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From e- to m-Learning: feasibility for an African-delivered tertiary program

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ABSTRACT Since 2000, the Early Childhood Development Virtual University (ECDVU) has offered graduate-level programs in sub-Saharan Africa. These programs have been highly successful in creating a cadre of early childhood development (ECD) leaders in countries throughout Africa. When ECDVU was launched, the program was considered to be at the cutting edge in its use of appropriate and feasible technology. Within the past decade, however, the use of information and communication technologies (ICT), including mobile phones, personal digital assistants and tablets, has expanded dramatically within the Minority ('Developed') and Majority ('Developing') Worlds. Thus, ECDVU has begun to explore whether and how the graduate-level ECDVU programs might be delivered partially or primarily through tablets or smartphones.

Introduction

The Early Childhood Development Virtual University (ECDVU), launched in 2000 and now in its second decade of operation, has provided graduate-level programs that have strengthened leadership and capacity in the field of early childhood development (ECD) throughout Africa. A recent external evaluation of ECDVU by the World Bank (2011) showed that completion rates across the first three deliveries of the program were very high, at over 95%. Moreover, the programs have been instrumental in building capacity in African ECD: 99% of graduates have stayed in their home countries, and over 97% have remained in child, family and community development positions. As the program moves forward, it is important to consider ways to build upon these successes, and to consider new modes of program delivery that are consistent with contemporary practices and possibilities in distance education in the Majority ('Developing') World.

From its inception, ECDVU has employed a combination of web-based learning and face-to-face seminars. Given electrical and connectivity challenges, core program materials have been purposefully redundant, with course readings being provided in print form as well as in electronic form on a DVD and on the course website. Learners typically make extensive use of the Internet to conduct research and to complete course activities, including discussion postings. Desktop and laptop computers and fixed-line Internet access have been the primary tools in the delivery of the program. Communication between instructors and students, when not face to face, has been primarily through email or via postings on the course website (see Schacter et al, 2005; Pence, 2007).

When ECDVU commenced operations in 2000, the program's use of technology was considered to be highly innovative, appropriate and feasible. However, given the recent and

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dramatic increase in the use of information and communication technologies (ICT), especially smartphones and tablets, ECDVU has begun to consider ways to modify its program delivery methods. Increasingly, ICT is regarded as an integral component of the delivery of educational programs in both the Majority and the Minority Worlds. Indeed, within the Majority World, ICT is seen as a key element in increasing access to education and training. Given the high rate of penetration of mobile phones in the Majority World, mobile learning ('m-learning') is increasingly seen as a viable mode of program delivery.

Given such developments, ECDVU wished to explore the desirability and feasibility of, for example, delivering the graduate-level ECDVU programs partially or primarily through tablets or smartphones, and incorporating the functionality of these devices into course activities and assignments. If such developments were feasible, ECDVU graduates would then be better placed to integrate the use of enhanced ICT into the design and delivery of ECD programs and initiatives within tertiary institutions and, potentially, at community levels, where the use of mobile phones is prevalent.

The first section of this article provides an overview of the ICT literature in education and training, with a particular focus on the use of ICT in Africa. The second section describes results of an informal survey on ICT use, conducted with Nigerian participants in the fourth ECDVU African cohort in Ghana in June 2011. Taken together, the information in Sections I and II then informs the discussion of possible future directions considered in Section III of this article, which are intended to help ECDVU plan for the further integration of ICT, and new ICT options, into future deliveries of the ECDVU program.

Section I. Literature Review

The Context for ICT: sub-Saharan Africa in a global context

Before developing plans to expand the use of ICT in ECDVU, it is important to understand the context for the use of ICT in sub-Saharan Africa. Table I (compiled from Development Data Group, World Bank, 2011) presents data on the access, usage, quality and affordability of Internet and cellular mobile networks in 2000 and 2009 in the world generally and in sub-Saharan Africa in particular. The table also provides some information on the social and economic context over this same period. The data illustrate that global trends and trends in sub-Saharan Africa are mostly parallel. The population, urbanization, gross national income, gross national product, adult literacy and enrolment in all levels of education have increased. With respect to the Internet, personal computers and telephones (land lines and mobile phones), access, usage and quality have increased on nearly all measures provided.

