

Developing use of ICT to enhance teaching and learning in East African schools: a review of the literature

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OUTLINE OF REVIEW

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Introduction and aims

The first aim of conducting the literature review was to inform a programme of ongoing research and professional development work by the ZRT ICT team and ultimately the writing up of outcomes of that work. Parts of the review will feed into each publication in future. Second, it is envisaged that the review will stand independently as a publishable work in an internationally recognized journal. Third, the process of conducting the review was carried out by experienced personnel at the University of Cambridge in partnership with Faculty members at IED-Pakistan and IED-EA, thus developing capacity of the latter in the area of systematically and critically reviewing the scholarly literature and other relevant sources, and informing our professional development programme. The audience for the review is the ZRT ICT Team and AKU IED-EA management, DfID (DfPHE) and Commonwealth Education Trust stakeholders, and an external audience of academics including teacher educators, plus the

Ministries of Education in East African Community countries. In this paper we outline the focus and scope of the review, summarise the findings pertaining to ICT use by teachers and learners in sub-Saharan Africa in general and East Africa in particular, and then elaborate specific implications for Tanzania.

Focus

This review synthesises the literature on uses of information and communications technology (ICT) in primary and secondary schools in Sub-Saharan Africa (SSA), with a particular focus on Commonwealth countries and on East Africa. It focuses on the role of ICT in improving the quality of learning and teaching in schools with reference to technologies appropriate for this context, and on the supporting and constraining factors.

In more detail we set the scene by auditing and evaluating both provision of ICT in schools and policy initiatives related to its use in supporting school learning and teacher education in East Africa. These include both national and school-level policies, financial investments and interventions. We delve below the surface to examine issues arising regarding access to and actual levels and types of use of digital technologies in East African schools. Key stakeholders and agents of change in ICT integration are identified, including national policymakers, school leaders and academics. Related to this we document and assess the impact of prominent past and current international and local initiatives to use ICT in widening access and participation, and in improving quality of teaching and learning in SSA schools. We explore the pedagogical, social, logistical and technical issues arising as we move on to characterise local needs and the facilitating factors and constraints on technology use in this developing context. Teacher factors influencing classroom ICT use, focusing on impacts of teacher training and continuing professional development, and on teacher beliefs about ICT and cultures of teaching. We conclude by drawing from the review a number of implications for further development of educational uses of ICT in East Africa and some suggestions for future research and professional development initiatives.

Scope

We focus on the five countries belonging to the East African Community (Burundi, Kenya, Rwanda, Tanzania and Uganda) in terms of documenting policy and provision of ICT resources in Sections 1-2 and in drawing out implications and a research agenda in Section 7. However Sections 3-6 include some messages learned from initiatives in other developing Commonwealth countries within SSA, where these are particularly informative, since the conditions and issues arising there are often similar.

The review covers relevant literature published since 1990 but focuses primarily on more recent work carried out since 2000. Printed and electronic sources include research studies (peer-reviewed wherever available), evaluation reports, government policy documents, donor policy documents and project reports, and international/local NGO policy documents and project reports.

Findings: ICT use in East African schools

Policy, investment and partnership initiatives for integrating ICT into schooling: Rhetoric and reality

The review reveals that significant progress is being made in the endeavour to incorporate ICTs into schooling in the five countries in the East African Community (Burundi, Kenya, Rwanda, Tanzania and Uganda), who generally now have clearly formulated policies and strategies in place to promote use in schools (Burundi is the exception). These policies are wide ranging but tend to focus on the curriculum and on professional development in particular. Encouragingly, there is growing awareness that *providing equipment is insufficient to promote educational change*. Governments are emphasising development of teacher skills and pedagogy as the key to effectively implementing curricula, to using ICT to enhance teaching and learning, and to raising educational standards. The elaboration of policies on integrating ICT into education has led to increased government investments in ICT in all countries except Burundi, and most prominently in Rwanda where pioneering use of ICT is well established. Available data on ICT infrastructure and usage is limited, however, and in many cases outdated, so the true picture is hard to assemble and trends cannot easily be charted. *Annual collection of information about pupil:computer ratios etc. would be most useful.* From what we can glean and in our experience, exposure to ICT in public schools remains negligible, especially in poorer, rural schools. Moreover emphasis is on secondary school education in all of the countries except Tanzania where ICT has been introduced in the primary sector. While the policies are highly ambitious, the limited evidence available of their implementation indicates that their status remains largely at the level of rhetoric in some countries and in some aspects.

