

## **Teacher Factors Influencing Classroom Use of ICT in Sub-Saharan Africa**

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### **Abstract**

This paper synthesises the research literature on teachers' use of Information and Communication Technology (ICT) in primary and secondary schools in sub-Saharan Africa, with a particular emphasis on improving the quality of subject teaching and learning. We focus on the internal factors of influence on teachers' use, or lack of use, of technology in the classroom. Our discussion attends to perceptions and beliefs about ICT and their motivating effects, technological literacy and confidence levels, pedagogical expertise related to technology use, and the role of teacher education. These factors are discussed in light of significant infrastructure and other external issues. We conclude by drawing out a number of pedagogical implications for initial teacher education and professional development to bring schooling within developing contexts into the 21<sup>st</sup> century.

**Key words: ICT; Sub-Saharan Africa; Pedagogy; Technology; Technological Literacy; School; Teacher Education**

## **1. Introduction**

There is substantial evidence that, in the right hands and used appropriately for specific purposes in specific contexts, ICT can be an effective tool in supporting teaching and learning. However, it is now firmly established that its introduction into schools does not by itself improve the quality of education or raise attainment. Encouragingly, there is growing and widespread awareness that the pedagogical and technical expertise of the teacher is absolutely critical here. Governments in sub-Saharan Africa (SSA), as elsewhere, are emphasising teacher development as the key to effectively implementing policy and curricula, to using ICT to enhance teaching and learning, and to raising educational standards. In many African countries, however, a major impediment is the lack of qualified teachers. This problem is further exacerbated by growing poverty and lack of funding for their salaries, and the exponential rise in student population in the last two decades (National Universities Commission, 2005) – that ironically relates to the admirable Millenium development goals concerning free universal primary education. The crisis is worsening further as increasing numbers of teachers become afflicted by HIV/AIDS. Indeed it has been observed by many that meeting the desperate need for more qualified, competent teachers is the most persistent and daunting challenge facing the African education system in general, and the integration of ICT in particular (Afe, 2002; Olakulehin, 2007).

Effectively introducing technology into schools is also largely dependent upon the availability and accessibility of ICT resources (e.g. hardware, software and communications infrastructure). Clearly if technology cannot be accessed by the teacher, as in so many educational settings in SSA, then it will not be used. We know that state funding for such resources is scarce, and that ICT resources tend to be more available in urban than rural areas. Our extensive review of the literature on developing use of ICT to enhance teaching and learning in East African schools (Hennessy & Onguko, forthcoming) shows that while the process has previously been painfully slow (Liverpool, 2002), the situation has been improving in the last few years. Schools are increasingly being equipped with computers for teaching, learning and administrative purposes, connectivity is improving and students are enthusiastic about using computers for learning, despite the lack of equipment available. Some countries are developing digital content for use across the curriculum. Nevertheless, access and usage of ICT, like the electricity supply itself, remain rather sporadic. The undersea cables currently being installed to run around the entire SSA coastline by 2011, and already in position down the Eastern coast<sup>1</sup>, bring the promise of widespread access to broadband connectivity for the first time. However, it will undoubtedly take time for funding to connect schools to materialise.

Formulation and implementation of national policies on ICT use, as outlined for the East African context by Wamakote, Ang'ondi & Onguko earlier in this volume, are additional essential prerequisites, along with supportive local policies, school leadership and curriculum. Wamakote et al. indicate that policies are at last coming into operation, although there are a number of gaps in implementation strategies. A major obstacle arising is the tendency of national policies and school curricula in most countries in SSA (and in developing contexts generally) to treat ICT as a discrete subject in the form of computer science or information technology when assessed by the national examination boards. There is an almost universal emphasis on teaching basic skills for software use and information gathering, whereas research indicates that integrating ICT into subject learning is far more effective for students. The skills emphasis is reinforced by the lack of technology located in classrooms and a corresponding concentration on purpose-built computer labs. This is a model that countries like the UK, with a high penetration of ICT in schools, are now abandoning,

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<sup>1</sup> <http://manypossibilities.net/african-undersea-cables>

especially as mobile and classroom-based technologies such as portable devices and interactive whiteboards increase in prevalence.

Our review indicates that further challenges include the optional status of ICT within the curriculum, and negative attitudes among school leaders towards computers and the internet. The lack of contextually appropriate course content for either teachers or learners also needs to be addressed (Hennessy & Onguko, forthcoming). In sum, despite a great deal of recent progress and optimism that many more learners can benefit from access to ICT, the infrastructures necessary for deploying technological resources are lacking in low-income countries. Furthermore, many teachers are working in conditions that are not conducive to supporting ICT use.

