Background Paper
The Learning Generation

A Landscape Analysis of Information & Communication Technologies’ Role in Education Effectiveness and Efficiency
Issues, Techniques, and Possibilities

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A Landscape Analysis of Information & Communication Technologies’ Role in Education Effectiveness and Efficiency: Issues, Techniques, and Possibilities

A Study by the International Commission on Financing Global Education Opportunity
Executive Summary

Developing economies are afflicted by a growing education and skills gap, which if left unaddressed, will prevent the active and meaningful participation of young people in the global economy. In the current model of the global education system, it is estimated that over 1 billion people in the workforce will still lack a secondary education by 2025 -consequently severely limiting economic and social progress worldwide and widening economic disparities. In this light, new models for delivering education delivery models are being sought in order to develop a well-skilled workforce with the ability to adapt to new emerging needs.

At the same time, an Information & Communications Technology (ICT) revolution has swept across the globe. This ICT revolution could serve as a possible means for supplying the quantity and quality of global education demand -as it enables the rapid creation of solutions to bridge the skills gap and exploits economies of scale unattainable in traditional classrooms. This may allow the expansion of high-quality learning at a low cost. But while recent technological innovations have provided opportunities to deliver education and skills to young people in newer ways, there exists a wide regional disparity in the use of technology-enabled education, and learning outcome results are mixed. Also, technology-enabled education has yet to significantly reach marginalized communities.

ICT-based school mapping/monitoring, ICT-based social accountability, Online learning, Mobile phone – based payment and monitoring mechanisms, and the use of Broadband technology for education are different methodologies by which technology can be used as an instrument for effectively delivering education services, skill development, and ensuring accountability in the education sector. This paper sheds light on these mechanisms and analyzes the necessary demand/supply-side, institutional, and financial conditions for these methodologies to be successful. It also examines the challenges that may be faced by practitioners upon pursuing the incorporation of these methodologies.

This paper is cognizant of the fact that applying ICT for education (ICT4E) provides value only if learners, teachers, and authorities can adopt it to a useful end. Against this backdrop, this paper provides a tool kit on how to effectively deploy ICT4E initiatives in targeted communities, regions, or countries. Critical ICT4E success factors identified by this paper are: Consultations with intended beneficiaries in the ICT4E design process; Comprehension of the prevailing education and ICT policy frameworks; Formulation of viable business models for ICT4E sustainability; Engagement with global innovators through incentives; Collaboration with targeted users for curriculum co-creation in adherence with learning standards; and Extensive ICT4E piloting and incorporation of feedback.
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>ICT</td>
<td>Information &amp; Communication Technology</td>
</tr>
<tr>
<td>ICT4E</td>
<td>ICT for Education</td>
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<tr>
<td>IT</td>
<td>Information Technologies</td>
</tr>
<tr>
<td>LAN</td>
<td>Local Area Network</td>
</tr>
<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<tr>
<td>MOOC</td>
<td>Massive Open Online Course</td>
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<tr>
<td>NGO</td>
<td>Non-Government Organization</td>
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<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
</tr>
<tr>
<td>OLPC</td>
<td>One Laptop Per Child</td>
</tr>
<tr>
<td>PFM</td>
<td>Public Financial Management</td>
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<td>Value For Money</td>
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Section 1: The *Youth Bulge* and Rising Education Gaps

1.1. Education-sector Challenges in the *Youth Bulge* Era

The education sector has made progress globally. For example, the number of higher education students globally rose from 163 million in 2008 to 199 million in 2013\(^1\), and is forecasted to increase up to 262 million by 2025\(^2\) -with much of this growth taking place in large and populous developing countries that started with relatively low levels of secondary education, such as China, India, and Nigeria.\(^3\) Large numbers of young people can provide developing countries with a unique opportunity to propel their economies through effective harnessing of extensive human capital. Enhancing young people’s suitability and productivity in the labor market entails upgradation in countries’ education capabilities, especially in basic skills and access to secondary and tertiary education.

But although young people are enrolling into school in greater numbers of concern is the overall poor quality of education imparted -limiting youth’ employability. This is evidenced by the fact that the double-digit and stagnating rate of unemployed youth is more than double the level of unemployed adults in many regions around the world, particularly in Sub-Saharan Africa, Middle East, and North Africa \(^4\) (Figure 1). While some of the barriers to youth’ competitiveness include social factors such as forced labor, early marriage, and discrimination, these statistics also imply that young people often still lack access to meaningful education and skills development necessary to render them ready for employment.

Compounding the situation is the prohibitive cost of expanding universal access to post–primary schooling in low income countries through traditional means. The annual total cost of achieving universal pre-primary, primary and lower secondary education in low and lower middle income countries is projected to increase from US$100 billion in 2012 to US$239 billion, on average, between 2015 and 2030.\(^5\)

1.2. The Need for New Education Delivery Models

Developing economies are afflicted by a growing education and skills gap, which if left unaddressed, will prevent the active and meaningful participation of young people in the global economy. In the current model

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of the global education system, over 1 billion people in the workforce will still lack a secondary education by 2025 -consequently severely limiting economic and social progress worldwide and widening economic disparities. In this light, new models for delivering education delivery models are urgently sought in order to develop a well-skilled workforce with the ability to adapt to new emerging needs and challenges.

1.3. Exploring the Role of ICT in Education

No longer limited to developed countries, an Information & Communications Technology (ICT) revolution has swept across the globe (see more details in Section 2.1). In theory, ICT could serve as a possible means for supplying the quantity and quality of global education demand -as it enables the rapid creation of solutions to bridge the skills gap and exploits economies of scale unattainable in traditional classrooms. This may allow the expansion of high-quality learning at a low cost.

But while recent technological innovations have provided opportunities to deliver education and skills to young people in newer ways, there exists a wide regional disparity in the use of technology-enabled education, and learning outcome results are mixed. Also, technology-enabled education has yet to significantly reach marginalized communities.

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The ensuing sections of this paper will dwell on the different ways by which technology can be used as an instrument for effectively delivering education services, skill development, and ensuring accountability in the education sector. This paper will also analyze the necessary demand/supply-side, institutional, and financial conditions for this to happen.
Section 2: The Digital Revolution and its Applicability to Education in Developing Regions

2.1. The ICT Reality

No longer limited to the developed world, there has been exponential growth in access to and use of ICT across the developing world, which includes the entire range of telecommunications networks, information technologies (IT), and electronic services (e-services). From telephone services over wireline and wireless networks, to the Internet and related multimedia applications, ICT has had a significant economic and social impact. Driven primarily by the rapid growth of wireless telephony, the developing world now has a widespread telecommunications infrastructure and a deepening number of users (see chart below).\(^7\) Noteworthy is the virtual explosion of mobile phones in many African countries, which surpassed 200 million subscribers in early 2007 itself (providing mobile telephony access to almost 50% of the continent’s population) and continues to grow at higher rates than any other region.\(^8\) According to the World Bank’s 2016 World Development Report, out of a global population of 7.4 Billion, in 2015 the number of mobile phone and broadband internet users stood at 5.2 billion and 1.1 billion respectively, with much of the growth in ICT access taking place in developing countries. At current ICT growth rates, it is projected that Internet access will reach 56 percent of the global population by 2020 having increased three-folds from 18 percent in 2005) while mobile telephony access will be near-universal by then\(^9\).

\[\text{In Sub-Saharan Africa, Nigeria, Kenya, and Tanzania have emerged as the region’s top ICT growth centers, in terms of rapidly increasing access to voice and data services since 2000 and emergence of a home-grown}\]

\(^7\) Source: ITU, World Bank data (2015)
\(^8\) Source: 10\(^{th}\) Africa Partnership Forum (2008), ICT in Africa: Boosting Economic Growth & Poverty Reduction
IT industry. Elsewhere, a growing middle class and improved business conditions have led Brazil, China, India, Indonesia and Mexico reap large strides in improved ICT access to citizens over the past decade and continue to hold promise in the future. To illustrate, while India only had a 20% internet penetration rate in 2014, internet access continues to increase at 14% annually -amongst the world’s highest. In general, the developing world as a whole is predicted to continue experiencing rapidly improving access to ICT over the next decade. The only exception to this trend is posed by some Balkan countries (such as Serbia and Croatia) and Eastern European economies (such as Moldova and Ukraine) attributed mainly to their rapidly ageing populations and diminishing economic growth.

Much of the mobile market growth can be attributed to the increasing popularity of smartphones. In 2012, only about 25 percent of all mobile users were smartphone users. But this number is expected to double, reaching 50 percent by 2018. This implies that the number of smartphone users worldwide is expected to grow by one billion to reach 2.6 billion by 2019. Each year, developing countries see an annual gain of about 500 million new smartphones, virtually all of which can generate a rich set of precise data (through their GPS and wi-fi capabilities). However, there exists wide disparity in smartphone access across countries and income groups. To illustrate, a median of 24% in emerging and developing countries own smartphones, as opposed to over 58% in the United States. About 10% or fewer Bangladeshis, Ugandans and Pakistanis own smartphones. Within countries, young people (those below 35 years of age), the educated (those with at-least a secondary degree), the economically better-off and those with English language ability are much more likely to access the internet using smartphones than their counterparts. But with average selling prices of devices decreasing rapidly by an estimated average of 13 percent annually, an increasing number of lower-income regions and communities can have access to a smartphone in the near future (see section 2.2.5.1 for more details).