Equally ambitious are the aims of the wide variety of ICT initiatives now in place to support teaching and learning in schools in SSA. These projects are funded through a myriad of public and private sources and partnerships including governments, commerce, philanthropic donors and other charities, educational institutions and NGO / development agencies. They are generally recently initiated, regionally bound and time limited. There are certainly some success stories, at least in terms of improved facilities; stakeholders have equipped schools with computers for teaching, learning and administration purposes and students are enthusiastic about using computers for learning despite the lack of equipment available. Access to ICT facilities in schools in Eastern Africa is growing and connectivity is improving, especially in urban areas through wireless networks. There is also extensive use of mobile phone technology, and some countries are developing digital content for use across the curriculum. Nevertheless access and usage remain sporadic and the claims made in reports of impact upon teaching and learning are tricky to corroborate as evidence is often anecdotal. As with ICT policies, *a lack of tendency to systematically evaluate the outcomes makes it hard to assess their success, and we suggest that this situation needs to be redressed as new schemes are planned.* Sustainability of schemes and potential for further rollout are also highly uncertain once funding runs out and deserve some attention; further support may be needed over the longer term, or ideally the principle of self-sustainability through development of local capacity will be addressed. Forward thinking in particular about the shelf life of equipment (especially refurbished machines) and *building in financial support for technical assistance and maintenance and/or developing local technical expertise* are needed too.

It is notable that most of the countries in SSA have a common feature in their ICT policies, curricula and initiatives in schools in the form of promotion of computer science or information technology as a discrete subject, examined by the national examination boards (in addition to increasing integration of

ICTs within school information and management systems). This is reinforced by the lack of technology in classrooms and its concentration instead in purpose-built computer labs (containing networked or stand-alone PCs), a model that countries like the UK with high penetration of ICT in schools are now moving away from, especially as mobile or classroom-based technologies such as portable devices and interactive whiteboards increase in prevalence. Location of equipment in a locked, gatekeeper-controlled lab some distance from the classroom is a deterrent to its use in the East African context, especially with large classes that are not easily or quickly relocated. Moreover, where computers are set aside for use on only special occasions, they remain an object of curiosity, fear, uncertainty, awe or mystery, rather than being seen as the useful, enabling tool that they can be.

There are many national initiatives and others such as NEPAD, Intel World Ahead, Schoolnet, One Laptop Per Child, PanAfrican Research Agenda, that span several countries in SSA, albeit sometimes with limited participation in each. Nevertheless the majority of schemes to develop ICT use in African schools in fact operate in isolation from each other, as summed up rather eloquently by Unwin:

There is considerable interest in delivering educational ICT initiatives across Africa. African governments are eager to use ICTs so that they are at the forefront of technological change; donors and international agencies are eager to provide resources to help ‘Bridge the Digital Divide’; the private sector is keen to invest where companies see potential market growth possibilities in the future; academics are interested in sharing the results of their research on the subject; and civil society organisations are willing to help facilitate delivery of schemes on the ground. However, this **multiplicity of interest means that there is frequent duplication of effort, lessons are not sufficiently learnt and shared, and there is a wasteful lack of co-ordination in the activities that actually take place**. There are many examples of small scale initiatives, embarked on with the best will in the world, but that only benefit a few people for a short while. If all those involved would truly work together for the interests of the poor and marginalised in Africa, rather than primarily for their own agendas and targets, it would be possible to achieve very much more than has heretofore been achieved. (Unwin, 2005, p.121).