There are further, important, teacher-related factors influencing classroom use that become apparent. These are predominantly ICT literacy and confidence among teachers, and education of subject teachers to assist them in integrating ICT into learning areas. This paper focuses on such issues, exploring both teachers' skills and experience with using technology, and their personal beliefs and perceptions about ICT gained through teacher education. These factors are considered in relation to classroom practice – how and why teachers use ICT in the classroom and what prevents its use – throughout primary and secondary schooling. While our synthesis focuses on SSA, some messages also emerge from research exploring the widespread integration of ICT into schools in developed country contexts. We now move to teacher conceptions of technology, and its benefits for schooling.

## **2. Why teachers use ICT**

A range of studies have looked at why teachers choose to use ICT. These typically involve conducting case studies of classroom use in a particular setting or from a longitudinal perspective. They portray the use of ICT in teaching as being inherently advantageous. Only a few reports adopt a quantitative approach exploring access, and the reasons why teachers in schools choose to use ICT in their classrooms. Tella, Tella, Toyobo, Adika & Adeyinka (2007) examined Nigerian secondary school teachers' uses of ICTs and implications for further development of ICT use in schools using a census of 700 teachers. The findings showed that most teachers perceived ICT as very useful and as making teaching and learning easier. It was recommended that professional development policies should support ICT-related teaching models, in particular those that encourage both students and teachers to play an active role in teaching activities. Additionally, emphasis should be placed on the pedagogy underlying the use of ICTs for teaching and learning.

Research and active development projects such as those run by EdQual, a Research Consortium of educational institutions in the UK and Africa (Ghana, Rwanda, South Africa and Tanzania) on Educational Quality<sup>2</sup> typically indicate two main reasons why teachers use ICT. Firstly, they feel that their own use of computers benefits their learners, and secondly, teachers feel learners benefit from using computers themselves. Teachers see ICT as kindling students' interest and learning in the subject. ICT promotes a positive attitude towards information technology as an essential part of a lifelong interest in learning. Teachers also perceive the use of ICT as enhancing recall of previous learning, providing new stimuli, activating the learner's response, and providing systematic and steady feedback. It is further perceived as sequencing learning appropriately, and providing access to a rich source of information. For example, Tella et al. (2007) found that computer use by teachers was driven by intentions to use it, and that perceived usefulness was also strongly linked to those intentions. The implication is that teachers will be inclined to use technology if they perceive it to

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<sup>2</sup> <http://www.edqual.org/research/ict.html>

be useful. Furthermore, ICT needs to be linked to specific needs of learners, desisting from the 'one size fits all' approach (Leach, 2005, p. 112). It is most effectively used as a learner-centred tool, instead of within a more traditional pedagogy. The real challenge for educationists is, therefore, how to harness the potential of ICT to complement the role of a teacher in the teaching and learning process. There is an understandable apprehension, even fear, as to the role of a teacher in an ICT-equipped classroom (Futurelab, 2003). Teachers who lack the chance to develop professionally in the use of modern ICT feel under threat. The relevance of a teacher in the 21<sup>st</sup> century is determined by their willingness to develop in this way, a discussion to which we return later.

From the aforementioned, we can conclude in concurrence with Cox, Preston & Cox (1999) that the factors contributing to ongoing use of ICT by teachers include: Making lessons more interesting, more enjoyable for teachers and their students, more diverse, more motivating, and supportive of productive learning. Overall, it is clear that the psychological factors of a teacher's own beliefs and attitudes to ICT and pedagogical innovation are both primary facilitators and barriers to teacher use of technology in the classroom. Those facilitators have been elaborated above, and we now take a closer look at the barriers that impede successful ICT classroom use.

### **3. Barriers to ICT use by teachers in SSA**

Across Africa and most developing countries there are many challenges in bringing ICTs into the education process in general. Anderson (1997) and Hennessy & Onguko (forthcoming) have identified a range of physical and cultural factors that affect ICT use by teachers, including lack of reliable access to electricity, limited technology infrastructure (especially internet access, bandwidth, hardware and software provision), language of instruction and available software; geographical factors such as country size, terrain and communications; demographic factors such as population size, density and dispersion. The issues of access are further exacerbated by extreme poverty, growing prevalence of HIV/AIDS, and a lack of political will to alleviate the situation through proper planning. In addition, educational factors including levels of teachers' own education and literacy rates, and access to professional development play an important role. Indeed many studies indicate that it is teachers' attitudes, expertise, lack of autonomy and lack of knowledge to evaluate the use and role of ICT in teaching (or technophobia in teachers) that are the prominent factors hindering teachers' readiness and confidence in using ICT support. There is also a general inadequacy of learning resources, course curricula and other learning materials that incorporate ICT use.