Increasing ICT access is likely to have a profound impact on the economies of developing countries. It is estimated that every 10% increase in basic mobile telephony services boosts GDP of developing countries.

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12 Source: www.internetlivestats.com
13 Ibid
15 Advancing Development with Mobile Phone Locational Data, Improving the Effectiveness of Assistance, World Bank (2014)
16 Internet Seen as Positive Influence on Education but Negative on Morality in Emerging and Developing Nations, Pew Research Center, March 2015.
17 Ibid
18 Ibid
by 0.8 to 1.2 % points. Saliently, a doubling of mobile data use leads to an increase in GDP per capita growth of upto 0.5 % points. It is anticipated that increased ICT access coupled with improving GDP per capita could potentially lead to a greater demand and supply of ICT-based services, resulting in greater need for ICT skills and consequently greater business opportunities for IT entrepreneurs. As a result, the need for further ingraining ICT in learning is bound to accentuate more (see section 2.2.6 for more details).

2.2. **Leveraging ICT in the Education-sector**

While access to electricity, computers, the Internet, and mobile phones is improving, even in the poorest countries, ICT access still remains limited for large groups of people. Lack of access to ICT devices, infrastructure, suitable ICT solutions, and also weak know-how on how to use ICT are key contributing factors to the ‘Digital Divide’ that renders some communities and regions with inadequate capacities to utilize ICT for education. Yet, the immense popularity of mobile phones and smartphone devices -even amongst low-income groups, the enhancement of supporting infrastructure (such as cloud-based computing and mobile signal availability), the rise of Open Source software and the emergence of a niche market for entrepreneurship in this domain, has encouraged the development of innovative and promising technological solutions and methodologies that can contribute to enhancing education sector outcomes and competitiveness in a multitude of ways. Through various examples, the ensuing sub-sections will briefly describe and analyze some of the main ICT methodologies in use today to provide a snapshot of the salient ways by which ICT is contributing to the education sector in developing regions and predict what the future may behold.

2.2.1. **ICT-based School Mapping & Monitoring**

In developing regions, the growing prevalence of smartphone and tablet devices -with their rich geo-referencing, imaging, wifi, and data capturing capabilities -is providing a new and powerful means for ensuring accountability, transparency, and integrity in the educational sector. School mapping & monitoring systems are ICT applications that capture, store, analyze, manage, and present educational and school-related data linked to location on a map. As a result, these systems allow viewing, understanding, interpreting, and visualizing of data in many ways that reveal spatial relationships, patterns, and trends in the form of maps, reports, and charts. Simple consultations with students, teachers, and headmasters can help stakeholders obtain data and information pertaining to educational performance, infrastructure, and

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20 “What is the impact of mobile telephony on economic growth”, GSM Association, Nov. 2012.
21 Open source software is software whose source code is available for modification or enhancement by anyone and is often free-to-use. Authors of Open Source software make it available to others who would like to view that code, copy it, learn from it, alter it, or share it.
service needs for plotting on a map -leading to improved and participatory planning. Such monitoring capability facilitates a greater understanding of educational needs for any particular school or locality, thereby creating opportunities for authorities to deploy resources to fill these gaps effectively. Several countries in the developing world are embarking on embracing this methodology for ushering greater accountability and management in their education sector. The case study presented in Box 1 provides an overview on how Ghana is transforming its educational sector through the use of this technology.

**BOX 1 – ICT-Based Secondary School Mapping & Monitoring in Ghana**

In Ghana, demand for Secondary education has increased due to a number of factors, such as an increasing population coming out of poverty, completing universal basic education, and moving to urban areas and away from agriculture in search of wage employment. However, three-fourths of youth typically either do not have adequate qualifications to enter Senior High Schools (SHS) or cannot afford to move or commute to the schools where they are placed by the Computerized School Selection and Placement System (CSSPS). Those coming from the poorest 20% of the households, the most deprived districts and/or from rural areas are about five to six times less likely to access SHS programs. Further, employment in the formal private sector is mostly available for those finishing tertiary education, for which the successful completion at SHS level is a prerequisite.

With an eye on the future, the Government of Ghana recognizes the need for a massive overhaul of the Secondary education system -requiring significant investments in upgrading the secondary-level curriculum, training teachers, building new schools while rehabilitating existing ones, and so forth. With poor oversight capabilities being a fundamental cause of failure in previous initiatives, the Government faced serious challenges in effectively managing, monitoring, and supervising such a massive nation-wide undertaking.

To enhance program implementation capabilities, the government adopted an innovative Smartphone-based ICT platform to ensure close monitoring and evaluation of secondary education improvement programs and it also provided school profiles using key performance indicators through a dedicated website accessible to the general public (see Figure 3). The establishment of a user friendly web platform for school reporting ([www.GhanaSchoolsInfo.org](http://www.GhanaSchoolsInfo.org)) and real time monitoring of all SHS through smartphones enhanced and strengthened the data collection capabilities in education sector which helped the government better report on results. The use of ICT also helped the government conduct a school mapping exercise to locate all secondary schools in the country with key basic data to help inform decision making about resources, teacher allocations, computerized selection and rehabilitation/upgrading needs.
Referring to Figure 4 below, the application of ICT significantly improved the management of schools by the country’s Ministry of Education (MOE) as it provided the following means:

- A Spatial understanding of the education facilities – Senior High School for quality improvement, with further levels like the Basic, Tertiary education facilities and amenities in communities, districts and regions. This informed decision making at the Ministry for planning resource allocation. For instance, how many communities are using a particular school? What distance do they have to cover? What is the nature of the roads to the school? Which schools or education facilities have sanitation facilities and toilets?
- Information on school performance and status
- A platform for monitoring information on Secondary education program improvement implementation
- Complemented Data Quality Assessments (DQAs) and monitoring visits at the MOE.
- Identification of areas that need assistance in the construction and repair of schools for efficient resource allocation.

**Impact:** According to MOE, the initiative delivers a very high return on investment. The real-time monitoring capability with visuals saves the government millions of dollars that may have been pilfered by school construction contractors and other entities owing to lax supervision. Students and parents now simply browse the website and save vast sums of money that may have otherwise been spent on visiting distant schools simply to get a better understanding on the kind of facilities that exist (prior to making a decision on which school to enroll into). According to MOE, the yearly operational costs for using the system (mainly involves transportation expenditures for educational coordinators to visit school sites, purchasing/replacing few smartphones, and monthly fee for cloud-based hosting of the platform) to monitor schools is approximately USD 50,000.
Figure 5: Screenshot of a sample report from www.GhanaSchoolsInfo.org

Amasaman SHTS

BASIC INFO

Title: Amasaman SHTS
Date School Record was Created: 11:54 Dec 36, 2015
Region: Greater Accra
District: Ga West Municipal
Images

LOCATION

LATEST DATA

No. of available placements (CSSPS)?: 400
No. of applicants via CSSPS?: 613
No. of Teachers?: 67
No. of Trained Teachers?: 64
No. of Resident Teachers:
No. of Students (SHS1): 410
No. of Students (SHS2): 408
No. of Students (SHS3): 316
No. of Resident Students:
Teach to Student Ratio: 16.93
EMIS Code: 000
ICT Lab: yes
Science Lab: yes
Library: yes
Sports Facility: yes
General Science: yes
General Arts: yes
Visual Arts: yes
Core Subjects: yes
Technical: yes
Agricultural Science: yes

COMMENTS

0 Comments
2.2.1.1. Success Factors for ICT-Based School Mapping

As discussed above, ICT-based school mapping and monitoring methodologies can provide a number of benefits such as advanced capabilities for data analysis, and rendering a geospatial framework for understanding and prescribing action for better decision-making. But effective implementation and leveraging of this methodology necessitates the following critical factors:

1] Funding:

This methodology may entail the need for adequate funding for the following purposes:

- Purchasing mobile phone gadgets, data & air-time;
- Conducting training sessions;
- Procuring ICT platforms that enable school mapping/monitoring (for example, ‘ArgoMark’)23, although some Open-Source platforms do exist;
- Logistics: Funds may be needed simply for transporting people conducting school mapping/monitoring from one geographic location to another
- Conducting awareness campaigns to sensitize students, teachers and stakeholders on how to best leverage ICT-based school mapping/monitoring platforms

2] In-house Technical Capabilities:

- Use of Open Source platforms may entail the need for in-house/local software programmers who can alter source codes to suit local needs and be capable of regularly maintaining and upgrading ICT systems
- Use of Open Source platforms may also entail the need for in-house/local IT technicians who can support hosting of ICT solutions on a server (either cloud-based or in-house)

3] Institutional Readiness:

- Institutional frameworks need to be in place such that data yielded by school mapping/monitoring platforms actually leads to proactive response and decision-making from agencies.
- ICT-based school mapping/monitoring systems are most suited in an environment where authorities permit transparency of education –sector data and are open towards receiving feedback from citizens.