The largely fragmented, regional, under-funded and inadequate nature of initiatives to build teachers' ICT capabilities is similarly pointed out in a damning snapshot report of all (English medium) teacher training initiatives in ICT in Africa by the Commonwealth of Learning (COL 2004). Unwin (2005) makes the complementary point that ambitious supply-led and externally driven teacher training schemes are being discussed at a pan-African level, with far too little thought being paid to the ways in which they can be integrated into existing and on-going initiatives in specific countries. In recent years, a more optimistic picture has emerged, with many new national initiatives that involve appropriate public-private partnerships between relevant stakeholders; experiences of the World Links for Development Programme in connecting schools to the Internet, training teachers and grappling with curriculum and education reform issues in developing countries indicates that this is the most successful partnership model (Hawkins 2002). However our conclusion must be to *call for “joined-up thinking”, namely a comprehensive framework across the East African Community at least, for both development of ICT use in schools and for large-scale professional development – whereby experience is shared both between and within nations*. This would undoubtedly be far more cost-efficient and effective in exploiting the potential that partnerships between governments, the private sector, civil society, academic institutions and global organisations can provide. Moreover, formal *evaluation of new policies and the aims and impacts of investments and initiatives is often lacking and needs to be culturally embedded so that lessons are learned and again wisdom is accumulated*, offering a much firmer foundation for future strategy and investment by both governments and donors.

Important questions remain about the level of investment required to introduce ICT in the most optimal way and form so as to improve the quality of teaching and learning in schools; research in this area would be extremely useful. Related to this is decision making about opting for low-cost, low maintenance portable technologies such as mobile phones and low energy or alternative energy handheld devices, versus aiming for introduction of more powerful but energy-intensive technologies. Likewise is broadband connectivity intended to leap ahead in the developmental process and “catch up” with the developed world desirable, or are current explorations into less powerful but low bandwidth technologies that support locally sustainable models of rural connectivity to be encouraged? Hawkins (2002) reports that wireless technology is most effective for connecting schools in developing countries but this may be more costly.

Barriers to developing ICT use in the East African context

A number of important physical, cultural, socioeconomic and pedagogical factors hindering the use of ICT by teachers and students in sub-Saharan Africa, particularly in rural schools, emerge from our review. These include lack of electricity and frequent power outages, poor technology infrastructure, overcrowded computer labs and low bandwidth, high costs of (mainly satellite) internet connectivity, software licences and equipment maintenance, insufficient and inappropriate software. Non-competitive telecommunications policies and regulations may impede connectivity and sustainability (Hawkins 2002). Geographic and demographic factors include population density and dispersion, linguistic and political factors. Wider socioeconomic factors such as extreme poverty and increasing HIV/AIDS levels exacerbate the situation and political will is needed to alleviate the situation through further “joined-up thinking” in terms of devising an integrated framework to improve standards of living, education and health provision, along with ICT infrastructure enhancement.

Further challenges to be faced include the optional status of ICT within the curriculum, and a universal emphasis on teaching basic skills for software use and information gathering. *Changing this culture towards one of using ICT as a tool to support and enhance subject learning using active knowledge building approaches is a key message for policymakers.* It is crucial for technologies, including print media, audio, video, computers and portable devices, the internet and a range of appropriate software, to be integrated across the curriculum. While school leaders are important agents of change, negative attitudes among school leaders and governors towards computers and internet obstruct prioritisation of ICT integration. Anecdotal evidence suggests a lack of ‘technology’ leadership to oversee the institutionalization of ICT integration and policy. In order to address these multi-faceted challenges, *schools may have to develop capacity of its leaders to guide effective and more holistic integration of ICT.* The lack of contextually appropriate course content for either teachers or learners also needs to be addressed and the potential here for *creating and integrating locally produced or adapted digital open educational resources* is currently being explored by Hennessy and colleagues in a pilot project in Zambia conducted by a schools-Ministry-academic-NGO-private sector partnership.