It is a common misconception that access to technology on its own motivates teachers to apply it in their teaching. The biggest barriers to the use of computers identified by teachers participating in the 1998-1999 survey assessing the World Links schools programme were the lack of time available in classes, and in their own schedules for planning; and the lack of a national policy on the use of computers in schools (Kozma, McGhee, Quellmalz, & Zalles, 2004, p. 376). Relatively few teachers identified infrastructure problems, such as the lack of computers in working condition, unreliable electricity or lack of access to the internet, although these varied by country. As less technologically advanced countries joined the programme in 1999-2000, the major barriers to ICT classroom use became the lack of computer hardware (60%), software (56%) and reliable internet connections (52%), particularly in African countries such as Mauritania, Ghana and Zimbabwe. Lack of access to technology is inevitably a major barrier in its application, but availability does not necessarily translate into use. However, in the study of Nigerian secondary school teachers by Tella et al (2007), a lack of technical support in the schools, and teachers' lack of expertise in using ICT, were the prominent factors hindering teachers' readiness and confidence in using ICT. Again, this

points to the need for appropriate, sustained teacher development, an issue discussed in more detail below.

The lack of incentives and support for teachers are other factors hindering their use of ICT. The SRI-World Links evaluation (Kozma et al., 2004) shows that teachers enthusiastically engage in collaborative projects and often portray a constructivist pedagogy. However, school administrators offer very little structural support and few incentives to use the technology effectively in the classroom. Too often the curriculum in developing countries is rigid and overloaded, leaving little time for innovative classroom practices. National policies need to make more commitment to helping teachers effectively integrate computers and internet technologies into the classroom by aligning curricula, exams, and incentives with the educational outcomes that they hope to gain. In the end, computers by themselves bring very little to the learning process – they are only tools for teaching and learning.

#### **4. ICT skills needed by teachers today**

Many school leaders still perceive the lack of ICT-related knowledge of teachers as a major obstacle to the realisation of their ICT-related goals (Pelgrum, 2002). The literature describes the kind of skills teachers may need when integrating ICT in new student-centred learning approaches. However, identifying which competencies each teacher needs to acquire is far from simple, as this depends very much on the circumstances of their particular school. Personal teaching styles also play a major role. Again, ‘one size fits all’ does not usually work (Davis, Preston, & Sahin, 2009). We also need to recognise that substantial learning can take place while teaching, and even learning, from students.

The UNESCO (2008) ICT competency standards for teachers go further, describing three approaches: technological literacy, knowledge deepening, and knowledge creation. These approaches are seen as part of a development continuum, and each approach has different implications for education reform and improvement, plus different implications for changes in the components of the education system: Pedagogy, teacher practice and professional development, curriculum and assessment, and school organisation and administration. ICT plays a unique, but complementary role in each of these approaches, with new technologies requiring new teacher roles, new pedagogies, and new strands to teacher education. The successful integration of ICT into the classroom depends on the ability of teachers to structure their learning environments in non-traditional ways, merging technology with new pedagogies. This requires a very different set of classroom management skills to be developed, together with innovative ways of using technology to enhance learning and encourage technology literacy, knowledge deepening and knowledge creation. At the knowledge creation end of the continuum, the curriculum goes beyond a focus on subject knowledge to explicitly include 21st century skills that are needed to construct new knowledge and engage in lifelong learning – the ability to collaborate, communicate, create, innovate and think critically. Teacher development is seen as a crucial component here. It ideally coordinates teachers’ sophisticated professional skills with the pervasive use of technology. This in turn supports students who are creating knowledge products, and who are engaged in planning and managing their own learning goals in a school that is a continuously improving, learning organisation. Teachers model the learning process for students, and serve as model learners through their own ongoing professional development, both individually and collaboratively.

## **5. Maximising utility from ICT use in classrooms**

Teachers need to be supported to get the most from using ICT in classrooms. Particularly where resources are limited, as is common in SSA, ICT initiatives need to be driven by the provision of appropriate technological solutions for the challenges faced by communities, rather than by an interest purely in these physical technologies themselves. Those implementing technological solutions need to ensure they are context-specific, and adapted to local needs and conditions. It is also imperative that ICT initiatives are sustainable or effective by ensuring that the technologies embedded within them meet the demands of users in appropriate ways. It is essential that potential users have a sound understanding of how to use new ICTs beneficially, and a cultural view of the relationship between learning and technology (Leach, Ahmed, Makalima, & Power, 2005).

