Feasibility Study to Connect All African Higher Education Institutions to High-Speed Internet

Report 3:

High-level Strategy to Leverage the Campus Connectivity to Achieve Learning Outcomes in Higher Education

DIGITAL DEVELOPMENT PARTNERSHIP

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Abbreviations

Term	Description
AAU	Association of African Universities
AUC	African Union Commission
CENIC	Corporation for Education Network Initiative in California
DE4A	Digital Economy for Africa
DEA	Direct Engineering Assistance
HEI	High Education Institution
ICDL	International Computer Driving Licence
ICT	Information and Communications Technology
INASP	International Network for Availability of Scientific Publication
ISOC	Internet Society
IXP	Internet Exchange Point
KCL	Knowledge Consulting Ltd
MDAs	Ministries, Departments and Agencies of Government
MOOC	Massive Open Online Course
NAT	Network Address Translation
NOC	Network Operations Centre
NREN	National Research and Education Network
NSRC	Network Startup Resource Center
PHEA	Partnerships for Higher Education in Africa
RREN	Regional Research and Education Network
SDG	Sustainable Development Goal
SPOC	Small Private Open Courses
Tbps	Terabits per second
TVET	Technical and Vocational Education and Training
UNESCO	United Nations Education Scientific and Cultural Organization
WBG	World Bank Group
Wi-Fi	Local area wireless computer networking technology

Acknowledgements

The report was prepared by a team led by Samia Melhem (Lead Digital Development Specialist) and Tim Kelly (Lead Digital Development Specialist) and comprising: Lucine Munkyung Park (Digital Development ET Consultant), Charles Hurpy (Senior Digital Development Specialist) and Sajitha Bashir (Adviser, Office of the Global Director for Education). Knowledge Consulting Limited (KCL) provided advice, analysis, and drafting support, with special acknowledgement to Francis F. Tusubira (Managing Partner, KCL) who led the team which comprised Lishan Adam, Ali Ndiwalana, Jules Degila, and Fekadu Mulugeta.

The team benefited from the overall guidance provided by Boutheina Guermazi (Global Director, Digital Development), Mark Williams (Practice Manager for Global Knowledge and Expertise, Digital Development), Michel Rogy (Practice Manager for Western and Central Africa and the Middle East, Digital Development), and Isabel Neto (Practice Manager for Eastern and Southern Africa, Digital Development). The team is grateful to peer reviewers – Alex Twinomugisha (Senior Education Specialist) from the Education Global Practice, and from Tounwende Alain Sawadogo (Senior Digital Development Specialist), Xavier Stephane Decoster (Senior Digital Development Specialist), Wilson Muyenzi (Digital Development ET Consultant), and Casey Torgusson (Senior Digital Development Specialist) from the Digital Development Global Practice of the World Bank – for their insightful comments and inputs. The team would also like to thank additional guidance and contributions provided by Javed I. Khan (Consultant) and Ekua Nuama Bentil (Education Specialist).

Lastly, this report could not have been produced without financial support from the members of the Digital Development Partnership (DDP), a Trust Fund administered by the WBG. The DDP offers a platform for digital innovation and development financing, bringing public and private sector partners together to advance digital solutions and drive digital transformation in developing countries, see: https://www.worldbank.org/en/programs/digital-development-partnership.

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1. Introduction

The African higher education sector comprising public and private universities, colleges, technical training institutes, and vocational schools[1] plays a critical role in training a skilled workforce, conducting research, and building the knowledge base and the human capital necessary for the countries' transition to digital economies. Digital technologies provide opportunities for addressing the challenges facing higher education—the growing demand for higher education, falling quality, the mismatch between education and employability, and the disconnect between research and development challenges. However, higher education institutions do not have access to affordable and functional quality high speed internet connectivity which is both a critical link and an essential enabler. This negatively affects national education goals and targets as enshrined in the Sustainable Development Goals (SDGs) and various country specific Development Plans.