Finally, having ICT-literate and confident teachers is clearly a prerequisite for integrating any form of ICT into schooling. Until recently training opportunities have remained limited in availability and inconsistent in quality, and teachers’ ICT proficiency and knowledge of the potential of ICT for supporting teaching and learning have thus remained limited too. Lack of teacher time to get to grips with new technologies is another obstacle, linked to the growing shortage of qualified teachers. The COL (2004) report pointed out that the prohibitively high cost of training teachers to use ICT and the shortage of public funds to devote to this are fundamental challenges to be overcome before ICT

capacity building can become a reality in African education. The situation has since become even more acute in the face of the recent economic downturn globally and increasingly large school classes as countries respond to the Millennium development goals concerning universal primary education. The consequences of this and of the designation of ICT as a discrete subject include a lack of subject teachers trained to integrate ICT into learning in their areas. Once more, *integrated initiatives are needed, with participation from multiple players in each country including Ministries of Education for provision of a policy framework, curriculum and software developers and teacher training colleges. Our key message here is that teacher education is an absolutely essential area for development in East Africa if ICT use is ever to effectively support learning.*

Teacher education and development

Considerable encouragement can be drawn from the recognition of the need for teacher education within recent policy changes and the finding that most SSA countries have invested in developing the capacity of teachers to use ICT for teaching and learning through both in-service and pre-service programmes. In theory this vastly increases the chances that facilities will actually be used. Long experience in many Northern and Southern country contexts indicates that *when a government (or anyone else) provides new technology equipment in schools it is likely to remain idle or used poorly unless teachers are cognisant about what they can do with it, and a short induction from its supplier is far from adequate to realise pedagogical potential.* It is extraordinary to find time and again that this lesson has not been learned (as witnessed in the UK's recent saturation of schools with expensive interactive whiteboards that are largely not used interactively at all: eg. Moss et al. 2007) and *we strongly hope that fuller awareness of the needs of teachers encountering new digital tools will shortly be realised; in particular new initiatives need to take heed of what has been trialled before, including in other country contexts.*

Identifying the *characteristics of apparently successful teacher training and development programmes* is our contribution to this endeavour. In summary, we suggest that these

- are pedagogically rather than technically focused, promoting active, independent, inquiry-based and collaborative classroom learning, and exploiting the potential of ICT to support it – while attending to teachers' prior attitudes, knowledge levels, subject disciplines and pedagogical approaches;
- infuse technology into an entire teacher education programme using blended solutions (rather than "bolting it on");
- model interactive pedagogical approaches including employing hands-on workshops to develop awareness of the potential of ICT; offer ongoing, collaborative and active learning opportunities for teachers.

Developing ICT use in East African schools: Overall conclusions

The needs identified through this review include:

- a shift from 'Education for ICT' to the use of 'ICT for Education' and *for ICTs to be integrated throughout the curriculum, blending their use with other tools and resources to support student learning;*

- *prioritising provision of initial and ongoing in-service teacher education that effectively equips teachers to integrate ICT into subject teaching and learning using contemporary pedagogical approaches;*
- *a holistic and comprehensive framework within and across East African countries to include infrastructure enhancement, development of ICT use in schools and large-scale professional development; this requires significant investment and strategic leadership by governments working closely with other partners, and decision making grounded in research evidence;*
- *building evaluation and sustainability into these programmes and into policies from their inception and linking them to broader education reforms and community agendas.*

We acknowledge that these are demanding recommendations given the current state of play but on the strength of our review of the prior research and development work in this field, we nevertheless assert the need to strive towards enhancing East African schooling in these ways.

Findings: Implications for education in Tanzania

ICT in education policies in Tanzania

The Tanzania ICT policy envisages that curricular review should go hand in hand with development of content hence transforming the educational content to e-content. The policy for ICT in education in Tanzania helpfully goes beyond the level of infrastructure and access to the realms of integration of content and instruction. The Survey of ICT and Education in Tanzania by Hare (2007) indicated that only a few private secondary schools around urban settings especially in Dar es Salaam had access to ICT by then. By the time of the survey, exposure to ICT in public secondary schools and primary schools remained negligible. The survey revealed the existence of an ambitious 5-year plan dubbed the eSchools programme which was ultimately meant to equip schools nationwide with ICT equipment (including access to the Internet), adopt educational management information systems at both the school and Ministry level, and develop curriculum and online content for secondary schools. It has not been possible to access any data or reports on whether the implementation took place.