It is also clear that many different types of technology can be used to support and enhance learning. For SSA, it is important that ingenious technologies with a high penetration potential are deployed. Affordable portable technologies are a case in point. These are not only low-cost, low-energy and low-maintenance, but they offer far more flexibility in terms of mode, timing and location of use. They place technology firmly in the learners' hands and this can increase student motivation and time spent on learning, as recent evaluation of a One Laptop Per Child (OLPC) project conducted in Ethiopia by the University of Groningen showed (Hansen, Postmes, Bos, & Tovote, 2009). Mobile phones are a related, much more widely available technology with a great deal of promise, especially for use in rural areas without mains electricity or internet connectivity. Although the technology has some technical limitations and security issues, several mobile learning pilot projects are currently taking place and links with student achievement are emerging (Banks, 2008; Traxler, 2009). Lei and Zhao (2007) describe how each technology is likely to play a different role in students' learning and it is clear that we need to think about what kind of technologies are being used in the classroom, and for what purposes. Two general distinctions are found in the literature. Students can learn where computers (in the broad sense of the term) are used essentially as tutors to increase students' basic skills and knowledge. They can also learn with computers where technology is applied to a variety of goals in the (more active) learning process, and is construed as a resource to help develop higher order thinking, creativity and research skills (Reeves, 1998; Ringstaff & Kelley, 2002).

There is a clear difference between teachers who choose ICT resources to enhance understanding of a particular topic, and those who choose resources merely to present students' work in a new way without any direct application to the topic. The evidence shows that when teachers use their pedagogical knowledge both of the subject and also of how students understand and learn the subject, they can then maximise the effects of using ICT in terms of increasing students' attainment (Cox et al., 2003). The effect on attainment is greatest when pupils are challenged to think and to question their own understanding.

## **6. Impact of ICT use on the teacher**

Research studies and initiatives such as the Digital Education Enhancement Programme, DEEP<sup>3</sup> carried out by an Open University team over two years in 12 primary schools in rural, disadvantaged areas of South Africa report that ICT use enhances teachers' professional knowledge and capabilities in very specific ways (Leach, 2008; Leach et al., 2005), namely by:

- extending subject knowledge;

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<sup>3</sup> <http://www.open.ac.uk/deep>

- enabling planning and preparation for teaching to be more efficient;
- developing the range of teachers' existing pedagogic practices.

In the DEEP studies, teachers were provided with a 'professional ICT toolkit' comprising high-quality, multimedia materials including classroom resources and planning tools (centred around a handheld computer, a laptop, digital audiovisual equipment and accessories). The nature of the uses made of these ICTs varied according to context, particularly with respect to teacher access to adjacent technologies, geographical location, local educational and cultural practices, home language, and teacher subject specialisms. Yet ICT consistently facilitated new forms of teacher-to-teacher cooperation that addressed their challenging circumstances: Large class sizes, lack of electricity and telephone connectivity, heating and other resources. Despite these challenges the majority of teachers were shown to be highly motivated to succeed in using ICT for their own development and for their students' learning. There was wide-ranging evidence of positive outcomes in terms of improved literacy, numeracy and science learning by students. The most successful uses of ICT were strongly grounded in educational and pedagogic principles (from teachers, school and the education system), employing quality resources (not necessarily the most expensive as demonstrated through the use of accessible, mobile technologies) and ensuring that appropriate local professional support was paramount to the school and system.

In addition to these broad policy implications, teacher confidence is another key element determining the quality of any ICT-enhanced school-based teacher education in developing contexts. Teacher confidence is found to have been boosted in programmes like DEEP that featured use of a personal computer, a project partner, joint evaluative activities and strong initial technological *and* pedagogic training. Curriculum activities that progressively built up ICT skills and knowledge also played a role. Other confidence-boosting features of DEEP included few prior expectations (including ICT-literate peers) to live up to, a commitment by school, students and community to support project partners in their efforts, clear overall programme management structures to ensure ongoing support, and affirmative feedback from peers, school principals, students, parents and the project team.

## **7. The impact of ICT use on classroom teaching and learning**

Bringing ICT into the classroom can have a considerable impact on the practice of teachers, in particular when ICT is conceptualised as a tool that supports a real change in the pedagogical approach. Not only do the teachers need to change their roles and class organisation, they also need to invest energy in themselves and their students in preparing, introducing and managing new learning arrangements. Some need to acquire basic ICT skills. Teachers also need to determine which applications have added value for learning in their subject area. While doing this they need to be aware that this is not a one-time activity, as the information environment is continuously changing. Perhaps most important and challenging for teachers is determining which basic subject, social and management skills students need to function in such environments. The change can impact on assessment tasks, with new learning environments moving away from summative methods of assessment to formative approaches and open-ended products (such as reports and research papers created by groups of students). These different aspects are time consuming, and result in an increased teacher workload.