As part of the Digital Economy for Africa (DE4A[2]) initiative, the World Bank commissioned a feasibility study to develop an operational roadmap to connect all African HEIs to high-speed Internet. The initiative, in support of the African Union Digital Transformation Strategy for Africa (2020-2030)[3], aims to digitally enable every African individual, business, and government by 2030. Connecting universities and research institutions is crucial for expanding the opportunities for teaching, learning and innovation to foster relevant digital skills on the continent. This study has received funding from the Digital Development Partnership (DDP)[4].

This feasibility study, which has received funding from the Digital Development Partnership (DDP),[5] was aimed at establishing a roadmap for connecting all African higher education institutions (HEIs), and other closely related institutions, to high-speed Internet, and estimating the costs based on different options. This was achieved through three sub-objectives:

i. Production of a gap-analysis report addressing the connectivity, ecosystem challenges (policy, regulation, institutions, human capacity, etc.), and funding.

ii. Development of cost estimates.

iii. Development of a high-level strategy to leverage the campus connectivity to achieve learning outcomes in higher education.

1 *The study uses the term Higher Education, also known as Tertiary Education in some countries, to refer to all post-secondary education, including both public and private universities, colleges, technical training institutes, and vocational schools https://www.worldbank.org/en/topic/tertiaryeducation.*

2 *See https://www.worldbank.org/en/programs/all-africa-digital-transformation.*

3 *https://au.int/en/documents/20200518/digital-transformation-strategy-africa-2020-2030.*

4 *https://www.worldbank.org/en/programs/digital-development-partnership.*

5 *https://www.worldbank.org/en/programs/digital-development-partnership.*

This Report addresses the second task: *Development of a high-level strategy to leverage the campus connectivity to achieve learning outcomes in higher education.*

While getting connected to the Internet is crucial, it requires a much broader effort to shift teaching practices to approaches that enhance students' learning ability to meet the new demands of the job market. Learning requires students that are ready to learn, effective teaching that is supported by inputs like digital technologies and skilled higher education management that pull everything together.[6]

There is no shortage of policy papers and publications related to the major gaps between what is taught in HEIs in Africa, and what the employment sector needs as graduate skills. There is similarly an abundance of literature about how the integration of Information and Communication Technology (ICT) in learning, and ICT-enabled shifts in both pedagogy and assessment can help in reducing the gap. Despite all this and related strategy proposals over the last fifteen to twenty years, the gap has been barely dented. While curriculum, pedagogy, and assessment are key elements of the solution, the focus here is therefore on the key ICT-related impediments to the integration of technology into learning and research, and recommending a roadmap for addressing them.

The integration of technology in higher education to enable better learning outcomes, academic excellence, foster research and innovation, and achieve greater operational efficiency needs to be accompanied by a digital **technology** integration **vision**, policies and strategies, change of **processes,** and a shift of the mindsets of **people**—e.g., students and staff. Technology is of little value if staff do not use it or do not have access to staff development aimed at building their proficiencies in how to integrate it in teaching and learning in the classroom and beyond. A well-staffed corporate ICT department, with highly skilled engineers and user support team is as critical as the presence of technology-savvy teachers and administrators that facilitate students' success in digital technology-enriched learning environments. The heads of the higher education institutions must lead the way in the integration of digital technologies in the instructional, research, and administrative realms.

6 *World Bank, World Development Report 2018 (WDR 2018)—LEARNING to Realize Education's Promise, https://www.worldbank.org/en/publication/wdr2018#*

2. Key Impediments and Recommended Interventions

Outside pedagogy, curriculum, and assessment, there are several well-known and top impediments to the integration of ICT in support of learning, research and effective administration in higher education institutions. While some challenges are "technology" related, the "people" and "processes" impediments (see Figure 1) are the most outstanding.

