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## **Deploying Contemporary Information and Communication Technology (ICT) Solutions for Academic Delivery in Higher Education Institutions (HEIs) – An African Experience**

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Higher education institutions (HEIs) have a fundamental role to play in enhancing the development and nurturing of demand driven digital and technical skills because of their quadruple mission, namely, teaching and learning, research and scholarship, public service and engagement, and innovation and entrepreneurship. The COVID-19 pandemic's effects on global economies has meant that, as with every other sector, higher education institutions face major transformations that require continuous reform to make them better responsive to the unyielding and unpredictable demands of the 21st century societies.

The restructuring of Universities is necessitated by pervasive and escalating digital disruptions mainly driven by the pandemic, rising demands for public service and engagement, changes in the credentialing economy, and escalating imperatives for lifelong and life wide learning. Given the changing nature and future of jobs, today's youth will not only have multiple jobs but several careers, some of which have not even been invented.

Contextualizing these pressures, it is increasingly evident that the traditional instructional methods, modes of knowledge production and consumption, and institutional mindsets of exclusivity are no longer tenable if higher education institutions are to remain relevant for Africa's regeneration. The emerging ecosystem of challenges and opportunities requires African and indeed Kenyan Universities and other tertiary institutions to embrace strategies that are mainly driven by digital considerations. These considerations must provide support for the use of ICT solutions that enhance support for round the clock learning beyond traditional geographic physical boundaries. This ought to be in a similar way to how modern business is increasingly turning to technology to operate on the cutting edge 24x7.

This paper details our experience and learnings at USIU-Africa in as far as using cutting-edge technology to set up learning and administrative platforms using an incremental approach over the years. These initiatives have invariably contributed towards blurring the boundaries between learning modalities, supporting students' sense of belonging and connectedness and student enrolment in courses that enable them to participate on site, synchronously online, or asynchronously online as preferred via the HyFlex mode of delivery.

There are some key considerations that educational institutions need to respond to before they embark on deployment of ICT solutions for academic delivery. These include the following;

1) Needs Assessment – Stakeholder engagement is important to determine what problems exist and how technology can be used to address the needs that arise as a result of such engagement. Once the appropriate technology has been identified, we must be able to do a proper cost-benefit analysis aligned to the institution's mission and course learning outcomes. If proper needs assessment is done from the beginning, then implementation will be done with minimal hitches because the choice of technology will be aligned to address the identified problems.

For instance, right now there are discussions around technology natives and learners of the future (Prensky, 2001). These are learners who have interacted with technology since childhood and have a different way of learning. You may find that they are more comfortable sharing materials and ideas via social media platforms such as WhatsApp. In Kenya, the introduction of Competence Based Curriculum (CBC) means that institutions have to make technological considerations that address the learning styles of this group. Accommodation of differently abled persons is often an area overlooked when digitizing academic activities. The use of technology in an education context can be modelled on Gagné and Wager (1992) Theory of Instruction which discusses the concept of “Events of Instruction” that include gaining the learner's attention, providing stimulating material, guiding learning and assessing performance. Institutions need to analyse the ICT resources that currently exist and see what improvements need to be made to support the design, development and delivery of instruction.

Internet Access, Redundancy and Load Balancing – Lack of stable supply of infrastructure and internet, in particular, is a major obstacle to student access to learning (Hamidi et al., 2011) Due to the unreliable nature of connectivity in most parts of the African continent, there is need for the deployment of a couple of dedicated internet links with some form of load balancing with failover capability. This implies that internet traffic is distributed between the two connections and if one connection fails, traffic is automatically redirected to a secondary connection. The main link and the secondary link ought to have the capacity to support on average 2 – 3 Mbps per single user. Dahil et al. (2015) observed that a good number of institutions limit themselves to delivery of theoretical education due to lack of equipment and technological infrastructure to support practical training. Wireless connectivity and support for Bring Your Own Device (BYOD) learning environments through which virtual laboratories (rather than brick and motor laboratories) can be accessed is gaining traction in African educational institutions. Luckily, Kenya's National Research and Education Network (NREN) called Kenya Education Network (KENET) provides educational and research institutions with adequate capacity at very competitive rates.

Another consideration on connectivity is how learners and instructors access resources off-campus. Institutions should consider partnering with telco companies to provide subsidized data bundles to their constituents. The cost of such an initiative can be borne by either the individuals, institution or co-shared among the parties.