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22 Based on interviews with School mapping teams associated with Ministry of Education in Ghana, Uganda, and Liberia
• Institutions need to accept a new organizational culture of conducting monitoring by moving away from paper-based processes and using technology instead.

2.2.2. ICT-Based Social Accountability in the Education Sector

Social Accountability tools (such as online blogs, forums, discussions) render a platform for large-scale citizen review/feedback/dialogue on education-sector policies and services via up-to-the-second feedback, news, meeting notes, postings, data, images, etc. These multiple-format mechanisms offer new barrier-free models of public participation in which real-time collaboration, experience-sharing and participation amongst citizens are becoming the norm. This enables authorities to constantly remain in touch with people in order to make education services more effective and representative. In view of the growing accessibility of ICT in most regions, students, parents, and stakeholders are in an increasingly powerful position to leverage mechanisms for Social Accountability in education.

The various tools that support ICT-based Social Accountability mechanisms in the framework of educational services are discussed in the ensuing sub-sections, and include:

1] Surveys (Forecast/Retrospective)
2] Citizen Outreach
3] Digital Publication, and
4] e-Participation

2.2.2.1. Tool 1: Surveys (Forecast/Retrospective)

| Description | Citizen surveys are investigations of the behavior, preferences, attitudes or opinions of a target group sample, collected through online questionnaires. Ex ante (or forecast surveys) can help authorities to shape future plans, such as investment/infrastructure plans in schools to expand services, institutional changes and fee changes. Post ante surveys (or retrospective surveys) can constitute effective mechanisms for conveying citizens’ viewpoints and review of initiatives and services to authorities. ICT-enabled surveys may cover particular sub-groups or geographical communities within the service area or the whole service area. Ex ante/forecast surveys may measure willingness to pay or preferences for (example) curriculum design and fee structures. Post ante surveys can be used to evaluate and monitor performance of initiatives and services from the citizen’s point of view. |


A wide variety of online applications exist for conducting surveys using Internet. Through mobile phones, respondents can submit their choices using SMS messages, touch-tone number punching, interacting with voice messaging systems, etc.

### Potential merit

1] Targeted forecast surveys are a useful tool for consultations on service development and improvement. Retrospective surveys can give agencies insights into problems being faced by citizens and bring pressure to bear for their resolution.

2] Within the targeted population group, there exists equal access for everyone.

3] Although surveys can be expensive to conduct, those high costs may be warranted for large planned activities – results are often used to create change.

4] Surveys can be institutionalized into normal utility or municipality operations.

### Success factors

1] Design and execution determine the integrity of the results.

2] Options considered must be within actionable range of utility.

3] Transparent publication of methodology and data.

4] To achieve impartial evaluation/feedback, target groups must be carefully selected to reflect balanced socio-economic conditions of citizenry.

5] Surveys require considerable financial and human resources as well as experience with statistical techniques.

### Example

*Educational Technology & Mobile Learning:*


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### 2.2.2. Tool 2: Citizen Outreach

#### Description

Outreach can be a first step to two-way dialogue and consultation – although it is mostly a one-way process, with information flowing from educational institutions to stakeholders through SMS messages & alerts or e-mail notifications. Citizen outreach pertains to efforts by agencies to connect directly with the public for purposes of disseminating vital information/messages pertaining to (for example) necessary health precautions for students, location of skill development workshops, change in fee levels, curriculum information, etc. Outreach can also be used to provide information on the utility, including works and service disruptions, and on how to use complaint and consultation mechanisms.

#### Potential merit

1] Community outreach can establish a basis for accountability by building trust and making utility/municipality staff more accessible.

2] It can be customized to reach specific/targeted communities or groups.

3] Cash costs are modest; costs for consumers are low; can be organized in parallel to other activities of urban and water-sector agencies.
4) Outreach activities can be easily made routine

Success factors

1] Should be well targeted and tailored to the groups and individuals who are meant to be reached.
2] Ad hoc utilization, misuse or exploitation of this tool by agencies (for instance, as a marketing/product promotion medium) needs to be avoided to maintain accountability.

Example


### 2.2.2.3. Tool 3: Digital Publication of data

**Description**

An effective way of ensuring accountability of Education-sector institutions is by making data from these entities available through online publishing of annual reports/metrics or disseminating relevant info using SMS messages. Such reports provide a mechanism for public overview of agency activities and a tool to monitor performance. It can be a powerful tool for citizen to demand change as well as for community representatives monitoring school performances, particularly if it provides data on student performance as well as finances. As educational institutions sometimes already publish students’ grades online, this existing medium provides a valuable channel through which additional data can be provided.

**Potential merit**

1] This tool offers high sustainability once a performance management system is place. Setting-up of these systems can be strongly encouraged by formalization through enforced laws or guidelines.
2] Effectiveness of publishing data can be easily enhanced based upon the relevance, quality, timeliness, and format of the information provided.
3] Publication of service and performance data provides the basis for accountability.

**Success factors**

1] For the public-at-large, which would not normally read formal reports, summarized plain-language data and visual presentation can make data more accessible.
2] Developing reliable data collection mechanisms, quality-control systems, and user-friendly materials can be expensive.
3] Education-sector institutions require a commitment towards reform and accountability, and must reach a certain maturity and capacity before they can produce dependable performance data.

**References**

*Using Smartphone and web technology for publishing school data online in Uganda* ([http://www.ugandaschools.net](http://www.ugandaschools.net))
2.2.2.4. Tool 4: e-Participation mechanisms

<table>
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<tr>
<th>Description</th>
<th>E-Participation mediums such as blogs, citizen forums, on-demand information channels (for instance, YouTube, Facebook), online chat rooms, etc. can render a virtual feedback, review, critique and complaint loop between students, parents, and concerned authorities. The goal of such mechanisms in governance is to enable greater citizen participation in managing and monitoring school administration. Through e-participation, people can interact with concerned officials and make their voices heard. It allows citizens to immediately see how and why their educational institutions are functioning the way they are, and enables citizens to share their comments and views on the functioning/performance of related agencies. Public officials/agencies can judge the prevailing mood of students, parents, teachers, and take corresponding course of action.</th>
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</table>
| Potential merit | 1) It is possible for users to remain anonymous while providing feedback to local administrators.  
2) The extension of Social networking tools to Mobile communications can vastly enhance the participation levels of ordinary citizens in governance  
3) Access to e-participation tools is often inexpensive to citizens, enabling even the poor to participate in the accountability process. |
| Success factors | 1) Inaccessibility to ICT equipment and infrastructure, especially amongst the poor, can lead to unfair/undemocratic planning initiatives.  
2) Lack of awareness amongst individuals regarding the capability of Social Networks towards enhancing accountability diminishes its transformational power.  
3) This technique only works effectively in the presence of citizen-centric or responsive agencies - open and tolerant to feedback and criticism from citizens.  
4) Dedicated staff for monitoring e-Participation mediums and relaying feedback to officials is required. |
| Example | Inside Higher Education [https://www.insidehighered.com/] |

2.2.2.5. Framework for ICT-Social Accountability Implementation

Figure 6 below\(^{24}\) shows how ICT-based Social Accountability constitutes a mechanism towards inculcating more citizen-centric governments by providing residents the opportunity to conduct open dialogue, feedback, situation monitoring and idea-exchange with local governments and municipalities. As

\(^{24}\) Adapted from Social Networking for Urban Planning. Available online at: http://www.slideshare.net/placevision/social-networking-for-urban-planning-1532502
illustrated, ICT applications for Social Accountability helps develop well-informed, aware citizens by fostering collaboration, participation, and idea-exchange (or ‘storytelling’) and puts them in real-time contact with elected officials or their offices. This allows voters to have a direct impact and influence on their local government, as officials are urged to take appropriate action based on prevailing views of constituencies.

Figure 6: Configuration of Social Accountability systems

2.2.3. Online Learning for Students and Teachers

"Online learning" is associated with pedagogical activities involving internet-enabled digital learning content - particularly popular in higher education, professional, and corporate training settings. This study regards online learning to comprise of two similar, yet disparate means, namely, E-Learning and M-Learning. Until recently, E-Learning has been the most commonly adopted approach, especially in developed countries, where online learning has been conducted via internet access using conventional desktops and laptops. In view of the growing ubiquity of mobile devices in developing countries, mobile–based learning (or M-Learning) comprises in today’s era a potentially more potent means for imparting education and scaling-up learning opportunities: Most teachers and students already own mobile phones or at least have access to the same; content is easier to update compared to printed materials; most people already know how to use

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25 This section synthesized from UNESCO Working Paper Series on Mobile Learning (2012)
mobile phones, so very little training is needed; and the mobile technology infrastructure is often robust even in developing regions. M-Learning strategies have been adopted by some universities to offer distance education programs in order to reach tertiary-level students located far away from school campuses and to

**BOX 2 – The ‘Worldreader Mobile’ app as an M-Learning Tool**

Worldreader Mobile (WRM) is an application launched in 2012 that allows people to access books and stories from a wide variety of mobile phones, including inexpensive feature phones. The application seeks to eradicate illiteracy by delivering a large, culturally relevant library to people in low-income countries both digitally and inexpensively. With a library of over 6000 digital titles, WRM had 334,000 unique active users per month during 2013 and allows anyone with a data-connected mobile phone to access Worldreader’s library of over 6,000 digital titles.