i. Absence of, or deficient ICT policies and strategies

ii. Limited ICT awareness and ICT literacy among student and staff

iii. Limited competence of campus ICT personnel

iv. Poor quality of campus networks

v. Poor digital learning spaces

vi. Limitations in resource allocation and coordination

vii. Limited individual access

viii. Limited digital learning resources

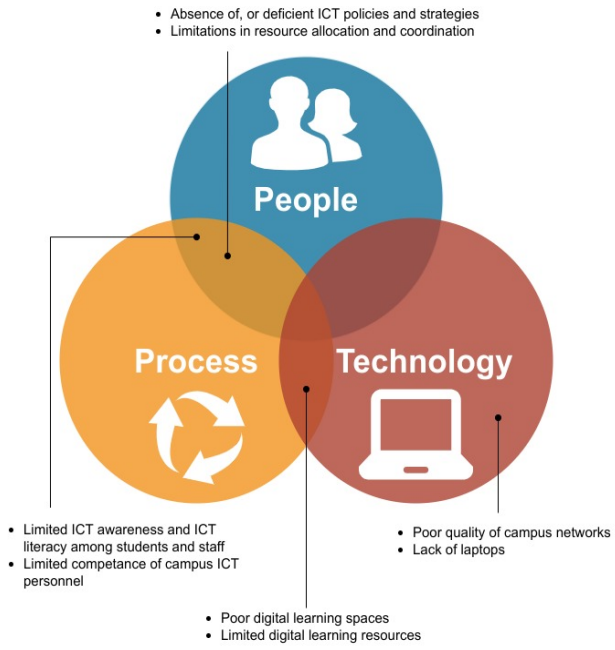

Figure 1: People, processes, and technology

All these have to be addressed if the opportunities of high speed connectivity are to be exploited for improved learning and research outcomes.

2.1 Deficient ICT Policy and Strategy[7]

A major challenge in many HEIs is the absence of, or deficiencies in the policies that provide for the strategic vision and plan for application of ICT in learning, research and administrative effectiveness, often because ICT is considered as a technology add-on to other policies, rather than a priority strategic intervention. A good institutional ICT policy should:

i. Define the why and objectives of ICT with respect to the HEI's mission of learning, research, and community outreach, which must also be supported by administrative effectiveness. The policy and strategy should be guided by the strategic priorities of the institution.

ii. Define the institutional positioning and organisational arrangements related to ICT in all aspects of the HEI activities. It is particularly important to note that the direction of ICT in the organisation is:

    a) Guided by the aspirations of the business units (learning, research, library, management, and administration), not by ICT personnel.

    b) Requires consensus among stakeholders to minimise the likelihood of system failure even when technical success is achieved.

iii. Define high-level priorities for the key information systems and corporate databases, infrastructure policy, security policy, and acceptable use policy. All these would be expanded into planning and operational documents at the implementation level.

iv. Address burning issues such as foundational and capability gaps.

v. Define the ICT management, control, and maintenance unit, ensuring that it reports to the top level of the HEI as its role is cross-cutting. The recognition that the HEI competes with the local private sector for expert ICT personnel, and that they (HEIs) need competent personnel to design, operate, and maintain advanced infrastructure and systems, should guide on decisions related to positioning, salaries and training of such experts.

vi. Provide an implementation Master Plan and Budget that guides prioritisation and integration in the HEI expenditure plans.

vii. Provides for annual review and adaptability in recognition of the rapid evolution of opportunities created by technology.

7 *See e.g., Tusubira, F.F.; Mulira, Nora (2005). Integration of ICT in organisations: challenges and best practice recommendations based on the experience of Makerere University and other organisations. in F.F. Tusubira and Nora K. Mulira (eds) Universities: taking a leading role in ICT enabled human development. Kampala: Phanton Solutions. pp.6-13, http://ahero.uwc.ac.za/index.php?module=cshe&action=viewtitle&id=cshe_426*

2.2 Limited ICT Awareness and ICT Literacy among Faculty

In HEIs, faculty are always part of any key decision. While the younger faculty are largely ICT-literate, the decision levels are still dominated by the older generation who went through their schooling to post-graduate level without experiencing ICT-enabled learning and research environments. This drives appreciation down, fuels resistance and impedes key decisions around ICT that would lead to major changes in all aspects of achieving the HEI mission. While many senior faculty members do have the basic ICT user-skills, such skills are far below the levels required for full time online learning design and delivery: and this creates a self-compounding challenge.