However, while global and sub-Saharan African trends are similar, some striking contrasts are apparent. First, penetration rates of all technologies listed (e.g. mobile phones, personal computers, Internet use) are much lower in sub-Saharan African than those seen globally. Second, while 2009 per capita incomes in sub-Saharan Africa are approximately one-seventh the amount of the global average, the use of land lines, mobile phones and the Internet is more expensive in sub-Saharan Africa. In particular, Internet access is nearly three times more expensive than the global average, despite a dramatically smaller available bandwidth in Africa. Finally, as pointed out, while the use of mobile phones and the Internet has increased from 2000 to 2009 in sub-Saharan Africa and globally, the rate of increase has been more striking in sub-Saharan Africa in some respects. For example, while mobile telephone subscriptions have increased six-fold between 2000 and 2009 globally, they have increased by a factor of nearly 22 in sub-Saharan Africa. Similarly, while the number of Internet users (per 100 people) has tripled globally from 2000 to 2009, in sub-Saharan Africa, the number of Internet users has increased by a factor of nearly 18.

These trends suggest that as the infrastructure for the Internet and mobile telephones expands, penetration rates will continue to increase. In Africa, research indicates that mobile coverage could be extended to cover 97% of Africa's population without public subsidy (GMSA Development Fund, 2010). In Kenya, the mobile phone penetration rate was estimated at 77.2% in September 2012, up from 67.2% in September 2011, and is expected to continue rising (Communications Commission of Kenya, 2013). As documented in a recent report focused on Mauritius, South Africa, Tanzania and Zambia (GESCI, 2011), most countries have developed or

are developing policies and plans to foster the development of a knowledge-based society in which the importance of consistent and pervasive access to ICT by all citizens is recognized. While the implementation of such policies and plans is still in the early stages, notable progress has been made, and is likely to continue.

Analysis category	World		Sub-Saharan Africa	
	2000	2009	2000	2009
Economic and social context				
Population (millions)	6085	6775	672	840
Urban population (% of total)	47	50	33	37
GNI per capita, *World Bank Atlas* method ($)	5293	8732	488	1125
GDP growth, 1995–2000 & 2000–2009 (avg./year, %)	3.3	2.9	3.2	5.1
Adult literacy rate (% ages 15 and over)	82	84	57	62
Gross primary, secondary, and tertiary enrolment	62	68	43	54
Access				
Telephone lines (per 100 people)	16.0	18.0	1.4	1.5
Mobile cellular subscriptions (per 100 people)	12.2	69.0	1.7	37.3
Fixed broadband Internet subscribers (per 100 people)	2.3	9.1	0.2	0.2
Personal computers (per 100 people)	8.0	15.3	0.9	1.8
Usage				
Mobile telephone usage (minutes/user/ month)	195	298	..	..
Internet users (per 100 people)	6.7	27.1	0.5	8.8
Quality				
Population covered by mobile cellular network (%)	..	80	..	56
Fixed broadband Internet subscribers (% of total subscribers)	15.7	59.7	0.2	31.8
International Internet bandwidth (bits per second per person)	102	3526	1	31
Affordability				
Residential fixed line tariff ($ a month)	..	10.1	..	11.5
Mobile cellular prepaid tariff ($ a month)	..	8.7	..	10.4
Fixed broadband Internet access tariff ($ a month)	..	29.7	..	88.0
Applications				
E-gov't Web measure index (0–1, 1=highest presence)	..	0.26	..	0.10
Secure Internet servers (per million people)	21.8	155.7	..	4.8

Table I. The ICT Context: comparison of world and sub-Saharan Africa (compiled from Development Data Group, World Bank, 2011, pp. 2, 8).

Towards Ubiquitous Learning: mobile learning

Given the prevalence of mobile phone use in sub-Saharan Africa, and its relative accessibility and affordability compared with personal computers and fixed broadband Internet, mobile learning (m-learning) is a more viable method of increasing access to education and training than traditional web-based instruction.

Indeed, the literature indicates that many Majority World nations find Internet-based learning unsuitable for their needs (Motlik, 2008), reinforcing a 'digital divide' that can be largely bypassed by taking advantage of the prevalence of mobile phone use, which cuts across income levels (Samrajiva & Zainudeen, 2008; Brown & Czerniewicz, 2010). As stated by Motlik: 'The technology is more affordable; learners are familiar with it; and with proper instructional design it promises educational opportunities with an increased flexibility for learners, satisfying the "anytime/ anywhere" component of distance education for thousands if not millions of learners' (2008, p. 1).