Learning Management System (LMS) – There are a number of options here, some of which may be open source. Whether it is deployed to complement learning in a face-to-face mode on one end of the spectrum or a core part of an institution’s online pedagogy, an LMS is essentially a virtual learning environment which is used in the delivery of educational content to learners and paperless assessment through a variety of technological functions which are connected to the Internet. According to Kilgore (2016), experiences during planning, production and development of learning design help to create a memorable experience for modern learners through enhanced engagement. It provides a set of interactive online services that provide learners with access to information, tools and resources to support educational delivery and management through the Internet.

The most important features of the most widely used LMS’s include learning content management – creation, storage, access to resources, curriculum mapping and planning – lesson planning, personalized learning experience, assessment, learner engagement and management – learner information, progress tracking, tools and services – forums, messaging system, blogs, group discussion forums. Student-centered learning is a key selling point for Learning Management Systems which promotes a learning process guided by an instructor (Butt, 2014). Traditionally, instructors have passively transferred learning as verbal communication (Rienties, Brouwer, & Lygo-Baker, 2013) However, using tools available on an LMS, an instructor is able to create a cognitive presence that would enhance student achievement of learning outcomes.

LMSs provide both synchronous and asynchronous communication tools to facilitate knowledge sharing and collaboration among learners which may take the form of student-to-student interaction as well as student-to-instructor interaction. Course learning activities can be realized by using a range of tools, both synchronous and asynchronous. “Social media” or “Web2” tools such as wikis, blogs and chats that have a strong social component and allow learners to interact and work together. These asynchronous tools are supported by most contemporary LMS platforms in addition to e-mail and other collaboration forums.

A standard LMS should conform to internationally recognized Web Content Accessibility Guidelines (WCAG) 2.1. This means that it should support creation of content accessible by all learners regardless of age, ability, or situation. Accommodation of disabilities such as blindness and low vision, deafness and hearing loss, limited movement, speech disabilities, photosensitivity, and combinations of these should be a key consideration in the selection of an LMS. Institutions should adopt a standard course/module design to ensure that interactive learning approaches and activities are embedded in the course to achieve full learner participation.

Videoconferencing Tools – According to Phillips (2015), students are more likely to accept online learning if they believe it offers an advantage over traditional alternatives, it is easy to use and is

compatible with their values. Synchronous tools, like chats or audio conferences, provide higher social presence in an online learning setup. Institutions must invest in videoconferencing platforms which support synchronous learning. Amongst the activities that a comprehensive videoconferencing tool provides support for include scheduling of study groups, class sessions, remotely located students, recording of lectures, co-teaching, connecting of laboratory environments to lecture halls, and facilitating of various modes of pedagogy such as online, blended, hybrid and hyflex.

The most notable features of Videoconferencing systems include Whiteboard and screen-sharing tools, Application sharing, recorded audio and video conferences which can be made available for later use and emulation of face-to-face experience and human presence.

Students are able to evaluate the learning and interaction that takes place during the online, blended, hybrid or hyflex learning mode. The learning outcomes can be measured through questionnaires and surveys, which are submitted to the students online at the end of the course. Also, students' participation can be monitored by the course facilitator throughout the program period.

Academic Integrity Tools – Academic integrity has always been an issue when it comes to administering assessments, whether face to face or remotely. When assessing learners using technology, Hsiao & Watering (2020) argue that sufficient preventive and dishonesty detecting mechanisms must be put in place. Technology can be used to authenticate students' academic work. There are various tools that can be used to support this. Anti-plagiarism tools embedded in the LMS run assignments, theses and dissertations through online databases to detect possible plagiarism attempts and compiles a report that is accessible to both the student and the lecturer. Formative and summative assessments administered on the LMS can be proctored using lockdown browsers. Examination taking is recorded and any suspicious behavior is flagged for investigation. In addition, course instructor(s) may employ video conferencing applications to proctor remote tests and quizzes.