In-depth country studies[8] in Burkina Faso, Côte d'Ivoire, Mozambique and Uganda indicate that one of the most significant challenges in leveraging campus networks for learning is training or upgrading the skills of staff in applying technology to their work. Understanding the pedagogy, and making the transition from the talking-head to participatory forms of learning is time-intensive for faculty: combined with limited technology-savvy and the compounding factors caused by massification, this creates one of the major barriers to reform. Across higher education, the improvement of faculty skills in the latest tools and technologies and ability in leveraging digital tools to conduct teaching, assessment and research should therefore be given a high priority.

The shortage of skills is often acute in the computer sciences and other ICT intensive fields. Digital skills are inherently practical, and staff who can teach by example and understand business applications for these skills can ensure their relevance to market needs.

It is particularly important to develop and follow comprehensive change management strategies to bring faculty on board in both formulating ICT policy and strategy, and leading their own individual transformation.

2.3 Limited competence of campus ICT personnel

The development of campus ICT environment depends mainly on the availability of skills and resources. One of the biggest challenges to HEIs in Africa with respect to hiring, developing, and retaining competent ICT human resource is direct competition with the rapidly growing ICT private sector. Ensuring adequate staffing capacity and staff retention in the face of retirements, growing external competition, rising salaries, and the demands of technology initiatives and innovation on both IT and non-IT staff is a major challenge. Except for very large and well-endowed institutions, HEIs cannot hope to compete sustainably with the private sector for human resource, and will need to adopt different approaches that include:

i. Leveraging the continuous flow of engineering and other ICT students on campuses:

8 *Refer to Country Case Study Reports that are Annexes to Report 3 (Cost Estimates)*

these always look for practical training opportunities as part of their courses, are innovative, and offer free services in exchange for training. They are also able to work as interns at modest costs. This "no-retention" model was adopted by, for example, by Makerere University during the 2002 – 2010 period where it worked very well.

ii. Sharing a pool of professionals, so that cost is distributed among different institutions and/or outsourcing services where it is more cost-effective to do that than having full-time staff in particular disciplines. The Corporation for Education Network Initiatives in California (CENIC), for example, is very well funded, but they have a part-time security expert.

The ICT staff needs identifiable and desirable career paths and ongoing training and opportunities for experimentation and the development of new services or technologies. Just like faculty need to understand and appreciate the importance of, and how to use ICT in learning, research, administration, and management, it is critical for ICT personnel to understand and appreciate the importance of letting business owners lead in defining functionality. ICT personnel particularly need to understand enough about learning, research, library services, administration and other campus business processes, to provide support that is empathetic and relevant. The empty knowledge valley between ICT personnel and business process owners is a major cause of misunderstanding and system failure in integrating ICT in organisations.

2.4 Poor Quality of Campus Networks

A campus network represents an important building block for driving learning, because it provides the primary and essential connectivity point to the Internet and global education resources (see Box I). An assessment by the Network Start-up Resource Centre (NSRC) and the International Network for Availability of Scientific Publication (INASP) indicates[9] that most of the campuses in the African higher education institutions suffer from poor design and fragmented institutional management, with campus ICT services often considered non-critical to the institutions—which leads to lack of funding. Large institutions that have more than one campus also face challenges of interconnecting different remote campuses together.