WRM books and stories encompass a variety of genres including religion, education, health, action/adventure and more. While most of the books in the WRM library are written in English, there are a growing number of titles in other languages including Hindi, Yoruba, Kiswahili, Twi and others. The WRM library has been growing steadily since the application was released and Worldreader actively seeks new agreements with publishers.

To read on WRM, users download the free application, which is available in several app stores including Google Play, Opera and GetJar. The application resides in the memory of the phone, but the books are stored in the cloud and all reading is done while the phone is connected to mobile data. However, offline reading is not possible on WRM, as the books are never downloaded to the phone to prevent piracy and unauthorized use of copyrighted content.

The vast majority of WRM books and stories can be read for free, although a small fee is incurred due to data use. In most countries, the data fees are equivalent to 2 US cents per 1,000, pages read. Some titles are not freely accessible and need to be purchased by end users for around USD 3.50, generally with mobile credit. Like the free books, purchased books are accessible via a mobile data connection.
complete their course work with the use of self-directed learning modules. Box 2 above provides an example on how M-Learning can offer a new and innovative means of imparting education and learning capabilities.

2.2.3.1. Stumbling Blocks to M-Learning for Students and Teachers

Despite their tremendous potential, most mobile learning projects implemented in developing regions are small-scale and ad hoc. The medium of M-Learning has not been harnessed to its maximum potential in developing countries, and in fact, mostly been overlooked due to a variety of reasons along technical, sectoral, social, and policy aspects. Critical challenges along these dimensions are summarized as follows:

1] Technical Challenges:

- Despite the rising prevalence of advanced mobile technologies (such as smartphone and tablet devices) in developing countries, the majority of mobile phones used by economically disadvantaged individuals and communities in these regions are basic models that have very limited capacity to offer substantial learning content. Consequently, there exist only few M-Learning applications and business models for these devices.
- SMS-based communication involves costs for each one-way transmission of text. As a result, learners are often not willing or are unable to pay for interacting with learning content.
- The high cost of smartphone/tablet ownership - on which M-Learning is more easily and effectively accomplished- and accompanying data plans for students and teachers is a major obstacle.
- Weak mobile signals in remote regions, insufficient data bandwidth to stream learning material through video/voice, and in many regions, unavailability of reliable electrical supply to charge phones are key technical challenges.
- There exist concerns amongst users on privacy and online safety, resulting in inculcation of negative perceptions regarding the use of mobile phones in education by some teachers and parents.

2] Sectoral & Social Challenges:
Students often view mobile phones as a means of communicating with friends, accessing social networking sites and downloading entertainment materials such as music and videos. They are more willing to pay for these services as opposed to shoulder the cost of mobile learning, probably because students do not associate mobile phones with education.

There are limited opportunities for teachers to incorporate mobile technologies into their classroom practices;

Mobile device ownership is not equitable across gender or age groups, as it is much more prevalent amongst males and youth groups.

Across many regions, M-Learning does not align with the conventional educational practices and beliefs of students, teachers, and communities as a whole. This is probably because mobile phones are mostly associated with communication and entertainment, rather than learning.

M-learning content is sometimes not suited to local contexts. For example, in an M-Learning program in Pakistan, teachers reported that the narrators in the instructional videos spoke too fast, and that their accent could not be understood by students.

3] Policy-level Challenges:

While several countries have developed strategic plans and policies to integrate ICT in the education sector, these plans do not usually address mobile technologies explicitly, as a result of which governments’ involvement and attention to this medium has been limited. For example, no countries in Asia have ICT or education policies in place that specifically address mobile learning, implying that mobile learning is still a relatively new phenomenon and has not yet garnered attention from education policy-makers.

Some national, regional, district and institutional rules strictly prohibit the use of mobile devices in schools.

2.2.3.2. Factors for M-Learning Uptake

As observed, M-Learning can yield immense transformative possibilities for bridging the education and skills gap, but this methodology entails key critical factors to ensure its widespread adoption and rapid replication. Technological, individual, and institutional drive and support are needed to make mobile learning more successful. In view of increasing affordability of smartphone and tablet devices, the growing percolation of these gadgets in developing regions offers hope that a larger audience of marginalized
communities would be able to better access and benefit from innovative M-Learning applications. Other critical factors include:

- The conceptualization and adoption of business models that can yield creative uses of mobile phones for learning while simultaneously ensuring sustainability of initiatives;
- Positioning the education sector for overall readiness to adopt mobile learning strategies; and
- Advocacy and social mobilization schemes that can alter negative cultural perceptions on the use of mobile phones for learning and also lead to community ownership of initiatives.

The role of social intermediaries is also deemed critical to leverage mobile technologies more effectively for educational purposes. The support of enthusiastic individuals and their institutions or non-government organizations (NGOs) is needed to liaise between communities, students, teachers, and technology.

### 2.2.4. ICT for Enhancing Efficiency of Education-sector

Effectiveness of ICT in education denotes the extent to which ICT can improve education outcomes and replace traditional instruction methods. On the other hand, efficiency refers to the extent to which ICT can improve productivity of the education sector in terms of more streamlined and adept administrative and managerial processes. Concerning the impact of technology in school administration and organization, there seems to be a consensus among practitioners that ICT does enhance daily efficiency of schools. Globally, an increasing number of schools are adopting ICT tools such as intranets and digital learning environments to support the administrative personnel in performing administrative tasks (e.g., financial management) and the daily organization of the school (e.g., planning of the rooms). For example, schools are using ICT applications to collect pupil test scores, monitor progress in pupils’ scholastic achievements, report the pupil education outcomes to the parents, share information among the teaching staff, etc.

#### 2.2.4.1. Practical Uses of ICT for Education-sector Efficiency in Developing Countries

In developing countries, simple yet state-of-the-art ICT applications have the potential to introduce greater accountability and efficiency in the education sector. This study sheds light on two ICT-based applications that have demonstrated potential in enhancing efficiency:

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27 Does ICT matter for effectiveness and efficiency in mathematics education? Kristof De Witte and Nicky Rogge, TIER WORKING PAPER SERIES TIER WP 14/05
2.2.4.1.1. Mobile Phone-based Payment of Teachers’ Salaries

Mobile-based salary payments to teachers can help prevent their need to travel large distances simply to collect a paycheck. Instead, they can remain in their classrooms and use their time productively in teaching activities. Another important benefit of using mobile money platforms as seen in various countries has been its impact on the problem of corruption. Since it eliminates the need for the ‘middle man’ to distribute individual salaries, actual salary payments often grow larger and employees can receive their full compensation amount. Mobile money platforms can also help to alleviate the problem of ‘ghost’ teachers and employees because of their thorough registration process prior to the first payment transfer. All employees are vetted and registered to confirm their identification as well as their employment. Early lessons and models as suggested in the case study in Box 3\(^2\) suggest that such mobile-based payment schemes may be particularly relevant in post conflict environments.

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**BOX 3 – Mobile Phone-Based Payments in DRC**

In Democratic Republic of Congo (DRC), it was often observed that once cash wages were passed down the hierarchy from the government to civil servants, it was common for workers to receive only the equivalent of USD 5 of their approx. USD 60 monthly wage. In the hopes of reducing corruption, in 2012, the Democratic Republic of Congo (DRC) adopted mobile banking to pay salaries to 270,000 of its civil servants which included thousands of teachers.

These civil servants were provided with a mobile banking account associated with their phone and government ID numbers, and their salaries were deposited directly to this account by the government through mobile banking or ‘M-banking’ agents (confirmed by an SMS received by the civil servant). To load any more money into their mobile banking account, civil servants had to visit an M-banking agent and make a cash deposit which resulted in electronic money being transferred into their mobile banking account. This money could easily be transferred to other mobile phone users by SMS transaction. To withdraw cash from their mobile banking account, the civil servants had to visit the agent and make an electronic transfer to the agent who will exchange this for cash.

Aside from getting paid on time, government workers could use their new mobile accounts to pay bills, make deposits, pay for retail purchases and conduct other transactions via text message. This system also avoided the mishandling of cash and “self-tipping” by superior officers. The transition from cash to mobile wage payment also uncovered “ghost workers,” fictitious employees added to the payroll so that officials could pocket extra cash. Thirty fake schools “employed” approximately 200 ghost teachers. The results of this initiative was found to be overall beneficial for the education system, especially in rural areas.

There exists very limited research that quantifies the amount that can be conserved using mobile phone – based teacher payment systems. Yet, its potential impact can be deduced when considering certain cases in

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Papua New Guinea, where teachers had to travel a week each way to reach the place to collect their salary - that was paid every two weeks.  

2.2.4.1.2. Mobile Phone-based Monitoring of Teacher Absenteeism

In the many areas of developing countries, teacher absence is a widespread problem. Teacher absenteeism can be attributable to a variety of causes, such as lack of financial incentives to teach, lack of motivation and domestic problems, non-availability of teacher accommodation facilities, and so forth. It has also been argued that teachers fail to attend school because of lax oversight capabilities, where neither their principal nor the beneficiary have the capacity to effectively monitor and penalize absence. However, by recording teacher’s attendance through visual images, capturing date/time stamps, and ensuring a top-down model of accountability, mobile phone based monitoring applications can play a role in introducing a degree of accountability. Box 4 shares information on one such experiment conducted in India.