Student Information System (SIS) – This is a learning institution's Enterprise Resource Planning (ERP) system. It holds and processes data that relates to every student's learning journey at an institution. There are a number of options that an learning institution could select each with its positives and potential pitfalls. These include developing it in-house, outsourcing its development or procuring an off-the shelf option. The SIS contains students' admission records and should, among other functionalities, enable the student to enroll for courses, access their grades, generate fee statements, do GPA projections and download academic transcripts. Instructors also have access to the platform where they can communicate with their students via email, input grades and review course evaluation reports based on feedback from their students. In an ideal situation, the SIS should be integrated with the institution's LMS so that learners are not subjected to numerous tasks to get a certain output. For example, once a student enrolls for courses on the SIS, this enrolment information is transferred onto the LMS where when the same student logs in, they are able to access course material for that course. Similarly, grades processed within the LMS should write back to the SIS. This guarantees integrity and minimizes potential data loss.

Library System and e-Repository – A modern library should offer one central location for all academic resources necessary to support teaching, learning and research. Online Public Access Catalogue (OPAC) is one platform which helps users to identify items in the library's collection including books, audio visual materials and journals that are relevant to their information needs. An institutions library, through associations such as the Kenya Libraries and Information Services Consortium (KLISC), should subscribe to online databases, journals e-books, magazines and newspapers. Access to proprietary e-resources off campus can be facilitated through a Virtual Private Network (VPN) connection implemented on the firewall within the institution's network. In recent times, we have also witnessed an increase in deployment of e-repositories. Away from known global reference databases, institutions are developing their own e-repositories where all their academic publications are archived and can be referenced over the internet.

Business Intelligence (BI) – The institution may also need to invest in third party software from that is integrated into the LMS to monitor interaction and activities on the platform. These BI tools provide real-time Business Intelligence (BI) analytics, interaction and content usage to users at various levels including teaching faculty, departmental heads, senior management and staff at the Centre for Excellence in Learning and Teaching (CELT) for data driven decision-making to aid student learning. Analytics will ensure improved content by reviewing quality and length of interaction. Faculty would be able to see which content has the most impact in student learning. Analytics would show how much time, for example, students spend interacting with a certain resource, maybe PowerPoint slides. Other insights may also come up, for example, which resource is being skipped and by how many students. This will enable the instructor to make appropriate adjustments to the material to make it more stimulating.

Learning Tool Interoperability (LTI) – The platforms above must not exist in isolation as apart from the negative impacts on efficiency that disparate pieces of data occasion in an institution, data held in various systems inevitably leads to compromises in integrity. LTI applications and/or tools make sharing data between an organization's LMS, SIS, payment services, and other services such as the Library simple, eliminating the need for manual processes. In the education sector, LMS providers can utilize a powerful platform to easily create connectivity and simplify the online learning experience. Learning Tools Interoperability (LTI) could be defined as a standard developed by the IMS Global Learning Consortium, which makes it possible for courseware and learning tools from different vendors to be launched within a learning platform, often an LMS.

System Availability and Data Integrity – The underlying infrastructure at any Higher Education Institution is an important element as all services run on it. Some of the areas that require close attention include the following;

Server Space: There is also need for a number of servers (either cloud based or in house) that are deployed to handle the data requirements of various core and peripheral processes at the institution: These include a Student Information System (SIS), Web services, Printing services, Library services, Learning Management System (LMS), Accounting and Finance, Procurement, Human Resource (HR), among many other functions.

**Backup and Remote Services:** Although they have been relatively slow to get on to the technology bandwagon in comparison to other sectors of the economy e.g. banking, the nature of contemporary educational institutions' operations have increasingly gone digital and for that reason, an institution would require multi-level onsite and offsite backups for its data and software. The operationalization of robust Disaster Recovery (DR) measures at three levels (on site, at a remote location and via tapes that are kept in a vault) ought to support data restoration incase services fail.

**Maintenance and Upgrade of Technologies:** Educational institutions need to ensure continuous effort is made to maintain and upgrade their core ICT infrastructure. This is ought to be guided by a 3 to 5-year ICT strategy which builds into the overall institutional strategic plan. The institution must budget for and upgrade/refresh its infrastructure (including storage, core and distribution switches, data centers, Access Points (APs) for Wi-Fi connectivity etc. on a continuous basis to ensure hardware does not get obsolete. To ensure reliability, privacy, safety and security of institution's data and infrastructure, the latest software patches must always be deployed whenever they become available and benchmarking with the latest industry standards must be done on a continuous basis to keep abreast with the latest technological trends.