9 *INASP, Improving ICT Infrastructure to Ensure Better Access to Research, https://www.inasp.info/sites/default/files/2018-04/nren_lri_details_web__04_15.pdf*

Box I: A Right Campus Network Environment

i. Delivers effective and efficient computing and communications infrastructure, services, and support teaching and learning, research, public service, and administrative programs of the higher education institution,
ii. Provides ubiquitous campus connectivity using a choice of wireless and wired technologies to offices, classrooms, laboratories, libraries, dormitories and to student' and active staff areas including cafeterias,
iii. Makes provision for remote access (using for example Eduroam) when students must be off-campus (e.g., non-resident students, external halls of residence, and during recess periods),
iv. Leverages standard technologies and processes, and work to eliminate duplicate processes and technologies,
v. Equipped with the appropriate management structure of staffing, budget, control and security,
vi. Furnished with appropriate plan and resources for continual growth and maintenance,
vii. Leverages new and emerging technology trends,
viii. Promotes technical and non-technical skills and growth for staff and the wider community,
ix. Ensure safety, security and privacy through a well-developed Acceptable Use Policy.

The poor design does not only affect performance but also exacerbates network security issues. Most networks use outdated wiring and switches/repeaters, as well as Network Address Translation (NAT) and firewalls to hide devices behind one public IP address. Although NAT remains useful in conserving IP address space, it prevents researchers from propagating services and network addresses across the Internet.

The GÉANT Association has, through the AfricaConnect projects and working with the Internet Society (ISOC) and NSRC, funded a lot of the Direct Engineering Assistance (DEA – See Box II) in design of campus networks across Africa, bringing out the importance of ongoing technical support and training in the latest campus network design techniques. Further, drawing on the European Experience, there is a need for national initiatives that facilitate the sharing of experience on campus networking design and technology environments. Such initiatives should allow higher education institutions to organise workshops to share campus network experiences, set up working groups around design, infrastructure, mobility, security, identity management, etc. issues, coordinate purchase of network equipment to benefit from economies of scale and develop shared national campus best practices repository.[10]

10 *GEÁNT, Campus Best Practices, https://services.geant.net/sites/cbp/Knowledge_Base/Reports/Documents/geant-campus-best-practices.pdf*

Box II: NSRC Experience in Direct Engineering Assistance and Training for Campus Network Design Best Practice

The Network Resource Support Centre (NSRC) of the University of Oregon has been providing Direct Engineering Assistance (DEA) and training in campus network design and other aspects of networks to higher education institutions in developing countries. The focus of DEA programs include assistance with network design and operations to solve identified problems at a campus network, within the infrastructure of a country's NREN, its Network Operations Centre (NOC), operation of Internet Exchange Point (IXP), or improving operations of a ccTLD registry for a specific country, such as the implementation of DNSSEC. The DEA model encourages local engineers to implement the recommended changes themselves, working hand in hand with NSRC staff.

The campus network design training workshop involves lecture and hands-on lab work to teach the skills needed to design, build, operate and manage a tertiary education institution's campus network infrastructure according to current best practices.

Source: https://sisu.ut.ee/skytteinternship/futureskills2025

Infrastructure is another important aspect that determines the quality of campus networks. Putting campus connectivity infrastructure such as cable, copper and fibre optics in place presents a significant challenge, because most of the buildings in higher education in the continent were designed for the traditional teaching and learning environment. Alteration of these buildings is often complicated—and in some cases, the presence of asbestos makes this hazardous for IT experts in wiring the building.

2.5 Resource Allocation and Coordination

Resource constraints, including the funding of higher education institutions, are challenges to the under-resourced campus networks. This is compounded where senior management and faculty are not familiar with the importance of well-resourced, well-designed and functioning campus networks to achievement of organisational objectives. Lack of funding, including the reluctance of faculties/departments to invest in upgraded equipment and networks, is cited as a limitation for upgrading campus networks across higher education institutions.

Most universities, colleges and TVETs have small and fragmented ICT support departments. Consequently, there is limited coordination in providing resources and centralising design and implementation of the different information systems, often with some departments acquiring donated equipment that may not be compatible with existing infrastructure, systems, and applications, leading to disputes between departments and central IT management.

Resource allocation and coordination challenges will need to be addressed through the ICT Policy and Strategy, and change management.