While m-learning has expanded rapidly in Asia (see e.g. Baggaley & Belawati, 2007; Valk et al, 2010), and is also gaining traction in Africa (Traxler & Dearden, 2005; Vosloo & Botha, 2009; Hellström, 2010), the field is still relatively undeveloped in terms of technological limitations and pedagogical considerations (Traxler, 2007; Park, 2011). Most organizations involved in m-learning are working on independently developed pilot projects, limiting the sharing of best practices (GMSA Development Fund, 2010).

Moreover, as pointed out by Guralnich (2008), today's m-learning designers tend to draw on their experiences with web-based learning, rather than designing programs that respond to the broader context in which learners will use m-learning programs (El-Hussein & Cronje, 2010). Perhaps for this reason, m-learning has enjoyed some success in increasing access to education and training, but, as highlighted by Valk et al (2010), it has not necessarily contributed to the development of 'new learning' that reflects the unique properties of the mobile medium. For example, many m-learning initiatives employ mobile devices, such as tablets, primarily as content delivery mechanisms, failing to take advantage of the potential of these devices to generate content (Murphy, 2011) and to promote collaborative learning (Caballé et al, 2010).

This failure to adequately address 'new learning' possibilities was of particular interest to the ECDVU program, as one of the ongoing objectives of the program has been to engage 'multiple knowledges', including local knowledge, in addressing children's care and development. The ECDVU program and its philosophical predecessor, the First Nations Partnerships Program, employ a 'generative curriculum' approach that seeks to create learning environments in which diverse knowledges and understandings can engage with one another, often resulting in the 'generation' of new understandings and possibilities (Pence & Marfo, 2004). It was felt that the broad penetration of mobile phones throughout Africa had the potential to enhance multi-knowledge approaches to education and development – another key reason for this exploration.

Mobile Phones: methods of access

In considering how ICT might be deployed in future deliveries of ECDVU, and in African post-secondary institutions and communities with which ECDVU graduates are connected, it is important to consider the various methods of access to ICT and their associated affordances.

Mobile phones are the most commonly used form of ICT in sub-Saharan Africa. Table II (excerpted from Hellström, 2010, p. 26) outlines the range of ways that citizens in sub-Saharan Africa access mobile phones, and what services are available through each method of access.

Of the options noted above, smartphones offer the potential for the richest m-learning experience. However, it is important to consider the fact that smartphone penetration is only expected to reach around 17% by 2014 (GMSA Development Fund, 2010). Therefore, to ensure accessibility for the majority of potential learners, the majority of m-learning programs for delivery in the near future need to be designed for low-end or feature phones. Currently, about 50% of m-learning programs in the Majority World are designed for feature phones (GMSA Development Fund, 2010). Within sub-Saharan Africa, most mobile phone users have access to low-end handsets, so many m-learning programs are designed to function with voice and SMS ('texting') alone.

However, a number of trends point to the possibility of increased m-learning options in the not-too-distant future. For example, IP mobile networks and new high-bandwidth submarine cables are allowing mobile operators in some regions of Africa to become increasingly serious Internet service providers. Also, as the cost of mid-range feature phones and smartphones gradually decreases, mobile phones are likely to become the dominant mode of accessing the Internet, including social networking sites such as Facebook, which is popular among young, urban people (Hellström, 2010).

Section II. Survey Results

Summary

To help determine the feasibility of possible approaches to the use of ICT in future ECDVU deliveries, an informal participant survey was conducted at the fourth delivery of the ECDVU graduate diploma program in Cape Coast, Ghana, in June 2011. The survey questions were used as the basis for informal discussions between ECDVU staff and learners. In addition, a written form of the survey was distributed to ECDVU learners, to which 28 responses were received (a 93% response rate). Further, a shorter, informal survey of graduates from the first three deliveries of ECDVU was conducted via email to determine their use of social media (e.g. Facebook, Twitter), email, mobile devices, and methods of accessing the Internet.

Methods of access	Channels	Examples
Radio The most accessible and widely used form of communication across the region	Broadcasting Community radio Feedback through mobile phone (e.g. SMS to radio, mobile phones equipped with an FM transmitter)	Common ways to combine mobiles and radio: Channel for listeners to contribute news, views, stories and feedback Sending SMS to listeners on upcoming programmes, competitions or events Using SMS to transmit important information to be broadcast on radios during emergencies, for search and rescue, alerts and early warnings, etc.
Basic mobile phones Low-end mobile phones	Voice SMS Voice to text/text to voice Interactive voice response (IVR)	Voice conferencing 'Dial-up radio' Data collection and monitoring Logistics coordination
Mid-range mobile phones	Data transfer through GPRS Java (J2ME) enabled Mobile WAP Additional features such as camera, Bluetooth	Mobile mapping Mobile community market Instant messaging
Smart mobile phones High-end mobile phones (mobile phone as a computer)	Sensor Rich Application (All Purpose Tool) Global Position System (GPS) Social network features Mobile web Video and audio recording and sharing	Mobile sensing Community-based monitoring Social network applications
Indirect access For people who do not have direct access to mobile phones, computers or Internet	Infopreneur (use of intermediary to access information) Village phone Village area networks	Shared access Shared handsets

Table II. Forms of access and the various channels (excerpted from Hellström, 2010, p. 26).

