight key elements of the social pillar. Its goals include to raise the quality and relevance

of education and to expand access to university education, with an emphasis on science and technology courses. The strategy aims to modernize teacher training by revising the curriculum for university and technical institutes to include elements of ICT. The Kenya Vision 2030 indicates that policies in all the pillars should be founded on all-round adoption of science, technology and innovation as an implementation tool (Government of Kenya, 2007, 11). The government has sought to create a science, technology and innovation policy framework to support Vision 2030.

The government, through the Ministry of Education, Science and Technology, commits to engage in policy and legal reforms to enhance the effectiveness of education and training. The Education Sector Report 2016 addresses this commitment through the strategic objective to "formulate, review and implement appropriate policies, legal and institutional frameworks for the sector" (Government of Kenya 2016, 13). The following are identified as requiring reform: the National ICT Strategy for Education and Training; the national policy framework on capacity-building in the ICT sector; the teacher utilization and deployment policy; and the NEMIS policy for education (Government of Kenya 2018b). This also includes the Teachers Service Commission Act, 2012. In light of changes in the education sector, the government is also considering adoption of a policy on open and distance learning approaches across all levels of education (Government of Kenya 2019a).

9.3 Status of social dialogue mechanisms

In Kenya, teachers' unions have made considerable efforts to engage employers in improving teachers' welfare. The 2016 Collective Bargaining Agreement (No. 297), signed on 20 November 2016 between TSC and KNUT, committed both parties to developing a system of communication and consultation designed for harmonious industrial relations. Previously, an acrimonious relationship between the TSC and KNUT had contributed to industrial action on several occasions. KNUT has been more active than KUPPET in lobbying the Government of Kenya for salary increments for teachers. On many occasions strikes have been called off, without teachers gaining the salary increments that had earlier been negotiated and agreed upon with the government. Some disputes have ended up in the Industrial Court of Kenya, where the unions have been forced to call off strikes and renegotiate with the government. The Collective Bargaining Agreement, which commenced on 1 July 2017 and will remain in force until 30 June 2021, includes provisions related to base and maximum salary levels, a range of allowances (for example, for commuting), leave, housing, hardship, travel and medical benefits.
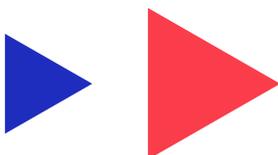
▶ 10. Support frameworks for teachers

In order to support the efforts for ICT integration into teaching and learning processes, the Ministry of Education, Science and Technology has initiated in-service programmes at various levels to meet teachers' ICT needs. Under the Digital Literacy Programme, which aims to build and enhance the capacity of teachers to deliver digital learning to students, a training module has been put in place for teachers in public primary schools. In the initial stages, three teachers per school were targeted to benefit from the training. The programme is being continuously reviewed and improved.

The Ministry of Education, Science and Technology also conducted the Kenya Primary Education Development Project, 2015–2018, which was sponsored by GPE and supervised by the World Bank. The project made significant progress in supporting teacher professional development initiatives. This was achieved through improved in-service training for early grade mathematics instruction and through regular pedagogical supervision and support (Government of Kenya 2017b, 2019c). In 2016, the TSC developed the teacher performance appraisal and development tool as part of the Primary Education Development Project. The tool focuses on strengthening school systems and governance. Managed by the TSC, the tool is used to monitor teachers' attendance, syllabus coverage, classroom performance, professional knowledge, innovation and creativity and engagement with parents, among other things. The TSC also intends to digitize all its records, numbering approximately 700,000 files. It also plans to "upgrade its current electronic management system ... to a more scalable system that will cope with the increased demand for document processing needs arising from the decentralization of functions" (Government of Kenya 2016, 38) This will facilitate data uploading and improve access to information for teachers and education stakeholders.