**BOX 4 – Reducing Teacher Absenteeism through Mobile Phones in India**

In 60 randomly-chosen informal one-teacher schools in rural India, a financial incentive program linked to mobile phones was initiated to reduce absenteeism. Teachers were given a camera with a tamper-proof date and time function, along with instructions to have one of the children photograph the teacher and other students at the beginning and end of the school day. The time and date stamps on the photographs were used to track teacher attendance. A teacher’s salary was a direct function of his attendance. The remaining 60 schools served as comparison schools.

The introduction of the program resulted in an immediate decline in teacher absence. The absence rate (measured using unannounced visits both in treatment and comparison schools) changed from an average of 42 percent in the comparison schools to 22 percent in the treatment schools. The program positively affected child achievement levels: a year after the start of the program, test scores in treatment schools were 0.17 standard deviations higher than in the comparison schools and children were 40 percent more likely to be admitted into regular schools.

2.2.4.2. Factors Preventing Wide Uptake of ICT-Based Efficiency Systems

Contrary to expectations, the vast majority of ICT initiatives aimed at enhancing education-sector efficiency in developing countries have not been fully institutionalized. The following list presents some factors that have prevented quick replication of these initiatives and hindered their advance beyond the piloting stage:

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29 *Paying teacher salaries with mobile phones*, Michael Trucano, EduTech (World Bank Blog on ICT in Education), Feb 2014

1. **Entrenched Interests & Social Dynamics**
   When teachers benefit from mobile payment schemes providing them with their full pay in a regular timely manner, it implies that other intermediaries stand to lose from the curtailment of ‘leakage’ opportunities. As a result, certain institutional and bureaucratic interests can advocate against consideration of mobile payment options for teachers. On the other hand, in remote communities, it is often members from culturally close-knit communities who hold teaching positions. As a result, school authorities may be reluctant to take disciplinary action against their own community members even if mobile-based monitoring initiatives provide the sufficient evidence.

2. **Security/fraud**
   Mechanisms may not be in place to prevent theft and fraud related to mobile money systems, or to detect where/when it is occurring, and how. Where it has been detected, an inadequate legal framework or law enforcement capacity may exist.

3. **Regulations**
   Existing laws and regulations may preclude the payment of teacher salaries through transfers of mobile money. Also, mobile phones may not be allowed in a school environment, thereby limiting monitoring of teacher absenteeism.

4. **Insufficient infrastructure and Institutional arrangements**
   Systems like mobile-based payments to teachers require certain key infrastructural elements to be in place. For example, teachers need to have access to mobile phones, accompanying affordable mobile networks, and mobile bank accounts. While advances have been made in this direction over the last decade, challenges persist for teachers in many remote communities. It also entails presence of m-banking agents (to accept mobile money and convert it to cash) within reachable distance. In the case of mobile-based monitoring of teacher absenteeism, while the community can effectively monitor attendance, it often lacks the power to penalize absence. Factors such as strengthening the flow of information between the community and the principal; involving the community in decisions to hire, fire, and pay teachers; or transferring wholesome control of teachers to the community are needed for this methodology to be a success. These factors are difficult to establish.

5. **Lack of Public Financial Management (PFM) Systems**
   Disbursement of salaries through mobile systems require the existence of up-to-date PFM systems. These may not be available in several countries due to intermittent electricity supply, a lack of access to computers or other electronic technology where information can be recorded and kept up to date, and limited technical skills of civil servants who are in charge of inputting and managing data within the databases.

6. **Lack of Clear Guidelines and Institutional Confusion**
In some countries, there are only few mobile money providers and governments may be reluctant to establish monopolies by choosing one over the other—as teachers often represent the largest single group of public sector employees. On the other hand, in countries with multiple mobile money providers, governments didn't know how to choose between the different options.

Table 2 on page 31 provides a cross comparison of the various technologies in education.

2.2.5. Broadband Technology for Education

This study considers the use of broadband-based internet connectivity as an enabling factor for the provision of technology in education. By facilitating seamless streaming of rich multi-media and sound-based instructional content over the web, provision of broadband services in schools and educational institutions comprises a vital ingredient for extending education programs access to outlying communities. Distance learning, cooperative work in virtual environments, online learning communities, and access to vast resources and databases are key benefits that can be reaped. Faster internet helps in improving accountability and efficiency capabilities of educational institutions. Also, broadband networks play a key role in helping poorer countries retain high-performing students who can help lift their nations out of poverty by serving as local entrepreneurs. While fixed broadband infrastructure continues to dominate the high-speed network in many countries, the steepest growth rate is seen in mobile broadband. Combined with the accelerated growth in mobile devices, as discussed in section 2.2.3., broadband-based M-Learning initiatives have increased in popularity—allowing for real-time, interactive and personalized learning. As a result, much learning now takes place outside traditional classrooms.

2.2.5.1. The Problem of Access

The broadband connectivity needed for sophisticated streaming, which is most common in modern massive open online courses (MOOCs), is the most limited in terms of current levels of access and use. As briefly outlined previously in Section 2.1, inequity in internet access across and within countries remains exceedingly high. To illustrate, in member countries of the Organization for Economic Cooperation and Development (OECD), 93 percent of secondary students have access to a computer and the internet at school. In stark contrast, in most African countries there are 150 students having access just to a computer itself, while the ratio of students to internet access is even lower. Only 31 percent of the population in developing

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31 This report considers Broadband to be internet connectivity with speed upwards of 2 Mbps
33 Ibid
countries had internet access in 2014 (against 80 percent in high-income countries) and only 17 percent of the world’s population is connected to high-speed broadband. In addition, half a billion people live outside areas with a mobile signal, as a result of which they are unable to benefit from mobile broadband connectivity. The lack of access to broadband services, especially in developing countries, thereby remains the main obstacle to extending and harnessing digital learning initiatives. Yet, as the table below shows, strong growth rates to internet access (in view of rapidly falling prices of internet access and gadgets) across all developing regions offers tremendous opportunity in the near future to harness broadband connectivity for enabling MOOCs.

<table>
<thead>
<tr>
<th>World Regions</th>
<th>Population % of World</th>
<th>Internet Penetration (% Population)</th>
<th>Growth in internet access (2000-2015)</th>
<th>Internet Users % (active at any instant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>16.00%</td>
<td>28.60%</td>
<td>7231.30%</td>
<td>9.80%</td>
</tr>
<tr>
<td>Asia</td>
<td>55.50%</td>
<td>40.20%</td>
<td>1319.10%</td>
<td>48.20%</td>
</tr>
<tr>
<td>Europe</td>
<td>11.30%</td>
<td>73.50%</td>
<td>474.90%</td>
<td>18.00%</td>
</tr>
<tr>
<td>Middle East</td>
<td>3.30%</td>
<td>52.20%</td>
<td>3649.80%</td>
<td>3.70%</td>
</tr>
<tr>
<td>North America</td>
<td>4.90%</td>
<td>87.90%</td>
<td>190.40%</td>
<td>9.30%</td>
</tr>
<tr>
<td>Latin America / Caribbean</td>
<td>8.50%</td>
<td>55.90%</td>
<td>1808.40%</td>
<td>10.20%</td>
</tr>
<tr>
<td>Oceania / Australia</td>
<td>0.50%</td>
<td>73.20%</td>
<td>256.90%</td>
<td>0.80%</td>
</tr>
<tr>
<td>WORLD TOTAL</td>
<td>100.00%</td>
<td>46.40%</td>
<td>832.50%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

2.2.5.2. Next Steps for Broadband in Education

In view of developing countries’ great need for increased access to Broadband for education, the Broadband Commission Working Group on Education makes a number of recommendations to governments and other stakeholders to bridge the digital divide, key of which are highlighted below:

- **Increase access to technology and broadband:** Policy-makers should continue efforts to implement policies ensuring affordable and equitable access to technology and broadband connectivity for all citizens, particularly women and girls and marginalized groups. The task of enhancing internet and broadband access can be achieved through a judicious mix of market competition, public-private

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partnerships, effective regulation of the internet and telecom sector, and placing greater emphasis on innovations in this sector.

- **Incorporate technology and broadband into job training and continuing education:** It is estimated that for every 10% increase in broadband internet service penetration in a particular area, employment would increase 2 to 3 percentage points per year.\(^{37}\) So given the pressing need to address socio-economic challenges such as high unemployment among youth, governments should provide the necessary incentives to support broadband adoption in all activities designed to create new jobs and open up prospects for employability. An improving employment scenario will encourage an increasing number of youth and their parents to continue pursuing education beyond primary level.

- **Teach ICT skills and digital literacy to all educators and learners:** Governments should prioritize the redesign of education systems in their national education agendas so as to better inculcate the role digital technology in the classroom. In particular, given the rising ubiquity if mobile devices, M-Learning at all levels and in all forms of education should be promoted through policies and incentives. Greater demand for ICT-enabled pedagogy and learning will stimulate the markets for provision of better internet infrastructure.