The efforts in Tanzania seem to have been concentrated on the first priority area identified by the Ministry of Education and Vocational Training (MoEVT) in the ICT policy for basic education of 2007 which was the teacher training sub-sector; ICT projects have been rolled out to all 32 teacher training colleges through this initiative by the government of Tanzania with the support of SIDA. However, first, there is now need for sustained effort in terms of content development and integration of ICT in teaching and learning; an area in which IED-EA could be involved, working with partners through the design and delivery of certificate programmes in ICT and research on current local practices while focusing on international best practice. Secondly, it might be beneficial under the economies of scale principle for the countries in East Africa to collaborate in the development and utilisation of e-content within their education sectors. Unwin (2005, p.126) pointed out that delivery of educational ICT initiatives across Africa has suffered from multiplicity of interest meaning that “there is frequent duplication of effort, lessons are not sufficiently learnt and shared, and there is a wasteful lack of co-ordination in the activities that actually take place.” This is true of initiatives both within and between countries.

National investment in ICT in secondary and primary schools in Tanzania

There is a direct involvement of the government of Tanzania through a consortium of stakeholders to ensure placement of ICT infrastructure in secondary schools. This is being augmented by efforts from the development partners, private sector and NGOs. At the primary school level, other than development of the curriculum (which has witnessed very limited adoption), there is not much documented government investment. The main investment here is targeted at teacher training colleges, where it is hoped the trainees can later use their acquired skills in ICT to implement the ICT curriculum in primary schools. However, it is important to point out that the availability of ICT-trained teachers and curriculum without the requisite equipment and tools such as computers and the relevant software will not yield fruitful outcomes. It is acknowledged though that the use of radio (common in schools) and television (rare) by MoEVT to deliver education programmes is ongoing and should be encouraged to continue as these media are more accessible in Tanzania to the wider population than computers.

Although an educational management system (EMIS) is in place at the Ministry of Education and vocational training in Tanzania and hence current school demographics data are available, it is still not possible to obtain data on ICT infrastructure levels in schools. This coupled with the lack of recent studies on ICT investment and possible impact of the investment to the quality of teaching in schools makes it difficult to draw an accurate picture of the ICT in schools landscape in Tanzania. EMIS data is important not only for planning for resources and programmes but also for research data which is an area of interest for the Aga Khan University and its partners.

Some initiatives supporting the use of ICT in Tanzanian schools

Initiatives supporting the use of ICT in schools in Tanzania are generally aligned to what obtains elsewhere in sub-Saharan Africa. There are government-led initiatives, public-private partnerships, private sector and NGO involvement in supporting schools' use of ICT in a number of sub Saharan African countries. Among the key initiatives are SchoolNets and NEPAD e-Schools. While the latter started as a demonstration on a pilot basis in 16 countries, it is worth noting that Tanzania was not among them and that this situation might be redressed. The NEPAD e-Schools has availed ICTs including state-of-the-art computer hardware, software and curriculum-relevant learning materials, and internet connectivity to six secondary schools in each of the 16 initial countries, including Tanzania's neighbouring countries of Kenya, Uganda and Rwanda. It is important for Tanzania to join the NEPAD initiative in order to benefit from the same connectivity and development of ICT skills in both learners and teachers (Farrell et al 2007).

SchoolNets, on the other hand are developed as collaborative national school networks that spearhead innovative use of ICT in education (as in SchoolNet Uganda¹). There is also SchoolNet Africa² which engages with national SchoolNets to promote high caliber education with the use of ICT. There are benefits for Tanzania that could be realized as a result of having a SchoolNet organization working in collaboration with SchoolNet Africa and the national SchoolNets in sub-Saharan Africa. This is an area where we know that public-private partnerships could work. MoEVT could provide a lead for such an initiative while letting the NGOs such as HakiElimu (a very active NGO in education in Tanzania) play a key role.