**ICT Tools' Adoption Strategy** – An institution's strategic plan, financial resources and focus will guide the selection of what tools that senior management prioritize hence this article outlines some of the key ICT solutions that higher education institutions may consider deploying in order to offer 21st century education that supports teaching, learning and administration. The choice of tools to be deployed should primarily focus on the affordances they provide in the learning environment. For instance, when selecting an eLearning authoring tool, you must consider one that can provide interactive content that can be viewed any time and on demand. The technology could provide increased learner engagement by presenting the same concepts in different formats. For example, a student may have hearing impairment but when they interact with visual content then they are able to piece together information, the same way their colleagues would.

**Change Management** – A learning institution must be cognizant of the negative impact changes in technology and or software can have on learning, teaching and the operations of the institution if these changes are not properly communicated in time to all constituents. Therefore, before introducing any changes to technology the institution ought to have a process of training and inducting users months before deployment and adoption. Latest research in this area proposes a socio-technical approach which adopts co-design; incorporating the users at every stage in the design and development of ICT solutions since a system is only as good as the team that develops it. The more inclusive the team is, the higher the chances of the system impacting the institution's operations positively.

In the case of online learning and teaching, students and instructors need to undergo training before using the LMS to support student learning. In every course during the orientation period this needs to be devoted to bringing online students up to speed with the technology requirements during the program they are undertaking. Each course should also have a course tour of the online learning environment for the

particular course they are undertaking. This tour will be a video that explains how to navigate the institution's LMS and for the course conducted by the course instructor.

Instructor and Learner Support – The ultimate success of the deployment of ICT administrative and learning systems is dependent on the level, quality and availability of support to users. Some of the factors that require close consideration include the following:

**Governance and Staffing Structure of the ICT Function:** Due to the increasingly central nature of ICT as the nerve center of an institution's day-to-day learning and administrative operations, there is need for a staffing structure that places the head of ICT operations at the highest possible level of the organization structure. The Head of ICT as a functional area would require support from Heads of Department (HoDs) each of which would have a staff compliment of majority permanent staff including Help Desk personnel, students on internship and Work Study programs who gain hands-on experience in the workplace and could potentially join on a permanent basis. Regardless of whether the institution adopts a centralized, decentralized or coordinated organizational structure, support from the very top of the organizational structure is key to the success of deployment of ICT systems and there is need for the institution to invest in continuous training to develop technological capacity that is sufficiently capable of developing and/or supporting technology used in learning and teaching. Due to the highly dynamic nature of the ICT industry, the organization must be nimble enough to appreciate the changing roles and titles that need to be put in place to support core processes. It is not uncommon to hear about positions like Chief Security Officer, Data Protection Officer etc. Organic development of appropriate controls, policies and Standard Operating Procedures (SOPs) is another continuous activity for which the Head of ICT would bear responsibility.

**Technical Help Desk Tool:** Higher education institutions would need fully functioning service desk to act as a single point of contact responsible for resolving technical issues raised by users.. The ICT call center, as the first line of support, responds to queries from students, instructors, and non-teaching staff and it is important that the platform deployed to support its activities encompasses multiple channels such as e-mail, telephone, online chat and social media applications to automatically raise tickets. The selected helpdesk tool must deploy an issue tracking system which enables the helpdesk operators to keep track of the user requests using a unique identifier, easily find solutions to common queries from a knowledge base, prioritize cases and use a Business Intelligence (BI) tool for data-driven decision making regarding real-time support trends data. The first-level issues are usually common queries that can be addressed by frequently asked questions (FAQs). If the help desk technicians cannot resolve the issue at the first level, the issue is then escalated to the second level, which will usually have specialist staff that can handle more complex queries. The tool should be able to send automatic notifications to the user when a ticket is captured, escalated, resolved and even closed.

Other than serving the ICT function, the helpdesk ticketing system can be deployed to support other areas necessary to facilitate teaching and learning. For example, the Academic Advising team would be able to track student issues relating to course enrolment and academic performance. The finance department

would also be able to capture school fee queries and ensure they are resolved and closed to student or parent's satisfaction.

User Empowerment: To a great extent, the ICT function should deploy tools aimed at getting users to be self-reliant. Automation of routine tasks such as password reset and unlock is crucial. This is the most common issue to be reported at the helpdesk and deploying a mobile app that allows users to do it from the comfort of their personal space would positively impact the turn-around-time for resolution of the same. Helpdesk personnel can then focus their energy on service improvement activities.

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