### 2.2.6. Situation of ICT in Higher, Secondary, and Vocational Education

The various types of ICT methodologies discussed in this report (ICT-based School mapping/monitoring, Online Learning, Social Accountability, and ICT for enhancing efficiency of education) have similar applicability and face similar obstacles in higher education vis-à-vis other education levels. Also, similar to the basic education sector, the higher education sector is challenged by issues of access, quality and relevance. However, there are some nuanced aspects regarding the role that ICT can play in higher education levels, and this section will shed some light on the main aspects.

At higher education levels, ICT skills can be imperative in conducting academic research activities and enhancing suitability to the job market. As a result of investment in ICT in this sector, many universities in developing countries today possess basic ICT infrastructure such as Local Area Network (LAN), internet, computers, video, audio, CDs and DVDs, and mobile technology facilities that form the basis for the establishment of e-learning, albeit with varying degrees of access and quality\(^{38}\). Exposure to ICT skills at higher education levels are also crucial to positioning students as future ICT entrepreneurs, programmers, and BPO employees – a growing trend in several emerging countries.

\(^{37}\) The Effects of Broadband Deployment on Output & Employment, Benton Foundation, Robert Crandall, William Lehr, Robert Litan, June 2007

\(^{38}\) Opportunities to Support Technology Entrepreneurship and Collaborative Open Innovation in East Africa, Paul Cunningham, Miriam Cunningham, Marlien Herselman, April 2013
So while ICT provides a great opportunity for all levels of post-primary educational institutions in developing countries to improve their teaching, learning, and research processes, related ICT uptake in secondary and higher education levels has remained limited in most developing countries. The main reason has been high drop-out rates from primary to secondary and to higher education levels and reduced number of institutions in each subsequent level. Another reason is the lack of suitable teachers qualified in ICT skills and training to use and impart relevant knowledge. Consequently, ICT, entrepreneurship and innovation skills are generally not integrated components in many post-primary programs and remain limited to university-level/vocational training -level students, a small number of selected trainees or otherwise delivered as commercial services. Also, this study notes that although a number of universities in developing countries today offer general ICT training for teachers and students, there are only very few that apply ICT into conducting general academic research or research into the development of software for teaching and learning purposes.

If a sustainable information society and knowledge economy are to blossom in developing countries, more concrete steps to leverage ICT in the higher education sector need to be undertaken. Possible avenues for the Education Commission to play a role in this regard are outlined in Section 4.

### 2.2.7. Possible negative impact of ICT on teaching, learning and attainment

Some practitioners have expressed reservations on the use of ICT in education-sector of developing countries. Concerns have been raised on a possible scenario where teachers and students’ excessive reliance on web-gleaned information may eclipse information from personal opinion or rigorous academic research. This may lead to dissemination and comprehension of incorrect learning content, as details of the work searched from the web may not be comprehensively checked through.

On the other hand, there are concerns that students, and sometimes teachers, can get hooked on the technology aspect, rather than the subject content. In other words, each access to online study resources may lessen students’ proclivity to attend classes, as a result hampering their overall cognitive, behavioral and social capacities. In addition, students may simply ‘cut and paste’ information from online learning,

39 ICT in Education Situational Analysis, Global E-Schools and Community Initiative (GESCI), Patti Swarts, Esther Wachira, July 2010
40 Ibid
41 Opportunities to Support Technology Entrepreneurship and Collaborative Open Innovation in East Africa, Paul Cunningham, Miriam Cunningham, Marlien Herselman, April 2013
42 Ibid
thereby affecting their reliability and ethical values. Social media networking sites (such as Facebook and Twitter) and other inappropriate content can be a distraction to learning in the real world.\textsuperscript{41}

Lastly, concerns have been raised on the possibility that ICT may eventually usurp the traditional role of teachers in classrooms, thereby leading to massive job losses and exacerbating the situation in already fragile economies.

However, if properly regulated, this paper considers the potential advantages of applying ICT in the education-sector to far outweigh any negative consequences. There exists no concrete evidence to support the hypothesis that leveraging ICT in education-sector context of developing countries has led to reduced social-interaction skills of students or enhanced unethical conduct. Further, the role of ICT in education-sector is seen largely to bridge the learning gap in regions where schools and teaching facilities are scarce or non-existent and to complement instructional pedagogy in other places. Hence there exists little scope of ICT to completely replace the role of teachers.

\textsuperscript{41}The Impacts (Positive and Negative) of ICT on Education in Nigeria, Israel B. Olaore, Developing Country Studies, Vol.4, No.23, 2014
Table 2: A comparison of ICT technologies in Education

<table>
<thead>
<tr>
<th>Imperatives for Success</th>
<th>Necessity of Government’s ownership of Technology?</th>
<th>Necessity of Community’s ownership of Technology?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Operation &amp; Deployment (Hardware &amp; Software)</td>
<td>Cost of Technology for Each</td>
<td>Cost of Deployment for Each</td>
</tr>
<tr>
<td>Internet</td>
<td>Regular mobile phones</td>
<td>Smartphones</td>
</tr>
<tr>
<td>Enhancing Students’ Learning Outcomes</td>
<td>Enhancing Overall Efficiency</td>
<td>Improving Access to Learning Materials</td>
</tr>
<tr>
<td>Improving Accountability</td>
<td>Enhancing Education Access</td>
<td>Enhancing Prometheus of Health &amp; Nutrition</td>
</tr>
</tbody>
</table>

**Cost of Technology for Each**

- **Smartphones**: Cost of Technology for Each (Hardware & Software) $1000 (USD)
- **Internet**: Cost of Technology for Each (Hardware & Software) $500-500 (USD)
- **Regular mobile phones**: Cost of Technology for Each (Hardware & Software) $500-500 (USD)
- **Smartphones**: Cost of Technology for Each (Hardware & Software) $1000 (USD)

**Enhancing Students’ Learning Outcomes**

- Smartphone: Cost of Technological Infrastructure $1000 (USD)
- Internet: Cost of Technological Infrastructure $500-500 (USD)
- Regular mobile phones: Cost of Technological Infrastructure $500-500 (USD)
- Smartphones: Cost of Technological Infrastructure $1000 (USD)

**Enhancing Overall Efficiency**

- Smartphone: Cost of Technological Infrastructure $1000 (USD)
- Internet: Cost of Technological Infrastructure $500-500 (USD)
- Regular mobile phones: Cost of Technological Infrastructure $500-500 (USD)
- Smartphones: Cost of Technological Infrastructure $1000 (USD)

**Impending Accountability**

- Smartphone: Cost of Technological Infrastructure $1000 (USD)
- Internet: Cost of Technological Infrastructure $500-500 (USD)
- Regular mobile phones: Cost of Technological Infrastructure $500-500 (USD)
- Smartphones: Cost of Technological Infrastructure $1000 (USD)
Section 3: The Science of ICT Delivery in Education

Section 2 shed light on the key technical methodologies related to the use of ICT for education (abbreviated henceforth as ICT4E). However, technology is only a means to an end. To illustrate, although race cars may be imported anywhere in the world, their performance in that country cannot be guaranteed unless certain conditions have been met such as availability of skilled drivers, high quality fuels, smooth roads, and other factors. Similarly, it has been demonstrated through a number or practices across the world that technology does not deliver educational success in either learning, accountability, or social accountability contexts on its own. It only becomes of value if learners, teachers, and authorities can adopt it to a useful end. The case study presented in Box 5 below depicts how a well-intentioned ICT4E initiative could not deliver envisioned results in view of inadequate local consultations and partnerships.

| BOX 5 – The ‘One Laptop Per Child’ (OLPC) Initiative |

In 2005, Media Lab of Massachusetts Institute of Technology (MIT)’s Media Lab launched the revolutionary One Laptop Per Child (OLPC) initiative with the aim of producing low cost, low power but high quality laptops to support children’s learning in developing countries. The OLPC XO laptop was subsequently launched -to be made available for only USD100, yet possessing the salient features of more expensive computing devices. These devices were intended to allow students to collaborate on activities and to share Internet access from one connection. It had a significant anti-theft system built-in, and all its other components are as low-cost as possible. It uses an operating system custom-designed for the device. It could browse the internet, word process, chat, play games, and even included a few creative tools like a music creator and a beginner’s programming guide.

While noble and lofty in its vision, the program could not realize its anticipated success. The OLPC project has faced backlash for adopting a "one-shot" deployment approach with little or no technical support or teacher training, providing no localized content, and for neglecting assessments and pilot programs in collaboration with intended beneficiaries. To illustrate, since students and teachers in beneficiary countries were not part of the design process, the OLPC XO-1 laptop lacked connectivity to external monitors or projectors, as a result of which students were unable to present their work to the whole class, while teachers found it difficult to use the keyboard and screen, which were designed with student use in mind. In the absence of any local technical support, students were unable to address the technical issues or ‘bugs’ affecting the device and many lost interest in using them.

As a result, in 2008 OLPC reduced their annual budget from $12 million to $5 million and reduced their staff to less than 20 members. As of 2015, OLPC reports that while over 2.4 million laptops have been shipped to date, this is far from the original target set in 2005 of “…providing every child in every developing country with a laptop”.