Furthermore, the report of the National Education Sector Strategic Plan, 2018–2022, states that the government, in its future teacher education reforms, plans to develop clear guidelines that link teacher professional development to predictable pathways for training and career progression. This would be achieved by reviewing teacher performance appraisal and development to respond to emerging issues and to make effective use of data in teacher performance rating (Government of Kenya 2018a).
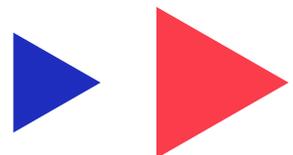
▶ 11. Analysis of positive contributions and challenges

The achievements captured in the aforementioned study provide an indication of the importance of ICT implementation in the education sector. Through the utilization of the TMIS, "improvement was realized in the use of online services, such as online registration, application for promotion, tracking of interview process, access of payslips and automation of third party deductions. The Commission has also enhanced interconnectivity through internet and intranet as a crucial input to the realization of Vision 2030 goals" (Government of Kenya 2016, 37). By 2015/16, there was improved ICT competency amongst practitioners, with 22,000 teachers, 2,705 master teacher trainers and 62,784 education officers trained in ICT use. The Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA), a resource centre mandated to build the capacity of mathematics and science teachers for effective classroom practices, was also successfully implemented in Kenya.

Governance in secondary schools was enhanced through management training held at the Kenya Education Management Institute, where 1,776 principals were trained for ICT integration in education management through the Ministry of Education, Science and Technology. In addition, all secondary school principals have been trained on pedagogical leadership through various workshops. At TVET level, to improve managerial capacities, 910 managers received training in various fields, including financial management, procurement and ICT integration (Government of Kenya 2016).

At various levels of learning, the development and pedagogical utilization of online content has been achieved. First, through the Kenya Institute of Curriculum Development, access to education has been enhanced via a broadcasting channel through which a number of educational programmes are delivered (2,700 radio and 150 television programmes). In addition, with intensified ICT integration into teaching and learning, there is greater diversity in access to educational materials. In a number of subjects, content has been digitized, and the resulting material is being used in learning institutions.

Further, through ICT integration initiatives at TVET level, a draft ICT curriculum has been developed and is awaiting validation. Forty TVET institutions have been connected to the internet through the fibre optic cable, and a training workshop was convened to sensitize teachers on the application of ICT to teaching, learning and management (Government of Kenya 2016, 25).

The youth polytechnics were moved to the Directorate of Youth Training under the Ministry of Youth Affairs and Sports in 2007, but that mandate was reassigned to the Ministry of Education, Science and Technology under Executive Order No. 2/2013. The Ministry of Education, Science and Technology consequently developed a training policy for youth polytechnics under which 150 youth polytechnics were supplied with computers; ICT guidelines were developed; 381 establishments integrated ICT in their programmes; the Youth Polytechnics Management Application System was developed and disseminated; and 200 youth polytechnic instructors were sensitized on how to use the system (Government of Kenya 2016).

In efforts to equip various government education officers with ICT-related equipment and facilities, an increased number of offices in the 47 counties were allocated assorted computer hardware and access to computer accessories for maintenance and support services. Printers, however, were not provided due to a lack of funding. In order to enhance the capacity of ICT technicians, eight technical institutions started offering Cisco Networking Academy programmes aimed at providing trainees with industry-valued certification in skills to repair and maintain computers (Government of Kenya 2016). At TVET level, under a six-year project commencing in July 2010, 200 trainers were trained in the use and maintenance of computer equipment in Kenya, while another 105 trainers were trained in China and the Netherlands (Government of Kenya 2016).

Despite the achievements of the Second Medium Term Plan, 2013-2017, significant challenges were encountered in its implementation, which need to be addressed during implementation of the Third Medium Term Plan. These include inadequate funding; high cost of ICT equipment and infrastructure; inadequate and dilapidated infrastructure; and weak data management (Government of Kenya 2018b). In addition to

these challenges, a recent report has noted the following challenges in the integration of ICT in education and training (Government of Kenya 2019a, 129–130):

▶ inadequate ICT equipment;

▶ lack of or poor internet connectivity;

▶ inadequate ICT integration capacity among educators;

▶ inadequate online safety and security of learners;

▶ inadequate or outdated digital content;

▶ high maintenance costs of ICT;

▶ lack of parental and community involvement in ICT matters;

▶ negative attitude towards technology;

▶ too much focus on examinations as opposed to competence attainment in the education system;

▶ weak governance in the area of ICT in education.