In general, survey results echo the findings on the use of ICT reported in the literature, as discussed in the previous section of this article. For example, mobile phones were cited as the most commonly used ICT tool used in participants' communities, but smartphones and tablets are not yet used by most respondents or by members of the respondents' communities, and are still seen as inaccessible and unaffordable by many. While personal computer and laptop use is common among survey participants, these learners may not be typical of the population in their home towns. Finally, while Internet use is common, both among survey participants themselves and among their students and members of their communities, it remains expensive for most people and service is unstable. Most significantly, power supply was cited as a major barrier to increased use of ICT in education and training and in ECD programs.

At the same time, respondents expressed a positive outlook about the use of ICT in their own ECD work and in the lives of people in their communities, while calling for more training in the use of ICT devices. Also, many people reported that they and/or members of their communities access social networking sites. Provided that identified barriers can be addressed, increased use of ICT in ECDVU and in college and community ECD programs with which ECDVU learners are involved seems desirable.

Below, we report on the most significant findings of the survey, based on the written responses received in June 2011 from the ECDVU cohort in Ghana. As the members of that cohort are all from Nigeria, the survey results are not generalizable to all of Africa. However, emailed responses received from ECDVU graduates, who are based in a broader range of African countries

(Kenya, Lesotho, Liberia, Malawi, Tanzania, Uganda and Zambia), are largely consistent with these findings.

Survey Responses

Current use of technical devices. Participants were asked which technological tools and devices they currently used in their own work, which were most commonly used by their own students (many participants were 'teacher-trainers' at universities or colleges), and which were prevalent in their home communities. As shown in Figure 1, the most commonly used technical devices are laptops, mobile phones and desktop computers, with over half of respondents reporting the use of these tools. Less than half of respondents reported using digital cameras, smartphones, tablets and camcorders, and nobody reported using an e-reader (e.g. Kindle).

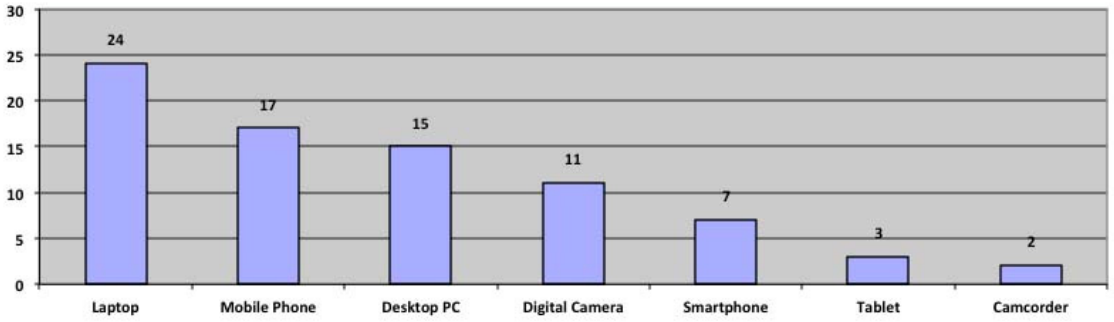

Figure 1. Technical devices used by respondents.

On the basis of respondents' impressions, the tools most commonly used by their students and members of their communities roughly paralleled their own pattern of use. Cell phones were most commonly used by these groups (16 responses), followed by desktop computers (14), laptop computers (10) and digital cameras (6).

When queried specifically about smartphone use, 12 respondents said that smartphone use was fairly common among their students, but quite uncommon in their communities, though growing in prevalence. However, the majority (15) commented that smartphones were too expensive for most students and community members, and that the use of these devices is limited primarily to the most wealthy or 'elite' students or community members.

Current and desired function of technology in ECD work. All respondents indicated that they and their students currently use technological resources in their ECD work. Some specific uses of technology noted in the responses were:

- teaching and learning (e.g. typing assignments, communicating with instructors and students, Moodle);
- project work (e.g., PowerPoint presentations);
- data storage and processing;
- networking (e.g., discussion forums, chat, email);
- research (i.e., Internet research);
- taking pictures/documentation; and
- playing games.