2.6 Digitally-enriched Learning Spaces

Digital and physical learning space is increasingly becoming an important aspect of student-centred learning. Higher education spaces are typically designed for traditional teaching methods, and therefore need to be upgraded to meet the growing blended learning requirement. African higher education needs to develop and adapt their physical learning space to facilitate integration of technology into the classroom, campus, and residences, and also to ensure that virtual learning space is safe.

The Ministries of Higher Education and those responsible for infrastructure need to develop new building codes that help create modern institutions with blended learning. The physical and architectural design of new educational institutions should take the need for interactive classrooms and digital-enabled learning into consideration (see Box III).

Box III: Design Principles of Digital Learning Space

i. Learning space should provide comfort. Furniture and floor surfaces should be chosen to attract users and foster collaborative learning.
ii. Design should maximize student access to and use/ownership of the learning environment. Student-centred learning requires a mix of formal and informal spaces. Users should be able to self-organise and make a claim over the spaces throughout the day, with movable chairs and tables.
iii. Design needs to bring technologies into space rather than built into space.
iv. Design needs to provide for remote participation.
v. Design should consider natural light to enhance the attractiveness and usability of space.

To ensure the safety of the virtual environment, universities and TVETs need to develop risk-based security strategies that keep pace with security threats and challenges and ensure adherence to technology acceptable use policies by students and staff. This will increase safe learning and caring in increasingly digital environment.

2.7 Limited Individual Ownership of Laptops

One of major challenges to access occurs especially at the student level. This has two dimensions:

i. **Limited or no ICT-literacy**—unfortunately, a combination of poverty and school systems where ICT-literacy is not addressed as a key area of learning means that a major section of the student population needs remedial intervention as a first year requirement. Some HEIs have instituted remedial learning, for example based on the

International Computer Driving Licence (ICDL)[11] structure or other, but the success of this is constrained by the second dimension;

ii. **Limited access to computers**—which compounds the challenge for those from poor family backgrounds. Modern learning requires more than just occasional access; and as discussed in a parallel Report[12] to this one, the approach of large computer labs has had major short-comings, especially consistent failure in sustaining the labs.

It is evident that programmes to ensure access to owned computers[13] must be part of the interventions aimed at addressing the remaining ICT-related challenges.

2.8 Limited Digital Learning Resources

Related to limited skills among staff is the shortage of digital learning resources. While there is a growing trend towards Massive Open Online Course (MOOCs) and Small Private Open Courses (SPOCs), efforts to develop African MOOCs or SPOCs are yet to catch on.[14,15] The MOOCs space is currently dominated by the big four—Coursera, edX, Futurelearn and Udacity, but the proportion of African students signing up for these is expected to be low, particularly if studying for certificates, because individual students must meet their own costs. While efforts have started,[16,17] these are still limited to South Africa[18] and Northern African countries like Egypt, Morocco and Tunisia.

The development of Study Webs of Active Learning for Young Aspiring Minds' (SWAYAM) in India provides a great example of how such a MOOC can be launched and maintained with access, equity and quality in mind. SWAYAM is an initiative of the Ministry of Human Resource Development (MHRD), the All India Council for Technical Education (AICTE), and the Government of India to provide an integral teaching learning platform in online mode.[19] SWAYAM shows the need for extensive coordination among different institutions in the preparation of the content, assessment, accreditation and quality control. Typical online courses involve the development of the syllabi, identification of content writers, enriching the content with multimedia supplements (e.g., images, animations, hand drawings, maps, graphs etc.), adding case studies, documentary, clear audio and video, as well as ensuring that the materials adhere to optimal curriculum and copyright requirements. The content should be evaluated and certified before it is widely available.