¹ <http://schoolnetuganda.sc.ug/>

² <http://www.schoolnetafrica.org/>

Factors affecting use of ICT in Tanzanian primary and secondary schools

Focusing on the Tanzanian scenario, use of ICT in education is hampered by the cost of bandwidth which is unaffordable for many schools. Rural schools that are located outside the national telecommunications network have to use expensive satellite technologies. The national electricity grid is limited to commercially viable areas missing out most of the schools in the rural areas. This, together with frequent breakdowns and load shedding, has increased the cost of owning ICT infrastructure (Farrell, 2007) and made it almost impossible for schools in rural areas to access and use ICT in education. The distribution of telecommunication landlines is limited, especially in rural areas again, where more than 80% of the population lives. However there is extensive use of mobile phones throughout Tanzania and most of the country has network coverage (United Republic of Tanzania, 2007). Mobile technologies could therefore offer a way of making ICT accessible to more schools. Traxler (2009) has described a scenario of two technologies in Africa, small and big. For the small, he describes the mobile phone networks as diverse, agile, familiar and powerful platforms for eLearning. Although sustainable and appropriate, these technologies are problematic in terms of equity, stability, access and standards though.

On the other hand, Traxler pointed to the government-initiated large-scale static installations as technologies that require networked desktop PCs in clean secure buildings with reliable mains electricity, software licenses and technician support. These are the big technologies that require huge investment and ongoing financial support. These large-scale investments are mainly concentrated in cities for obvious reasons, mainly adequate infrastructure. From the two positions above, many people including Traxler (2009) would argue for mobile networked technologies which people can use as part of real everyday life in cities as well as rural areas.

The pioneering work at IED-EA on SMS support in leadership and management certificate programmes is a possible beginning for opening up more use of mobile and portable technologies in East Africa generally and Tanzania in particular. One such programme has already been carried out in Kisumu, Kenya, while two are ongoing in Mombasa, Kenya and Turiani in Mvomero district of Tanzania. This SMS initiative forms part of the ZRT2 research reports based on one MEd dissertation. The report and its recommendations may be helpful in providing a roadmap for the way forward for mobile learning at the institution.

On school-related factors influencing integration of ICT in primary and secondary classrooms, Tanzania is ahead of the other East African countries in that there is a curriculum for teaching ICT as a discrete subject in both primary and secondary schools. While this tends to limit integration of ICT in curriculum subjects, it has been the trend in most developing contexts. The Tanzania curriculum for ICT in primary and pre-primary education is currently only taught in a few schools located at district headquarters, which have ICT facilities. Very few primary schools have computers or Internet access (MoEVT, 2007). At secondary level, Information Computer Studies is taught in Tanzania, Kenya and Uganda and assessed by the national examinations bodies (MOEST, 2002; UNEB, 2005; MoEC, 2005). However, moving beyond teaching ICT as a discrete subject to integrating it into specific subjects will require the participation of many players including the MoEVT for provision of a policy framework, the Tanzania Institute of Education for curriculum changes and institutions like the teacher training colleges and the universities that prepare the teachers, including the Aga Khan University.

Possible areas of collaboration between Ministry and AKU / Cambridge / Calgary

Arising from the literature review, the following areas have been identified as possibilities for collaboration by the Ministry and the ZRT partnership:

1. Content development and integration of ICT in teaching through design, development and delivery of certificate courses in ICT for teaching and learning;
2. Research studies on required investment in ICT and on how to maximise the investment so as to improve the quality of teaching and learning in schools;
3. Deepening or institutionalizing the use of portable and mobile technologies such as mobile phones in delivery of programmes in Tanzania hence utilizing the available “small technologies”.

Conclusion

In conclusion, it is important to note that it is one thing to have a curriculum and trained teachers and yet quite another to implement the curriculum especially if the requisite teaching materials are not availed – as in the case of ICTs which require heavy investment by both government and other partners. We do not yet really know whether the ICT subject curriculum has been implemented and how this may have impacted on ICT integration in specific subjects, but it seems as though it has not. Research into this area and above all, into the optimal ways to achieve the integration of technologies into teaching and learning in the East African context is sorely needed. First, infrastructure issues will need to be resolved so that we can truly bring Tanzania into the 21st century and harness ICTs to support its further educational and economic development.

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