All respondents felt that the use of technology had a positive effect on their work, and that they and their students would like to make greater use of technology, including mobile devices such as smartphones and tablets, in their ECD work and at the community level. Greater technical training was noted by the majority of respondents (19) as their greatest need in harnessing the power of ICT within the ECD field, including its role in community capacity building.

Participants were asked about the use of social networking sites (e.g. Facebook, Twitter, LinkedIn) in their own work, and about the use of such sites by their students and by community

members. Many respondents did not specifically indicate using social networking sites, though nine respondents noted that while they did not personally use these resources, they (especially Facebook) were popular among their students and among the younger members of their community.

Internet connectivity and power supply. Sixteen of 28 respondents indicated that Internet connectivity was problematic in their workplaces, and even more so in their communities. Most respondents indicated relying on a modem for Internet use. Similarly, the majority (16) of respondents noted that connection to the Internet was expensive in their communities, though nearly half (12) reported that Internet connectivity was relatively affordable for them personally.

Stable power supply was cited by all 28 respondents as a major issue, both in their workplaces and in their communities. One respondent noted that at his/her workplace, the generator runs every day, from 8.00 am to 4.00 pm, and highlighted the expense of the diesel fuel to run the generator. Another respondent commented that s/he relies on a generator approximately 70% of the time, at work and at home. Finally, one respondent noted that without a generator, it would be impossible to work with ICT tools – even basic cell phones, which must still be charged – on a consistent basis. While this challenge may be particularly acute in Nigeria, power supply is a known challenge throughout most of Africa, suggesting not only the need for improved infrastructure, but also for alternative sources of energy (e.g. solar-powered devices).

Section III. Discussion

This article originates from a background paper developed to assist the ECDVU in determining whether, and at what point, it would be feasible to incorporate cell phones, tablets or smartphones into ECDVU African deliveries.[1] Once questions of technology and timeline had been addressed, the ECDVU would then determine a suitable framework within which to explore questions of pedagogy, or the nature of a curriculum designed to advance an interactive, generative approach capable of engaging not only student participants, but community members as well.

On the basis of the literature reviewed and the informal survey conducted, it is reasonable to conclude that while ECDVU delivery via tablet and/or smartphone holds considerable promise, it is not feasible to make the transition to this technology in the immediate future for a sub-Saharan Africa delivery. Nonetheless, given the current prevalence of mobile phone use in sub-Saharan Africa, the increasing use of mid-level web-enabled mobile phones, and the likely adoption of smartphones and tablets within the next five years, it is important to begin considering how to phase in the use of these devices over time, beginning with those that are the most commonly used and the least demanding of an unstable power supply, and gradually moving to those with the richest pedagogical capabilities and the highest dependence on a stable power supply.

In particular, as administration and delivery of the ECDVU program gradually moves from the University of Victoria to sub-Saharan African institutions, a transition from a web-based 'e-learning' approach to program delivery to a mobile-based 'm-learning' approach to delivery may be a key contribution to the program's long-term expansion. In planning for this transition, ECDVU will begin to monitor 'best practices' in m-learning in Asia and Africa, so as to take advantage of the lessons learned from earlier m-learning experiences (see e.g. Valk et al, 2010), the gradual development of pedagogical frameworks (Park, 2011) and emergent research on the effective pedagogical use of mobile learning devices (Brand & Kinash, 2010).

In addition, given the growing use of m-learning in Africa, even on low-end handsets employing only voice and SMS, it is important that current ECDVU participants begin to understand, develop, and pilot ECD programs that incorporate m-learning, starting in the very near future. As the use of mid-level web-enabled handsets and smartphones increases, both among post-secondary ECD students and community members, mobile learning initiatives can grow in richness and complexity. Accordingly, planning will commence to augment an existing course in the current ECDVU program, focusing on m-learning. This course could provide learners with information on existing m-learning programs in sub-Saharan Africa and beyond, and could engage learners in a generative curriculum approach to developing ECD m-learning programs that are

suitable for delivery within the current infrastructure and that can expand and change as infrastructure and ICT use evolve.

Note

[1] Agreements with the University of Ibadan, Nigeria are laying the groundwork for University of Ibadan-led, University of Victoria-supported delivery of an ECDVU-type program in the near future. Similar discussions are under way in other parts of Africa. The ECDVU materials and related documentation are all freely available to such partners for their use.

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