A well-developed online education system at higher education and national and regional MOOCs can accelerate the uptake of online education—a less than 1% online education uptake in Africa now can jump to at least 5% by 2030. Online education is dependent on the

11 *https://icdlafrica.org*
12 *Refer to Report 1: Connectivity Gap Analysis and Review of Existing Programme*
13 *Refer to Report 3: Cost Estimates for Connecting All African HEIs*
14 *MOOCs in Africa, https://blogs.worldbank.org/edutech/moocs-in-africa*
15 *https://en.unesco.org/news/unesco-supports-open-moocs-africa*
16 *https://trueafrica.co/lists/e-learning-platforms-africa-tutor-ng-mest-school-education-startups/*
17 *https://www.atingi.org/en/tool*
18 *https://www.news.uct.ac.za/article/-2020-04-29-massive-uptake-in-mooc-participation*
19 *Majumder, C., 2019. SWAYAM: The Dream Initiative of India and its uses in Education.*

availability of robust Internet connection across the country, underscoring the importance of meeting connectivity targets and extending connectivity beyond the confines of higher education institutions.

3. Strategy and Roadmap for Change

Change at the infrastructure/technology level is easy, but the changes required will not be sustainable unless they are accompanied by changes in people and processes. Interventions should also be carried out at the regional, national and institutional levels.

3.1 Recommended Strategic Interventions

The following recommended strategic interventions provide the framework under which detailed activities would be undertaken:

i. Establishing and sustaining regional partnerships with other agencies and organisations that are interested and active in digital technologies for improving learning outcomes and employability in Africa;

ii. Identifying leadership and catalysing the formation of national level coalitions that will be responsible for spearheading change in integration of technology in higher education;

iii. Guiding national and institutional level approaches through toolkits; and

iv. Support for specific quick-win demonstration projects.

These are expanded on in the following sections.

3.1.1 Establishing and Sustaining Partnerships

The success of the recommended interventions will require significant funding as well as expertise in the relevant areas of improvement or transformation. Partnerships will bring together key agencies and organisations that bring on board:

i. Funding (for example European Union Commission, African Development Bank, bilateral and multilateral development agencies, private charities, private sector, NGOs, and the ICT industry both within and outside Africa);

ii. Policy leadership (for example the African Union, the Association of African Universities, regional groupings of universities in the different regional communities, RRENs and NRENs); and

iii. Expertise (for example communities of practice, learning associations, RRENs and NRENs, NSRC, ISOC).

The partnerships create a resource that can work together to create synergy and generate

push for integration of ICT in higher education in the region. The Partnership for Higher Education in Africa[20] (PHEA), which brought together seven private foundations for 10 years (2000 – 2010) could be examined for experiential lessons about working towards a common goal through joint funding. While it might be harder for public funders to do the same, an integrated intervention plan would create the required synergy.

Regional partnership is important to:

i. Achieve common understanding of the scale of the challenge, resources requirement and funding by different organisations,

ii. Create synergies, common approaches and mutual learning in higher education connectivity,

iii. Conduct ongoing research and analysis so that learning and adaptation are integrated into the implementation.

3.1.2 Formation of National Level Leadership and Coalitions

Policy is vested in the ministries responsible for higher education, and that is a necessary starting point for establishing national leadership. The ministry will, in most cases, have direct control of policy for TVETs, but will not have direct control among universities. The coalition should include the ministries responsible for ICT, science, and industry; associations of Vice-Chancellors, Presidents, and Rectors; the national bodies responsible for HEI quality, standards, and accreditation; HEI academic and business leaders and ICT directors; the NREN; the ICT service providers; and professional associations.

The formation of such coalitions should be followed by a dialogue among these players at national level on integration of technology in education. A nationwide higher education ICT integration master plan that is sponsored by the relevant ministry can be a starting point for such discussion. The plan could, among others, outline strategies and steps to upgrade campus networks, improve access to devices by students and staff, enhance the development and exchange of learning content, promote digital skills of staff across the country, and provide approaches to funding and sustainability.