Figure 8: An OLPC XO laptop
Against this backdrop, this section provides a tool kit on how to effectively deploy ICT4E initiatives in targeted communities, regions, or countries. In order for ICT4E initiatives to be successful, this study considers the following factors to be critical:

- Consultations with intended beneficiaries in the design process
- Comprehension of the prevailing policy frameworks
- Formulation of viable business models for sustainability
- Engagement with global innovators through incentives
- Collaboration with targeted users for curriculum co-creation in adherence with learning standards
- Extensive piloting and incorporation of feedback

The following sub-sections describe the process in more detail and forewarn on potential pitfalls.

### 3.1.1. Step 1: Analyze Prevalent Infrastructure and Capacities

The first step in the direction of harnessing ICT4E in the targeted community or region should involve a comprehensive assessment of the prevailing physical building blocks and conditions that support the delivery of learning content or accountability in the education sector. The main components of the physical building blocks include aspects such as availability of education platforms, internet connectivity, devices, etc., while the supporting conditions include education-sector policy framework, availability of locally relevant content, tutoring/mentorship facilities (for blended learning), partnerships with local actors (for localization), and so forth. To illustrate, large percolation of smartphone devices in any community may indicate that implementing app-based solutions might be the best approach. It may also indicate the need for projects to provide different devices (such as laptops) to communities to support E-Learning initiatives. On the other hand, policy frameworks that support, for instance, Open Data, may indicate that initiatives involving social accountability can be implemented locally and may flourish.

Undertaking this step one region or community at a time ensures that envisioned solutions fit the specific capacities of the local context (e.g., a refugee camp) under the assumption that long-term operations would be locally managed.

### 3.1.1.1. Key Challenges

- Rapid evolution of technology leads to increasingly decreasing costs for newer gadgets ownership, thereby enhancing scope for their affordability in lower income communities or regions. As a result, communities having access to only basic or low capacity gadgets (such as regular mobile phones) today
may eventually have greater access to more sophisticated equipment in the near future. This may necessitate a re-design of the technical solution in a short time span.

- Being highly sensitive to local requirements, this step entails expertise across the entire chain of education delivery and interaction and partnership with a large number of stakeholders across vastly different industries.
- The medium- to long-term operational sustainability of this step is contingent upon local ownership, as there may be an interim risk of replacing or eclipsing the role of local agencies in developing capacity to deliver education. In other words, a ‘project dependency’ may set in. For example, new gadgets provided to communities during projects should be maintained by the communities themselves—failing which, educational initiatives may falter after the end of any particular project. But communities often get attuned to external actors stepping-in to fulfil requirements for the sake of operationalizing projects.

### 3.1.2. Step 2: Incentivize Innovators/Entrepreneurs for Designing Solutions

Comprehending the physical building blocks and supporting conditions as suggested in Step 1 provides the possible *breadth* and *depth* dimensions of envisioned ICT4E initiatives in local contexts. Based on this, there is a need to develop the related applications, course authorship tools, content creation spaces and so forth such that ICT4E initiatives may be implemented within the *breadth* and *depth* framework. To this end, entrepreneurs and enterprises need to be invigorated and incentivized to develop locally suitable learning content in collaboration with local actors. Thereby, this step entails provision of the necessary capital (e.g., grants, equity, debt) to spark innovation for specific education-sector gaps, such as content creation or delivery mechanism. Possible models for incentivization may involve: a Pay-for-performance fund that awards grants to teams for innovations that have had a demonstrated impact on elements of the delivery system most needing improvement (for example, teacher training); a Fund or social impact bond for entrepreneurs; Rewarding entrepreneurs based on student success, so that only applicants or ventures which achieve the highest education outcomes are advanced to higher stages of funding; and so forth. Box 6 sheds light on an innovative and popular way of ‘Hackathons’ for incentivizing programmers to design promising applications.

#### 3.1.2.1. Key Challenges

- Developing and implementing ICT4E solutions in developing countries is often seen as a high risk undertaking to many entrepreneurs. Coupled with the fact that only few proven business models exist, entrepreneurs often shy away from venturing into this space.
• Creation of ICT4E solutions in itself will not drive communities’ up-take of solutions. Ensuring success of initiatives will also need to involve a local marketing, deployment and engagement strategy.

• Using a competitive prize model or fund solves for problems in the delivery system that are in need of specific (often technical) innovation or improvement. It is less well suited to generating solutions to broader cultural or institutional challenges.

• In high-need areas where qualified recipients are lacking, or in areas where access is limited to external actors (such as conflict-prone regions), there is a risk of solutions being developed without authentic local authorship.

BOX 6 – ‘Hackathons’ as an instrument for Incentivizing Entrepreneurs

A hackathon is an event during which computer and hardware programmers collaborate intensively on ICT projects, often on a voluntary basis. These events are usually associated with a specific theme in relation to which solutions need to be designed, and typically last between a day and a week. For example, Science Hack Day is a hackathon event held for innovating applications related to Science, and has been held over 45 times in over 15 countries since 2010.

Some hackathon events are intended simply for education or social purposes, although in many cases the goal is to innovate usable software. For programmers, the immediate advantages of participating in a Hackathon event include: Exposure to networking opportunities with other like-minded professionals; Opportunities for winning prize money; Direct showcasing of skills to attending sponsors and tech gurus; Learning and incorporating from other individuals, and sometimes, grouping together with other attending individuals to form a start-up company to further build-upon a promising idea. Some programmers participate in Hackathon events simply to assume an activist role for co-creating solutions associated with a social cause, especially related to improving social accountability and Open Data.

Hackathon events have led to some interesting and exciting innovations, such as:

• Homework Hack: This solution can read basic math problems, solve them, and write out the answers in the users’ own handwriting
• Divvly: Allows friends to easily split the restaurant check. One user uploads a picture of the receipt and splits the meal items amongst friends appropriately. Then everyone pays through the said person through Venmo app.
• What I cook-up: An app that allows users to plan meals based on the food actually available in the kitchen. Users snap a pic of their ingredients and the app suggest recipes they could easily make.

In this light, Hackathons can play a valuable role in bringing innovators and entrepreneurs together to co-create interesting solutions for the education-sector.

Figure 9: Photograph from a Hackathon event
3.1.3. Step 3: Accreditation and Content Creation for ICT4E Solutions

In order to legitimize online learning and contributions, students need an accreditation system that is recognized by the local and regional authorities, such as employers, governments and school boards. In case none exist, then prior to blending learning content into the ICT applications, it is critical to liaise across national and local governments, institutions, and job markets to develop learning standards for imparting education online. This process helps ensure that students’ and teachers’ learning through ICT meets an established standard. It is also recommended to establish a set of standards for the curriculum component (what is learned) as well as a governing component (how it is learned). The certifying body should seek partnerships with local or regional organizations that provide, certify and or recognize learning. Once standards have been outlined, local organizations, teachers and students should be catalyzed and consulted with to develop the learning materials and content to be imparted via the ICT platforms. As this step depends on a strong level of local participation, collaborative platforms should be leveraged to support educational innovation and entrepreneurship relevant in local contexts. Box 7 provides a case study on how Living Labs can provide such a platform for innovators and content creators to collaborate and develop localized ICT4E solutions.

3.1.3.2. Key Challenges

• Lack of credential portability is unfortunately a globally ubiquitous issue. Portability of accreditation across borders needs to be facilitated, addressing education for populations that migrate due to conflict, crisis or other factors.
• At present, most M and E –Learning platforms are creating their own proprietary certifications that lack transferability and global recognition. As a result, many employers (human resources departments) globally still recognize a recognized degree as the minimum barrier to entry.
• Standardized testing has been heavily criticized, yet is hard to imagine implementing a global certification system without it
• Localization and community buy-in for developing learning content are key ingredients of this step. But it is unknown whether enough communities have this capability or perceive the benefits to participation.
3.1.4. Step 4: Aggregate Platforms

To prevent the creation of a multitude of stand-alone applications and content, the final step involves aggregating all existing content from active ICT4E initiatives and then translating and adapting content to local cultural context. This content would be categorized and adapted for appropriate technical presentation relevant to each region, through different user interfaces of each region. For example, in low-connectivity areas, this model will offer a simple text-only version of an otherwise video-rich lesson.

The major benefit of undertaking this step is that users have a central landing point for content originating on multiple learning platforms in order to find the one relevant to their needs or resources. The main

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**BOX 7 – ‘Living Labs’ as a Platform for Co-creation of ICT4E Solutions**

*Living Labs* is a research concept originally developed by MIT (Massachusetts Institute of Technology) in late 1990’s to assess both the performance of a product or service and its potential adoption by users. According to MIT “Living Labs bring together interdisciplinary experts and stakeholders to develop, deploy and test new technologies and strategies for designing services/products/concepts that respond to this changing world”.