The driving force behind any initiative is the implementation process embedded within well established legislative provisions and developed policy frameworks. Implementation processes must be specific and systematic, with clear evaluation and monitoring strategies that can provide data and indicators for improved ICT integration and services countrywide. The data can also be used to amend and develop ICT-related legislation and policy frameworks that are contextually determined and driven. In this respect, the Government of Kenya has to make greater efforts in developing and establishing policy frameworks and employ more diligence in implementing processes related to ICT utilization in all government institutions and sectors, including education.
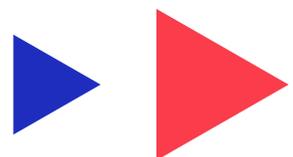
▶ 12. Conclusion

Despite the initiatives undertaken to develop digital infrastructure, especially at primary school level, much still needs to be done to achieve this objective. The infrastructure needs to be improved, the development of digital content fast-tracked, capacity-building of teachers enhanced and investment in ICT-related devices scaled up. The government agenda on the integration of ICT in education is still very fragmented because it is articulated in a large number of policies that require harmonization for effective implementation. The Ministry of Education, Science and Technology has received support from international organizations for the in-service training of teachers. However, there is a need to synchronize this training to ensure that it is developmental and that the competencies acquired by teachers go beyond the basics. Best practices and experiences from other African countries can provide knowledge to help Kenya further the digitalization of the education sector and mitigate implementation challenges.

The development of an ICT policy and its further revision in 2019, and contracting universities to set up local plants to assemble digital devices, are indicative of steps in the right direction. This has facilitated education technology companies to build new models for students to learn through mobile phones, tablets and applications with digital content, and through gamified learning. To some extent, personalized learning driven by artificial intelligence has been made possible. In effect, accessibility to education at low cost and at a substantial scale has been increased. Digitalization of the education sector has enhanced teaching and learning, as reported by teachers involved with the Digital Literacy Programme. There has been increased student alertness, boosted attendance and an overall increase in student admission.

The integration of ICT in teaching and learning has fallen short due to infrastructural and teacher competency-related issues. Though tablets and mobile devices pre-programmed with interactive educational materials for students have been distributed in some schools, the inadequacy of ICT skills of many teachers limits their usage. Lack of internet connectivity and power supply in some regions has remained a challenge to nationwide integration of ICT in teaching and learning. In addition, the variation in awareness of ICT between rural and urban populations is an obstacle to nationwide adoption of ICT in teaching and learning.

Digitalization of the education sector has the potential to generate a number of opportunities. For instance, the Digital Literacy Programme created 11,000 employment opportunities in ICT support centres, local laptop assembly plants and digital education content development. This figure is likely to grow with progressive roll-out of ICT projects in the education sector, attracting investors in related ventures. Teaching and learning from home becomes more of a reality with digitalization of the education sector. To realize this potential, investments in infrastructure and teacher development need to be made.
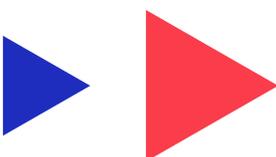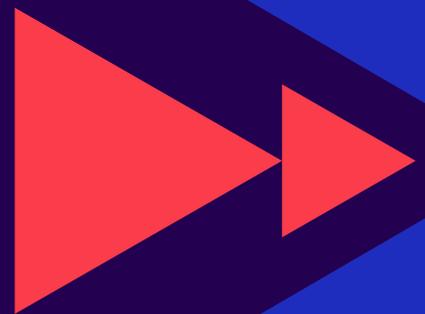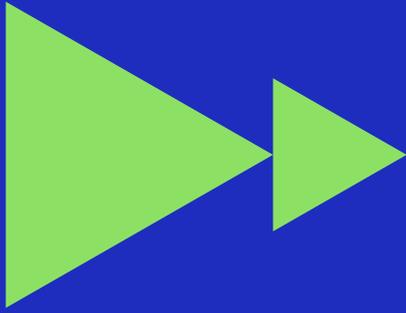
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