3.1.3 Guiding National and Institutional Level Approaches for ICT Integration in education

Many key changes required to deal with the ICT-related gaps are not context specific, and can therefore be guided by toolkits that provide menus of choices and also point to resources. Toolkits and/or Guidelines can be developed for the following specific areas:

i. Institutional ICT policy and strategy development and implementation

20 *See https://www.fordfoundation.org/media/1760/2010-accomplishments-of-the-partnership-for-higher-education-in-africa.pdf (Report on a Decade of Collaborative Foundation Investment)*

ii. Roles, membership, and structure of the National Level Leadership Team

iii. Laptop ownership strategies that ensure sustainable interventions

iv. Sustainability strategies for major initiatives

v. Campus network design principles and blueprints

vi. Effective methods for building staff digital skills[21]

vii. Development of MOOCs and SPOCs

viii. Digital technology integration self-assessment tool.

3.1.4 Support for Specific High-impact Interventions and Quick-win Demonstrators

In addition to any major systemic interventions, there are various opportunities for specific interventions that would accelerate the pace of change, or support countries and institutions that come up with quick-win proposals. The following attributes should be satisfied by each:

i. Should be in one of the key areas where change is required;

ii. Should be bedded in supportive policy and strategy environments;

iii. Should bring on board a good number of the key stakeholders around the initiative;

iv. Should be based on a strong theory of change with measurable outcome indicators; and

v. Should have significant internal funding to show ownership, along with a realistic sustainability plan.

Possible high-impact interventions and demonstrators include:

i. Working with regional RENs, the identification of universities in Africa and other developing regions, as well as those than can provide good examples in more advanced countries, as an aide to peer-learning and twinning in creating digitalised campuses. Several African NRENs were able to develop through peer-learning and twinning arrangements, and this is an approach that can produce visible high impact in a short period of time.

ii. Working with regional university associations, MOOCs and SPOCs providers rolling out comprehensive ICT-enabled learning in selected pilot courses across selected locations as demonstrators and program learning opportunities.

iii. Working with NRENs for:

21 *See for example the all aboard initiative in Ireland, https://www.allaboardhe.ie/*

a) Developing national blueprints for digital campuses, and leading their rollout and implementation, along with capacity building for campus ICT staff.

b) Developing/updating and rolling out training programs to develop awareness among HEI governance, management, and faculty levels; and skills for faculty, administrative staff, and students.

c) Supporting the development and rollout of shared skills and resources, including human expertise.

iv. While regional and national level initiatives are essential, real progress can only be made at institutional levels. This leads to support to selected HEIs to measure progress and facilitate knowledge exchange on how best to create digitalised higher education environments with focus on:

a) Development/updating of institutional ICT policies to ensure digital technologies are fully integrated into teaching, learning and administration;

b) Designing and implementing a robust campus digital infrastructure;

c) Design of digital services with consideration for accessibility to all devices (mobile phones, tablets, computers, and future devices);

d) Evaluating physical spaces in relation to changing pedagogical models, accessibility needs, and emerging instructional technologies, and to foster innovation in learning spaces;

e) Staffing their ICT operation departments and motivating and retaining engineers and support team;

f) Developing, implementing, adaptation and sharing lessons on Acceptable Use Policies;

g) Sharing ICT expertise with other institutions.

4. Conclusion

The high-level strategy and roadmap present major initiatives, with multiple elements and inter-relationship. The recommendations, therefore, need to be examined in considerable depth as part of implementation planning. Everything proposed above is doable and achievable within clear time-frames, depending on policy-level commitment and availability of sufficient funding.

The impediments discussed above provide the starting-state of digitalisation in higher education. The end-state would be fully digitalised campuses where all categories of users, both on and off-campus can exploit the opportunities of digital technologies for their work—with competent ICT support staff enabled by sustainable funding to maintain the resources in optimum working condition. The rapid evolution of technology, however, means that change and improvement are open-ended processes. While funding from external sources remains critical for the achievement of progress for up to five years or more—and then phasing out during another five years, consistent funding from higher education institutions and national governments should be available to ensure that national economies continue benefiting from the returns from digitalised HEI campuses.