The value of *living labs* is that they connect developers to local users, business partners and policy makers in a shared innovation process that combines the professional and real-life experience to local research & development practices. *Living Labs* as testing environments are closely connected to initiatives taking the advantage of Open Data. A good example is where living labs have been used as testing environments to create toolkits to help make it easier for developers to create new and innovative applications in urban context and transfer these amongst 9 "smart" cities from Helsinki (Finland) to Istanbul (Turkey). Several hundreds of services and apps based on Open Data have been developed, tested and brought to the market through practical platforms engaging users into real-life experimenting process through *living labs*. The living labs process consists of the following main activities:

- Co-creation: Subject innovations to a diversity of views, constraints and knowledge sharing
- Exploration: Engage all stakeholders, especially user communities in the co-creation process for discovering emerging scenarios, usages and behaviors through live scenarios.
- Experimentation: Implement technological solutions to experience live scenarios with a large number of users while collecting data which will be analyzed in their context during the evaluation activity.
- Evaluation: Assess new ideas and innovative concepts based on data collected from the Experimentation stage.

Citilab based in Cornellà de Llobregat, Spain, MIT Living Lab in Boston, USA, Kathmandu Living Labs in Kathmandu, Nepal are examples of successful Living Lab concepts that can serve as a model for establishing co-creation platforms in the domain of ICT4E.
rationale for this step is that the sorting and unifying functions of an aggregating platform will drive more students and teachers to learn and use online content suitable for their contexts.

### 3.1.4.2. Key Challenges

- Different entrepreneurs/enterprises may not be amenable to sharing their content with each other, as content is often proprietary and expensive to create.
- Integration of disparate user interfaces and content will be expensive and challenging to implement.
- Translation of disparate content into various local languages will be expensive and challenging to implement.
- In itself, translation of externally sourced content is insufficient for providing a truly culturally appropriate learning environment.

### 3.2. An Assessment of Value for Money (VFM) of ICT4E Initiatives

Cost-effectiveness analysis is an important ingredient in the science of ICT4E services delivery as it determines how much impact (e.g. on teaching practice or learning outcomes) an intervention achieves relative to the inputs invested in it. Without this, it is difficult to make comparisons between ICT and non-ICT interventions that could deliver the same outcomes. Therefore, prior to embarking on ICT4E programs, the costs of conducting the key steps should be estimated, VFM metrics developed, and a cost-effectiveness analysis carried out. These cost indicators should be revisited throughout the project cycle, and be used when evaluating the effectiveness of interventions.

However, upon conducting a survey of several ICT4E initiatives, this study found there to be a lack of cost data and cost-effectiveness analysis for any of the assessed initiatives. Only a small fraction of initiatives presented any breakdown of costs, or provided value for money (VFM) indicators, or conducted a cost-benefit analysis linking the input costs of the ICT4E interventions with their impact on education-sector outcomes. This is largely in part due to 3 factors:

- Most ICT4E initiatives are donor-funded activities, where the emphasis is more on triggering education-sector outcomes in marginalized regions as opposed to realizing V4M.
- Measuring ICT4E-based accountability achievements in education-sector involves a subjective evaluation of outcomes, often in qualitative terms -which may not be easily possible to quantify.
- Many ICT initiatives have been demonstrated impact on learning outcomes only in a pilot setting
In the absence of adequate baseline or benchmarking indicators in this area, this study suggests that ICT4E initiatives should only be embarked upon only if it is affordable to all stakeholders and can really add value that is better or different in comparison with other possible options.
Section 4: Possible Role of the Education Commission in ICT4E and Next Steps

As seen in the previous sections, there exist a number of innovative ICT4E applications and initiatives that aim to transform learning outcomes for students and teachers and also introduce accountability in the education-sector. However, many stakeholders, authorities and institutions do not yet possess the requisite know-how, financial or risk-taking capacity to apply ICT for improving Education-sector performance and services. In other words, the ’ecosystem’ for pursuing education-sector reform objectives through ICT in many regions may be under-developed. To this end, as shown in Fig. 10, the Education Commission -as a political agency that can help implement change through advocacy and lobbying -can have a salient role to play in strengthening possibly nascent or broken ecosystems (through guidance from the Technology Panel) where some of the key linkages are weak or lacking altogether.

Figure 10: ICT-Education ‘Ecosystem’
Promising ICT4E strategies sometimes remain immaterialized because, at the points of intersection between various nodes of the ecosystem, the interplay is often insufficient or counterproductive. It is here where promising initiatives are often lost and the need for new approaches becomes essential.

4.1. Menu of Options for the Education Commission

As can be inferred from Figure 10, strengthening the fragile ICT- Education ecosystem presents vast scope as well as challenge for the Education Commission to apply its expertise. In view of its existing capabilities and comparative advantages within this domain, where should the Commission focus its resources and expertise in order to scale up ICT4E in marginalized regions? To address this question, a framework of options is being provided for discussion with the Technology Panel.

Areas to be explored are as follows:

- **Formulating ICT4E Sustainability and Funding models:** ICT4E initiatives have been found to often collapse after the end of donor financed funding. Therefore, sustainability options are needed that can help ensure continued operationalization and upgradation of initiatives post-project phase. In this regard, funding models are needed that can guide on successful leveraging of ICT4E throughout the project lifecycle - from developing ICT4E applications, to co-creating content, piloting, and then taking promising initiatives to the next level and sustaining these after the end of initial venture funding. Millennium Challenge Corporation (MCC)’s and Concordia’s Public Private Partnership (PPP) are possible platforms whose guidance and advice the Commission could solicit in this direction.

- **Development of Business Case(s):** To trigger greater responsiveness & initiative-taking across the platform of key stakeholders (policymakers, authorities, ICT developers, etc.), a business case detailing the economic value of leveraging ICT4E solutions is required. This would entail in-depth case studies/analysis of ICT4E initiatives to develop a solid business case highlighting:

  1] The economic benefits of ICT4E in marginalized communities (such as transparency gains, cost savings, efficiency, citizen convenience, etc.).

  2] Lessons learned from successful ICT4E initiatives, including identifying conditions necessary for success, pitfalls to be avoided, etc.

There are a range of private sector management consulting firms (such as McKinsey) or even renowned researchers who could be approached for developing such a business case.
• **Dissemination of ICT Awareness**: Often, the bottleneck for incorporating ICT as a component of education-sector activities in developing countries involves the lack of know-how, comprehension, and guidance regarding leveraging ICT. Therefore, raising the related awareness amongst stakeholders is vital.

  - In his direction, workshops/campaigns could be organized geared towards: 1] Showcasing specific examples of ICT usage towards addressing education-level issues and bridging the rapidly growing skills gap; and 2] Enlightening the Commission’s partners and stakeholders on recommended strategies (such as the ones discussed in this report) for ICT4E inculcation for transforming the education-sector.

• **Foster Collaborations**: Conceptualizing/implementing ICT initiatives for education need not involve ‘re-inventing the wheel’. Various organizations (e.g., UNICEF, The World Bank, InfoDev, and local NGOs such as Ghana’s People’s Dialogue, etc.) have garnered experience in applying and leveraging strategies for ICT in education (for example, organizing Hackathons, establishing Living Labs, subsidizing development of ICT4E solutions, etc.). But many of these agencies’ initiatives are undertaken in institutional ‘silos’ with lax knowledge sharing amongst each other -leading to overlaps and thereby resource wastefulness. The Education Commission could play a crucial role in harmonizing efforts of agencies for a unified approach that may be more impactful. The Commission’s global platform could possibly provide a space for fostering inter-agency collaborations.

• **Helping Establish ‘Standards’ for Online-learning**: As discussed in this report, the lack of concrete and universal ‘accreditation’ standards in online learning courses poses a major hindrance towards wider enrollment of students into online learning programs. Pushing for establishing such standards through active collaboration with policymakers, entrepreneurs, and academicians could be a most valuable endeavor of the Commission.

• **Bridge Skills gap in Higher Education**: Given that very few youth in developing regions (such as Sub-Saharan Africa) are currently able to enroll into University-level degree programs, there is an immense need for more ICT-based skills programs that support entrepreneurship, innovation, and BPO-employability in higher education and vocational training institutions. This study recommends the Commission to possibly play a role in helping co-create comprehensive certification friendly, modular blended learning curricula, to address common ICT and Entrepreneurship skills gaps. It is recommended that existing high quality local and international training materials are adapted where possible, with new modules only commissioned to address identified gaps. The Global Partnership for
Education (GPE) is currently pursuing some work in this direction and could be approached by the Commission for assistance and guidance.

4.2. Recommended Options for the Education Commission

Based on the capacities and mandate of the Education Commission, and given the relative strengths, weaknesses, and complexities associated with each ICT-Education methodology (as outlined in Table 2), this paper recommends Online Learning and ICT-Based School Mapping as possible ‘game-changing’ mechanisms for enhancing learning and accountability outcomes (respectively) in the education-sector. As opposed to other methodologies, Online Learning and ICT-Based School-Mapping/Monitoring mechanisms have a stronger history of institutionalization amongst governments of developing countries and have demonstrated impact. Rapid uptake of mobile devices (such as Smartphones) and increasing internet access in developing countries (including the emergence of community internet ‘hot-spots’) imply that the stage is widely set for easy adoption of these methodologies. This study also encourages the Commission to actively pursue Public Private Partnership (PPP) platforms (such as Concordia) as optimum mediums for co-formulating viable ICT4E sustainability and funding models with industry leaders and top academicians.