Some things can be done to reduce the workload. Teachers can be encouraged to share resources with others, locate good practices on the web (where available) and adapt these to their local circumstances. In a number of cases the high workload is caused by teachers wanting to control all the activities of their students, which means answering many questions and running from one

student to the other all the time. Teachers can take time to discover that computers do not mean extra work – rather they actually make their work easier. Again, more competent students themselves can be a useful resource, this time for their peers.

There is no doubt that teachers who use ICT in classrooms have to demonstrate high levels of energy, hard work and perseverance, often in the ‘face of considerable odds’ (Lankshear & Snyder, 2000, p. 110). If they are early adopters then they are required to be resourceful and overcome many barriers to make things work. Planning lessons involving computers can take considerable time and demands complex scheduling and resourcing. Therefore, teachers using computers in the classroom should not act in isolation from each other. They need access to resources which will supply ideas and material for different classroom applications, including peers who are also developing their own pedagogies and resources (Leach et al., 2005). For while computers have great potential in education, they also present teachers with additional obstacles to overcome.

## **8. The role of teacher education in facilitating integration of ICT**

The discussion above indicates that the changing landscape of communications and information exchange in the 21<sup>st</sup> century requires teachers to be at the cutting edge of knowledge production, modification and application – rather than consumption. They need to be prepared for this by being educated to use ICT effectively and creatively. In many developing countries, however, most teachers have minimal or no ICT skills themselves and therefore cannot develop these in learners. Two of the most important supports for ICT integration into teaching and learning are effective Initial Teacher Education (ITE) and Continuing Professional Development (CPD). Both have the greatest impact on the beliefs and practice of teachers, and yet professional development time in particular is often not budgeted for (Venezky, 2004). Moreover, research into teacher learning in northern hemisphere contexts suggests that traditional, one-off external in-service workshops tend to be of limited value in developing sustained transformation of practice (e.g. Glazer & Hannafin, 2006; Muijs & Lindsay, 2008). The multiplicity of schemes over the last decade to introduce ICT into schools in SSA (infodev<sup>4</sup> offers a database of such activities) have likewise often failed to live up to their aspirations because of their top-down nature and insufficient attention given to involving teachers. A growing body of research in this area shows that a more promising way forward is a sustained professional development programme that draws on teachers’ local professional communities, encourages ongoing peer learning by teachers of similar subjects and age groups and supports reflective classroom practice (e.g. Bowker, Hennessy, Dawes, & Deaney, 2009; Zwart, Wubbels, Bergen, & Bolhuis, 2007).

In recent years, there has been an encouraging emphasis on in-service development, supported by enlightened national ICT policy initiatives (as outlined for the East African context by Wamakote et al, this volume). Examples of seemingly successful CPD programmes have included the Connectivity for Educator Development programme in Uganda<sup>5</sup>, Schools OnLine programmes<sup>6</sup> in Senegal and Tanzania, World Links programmes<sup>7</sup> in Ghana and Uganda,<sup>8</sup> and the Commonwealth of Learning Southern Africa Teacher Training Programme<sup>9</sup>. Such programmes focus on helping teachers to use technology as a tool, and to transform their classrooms into interactive learning

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<sup>4</sup> <http://www.infodev.org/en/TopicResources.4.html>

<sup>5</sup> [http://www.wougnet.org/Profiles/connect\\_ed.html](http://www.wougnet.org/Profiles/connect_ed.html)

<sup>6</sup> <http://www.schoolsonline.org/>

<sup>7</sup> <http://www.world-links.org/>

<sup>8</sup> <http://www.schoolnet.na/>

<sup>9</sup> <http://www.col.org/programmes/catalyst/safricateacher.htm/>

environments. For example the Intel Corporation ‘Teach’ programme is currently supporting Kenya’s transition from traditional teaching methods through educating teachers in the integration of ICT into primary and secondary school education (Panafrican Research Agenda on the Pedagogical Integration of ICTs: Karsenti, 2009).<sup>10</sup> Using a ‘train the trainer’ model, the 25 selected participants from teacher training colleges, Centre for Maths and Science and Technology Education in Africa, Kenya Institute of Education and Kenya Education Staff Institute, are working on the development of online material to then orient 250,000 teachers nationwide. Anecdotal evidence suggests, however, that teachers experiencing national and international training programmes falter after their initial learning success if they do not receive follow-up support in schools.

Earlier we discussed the pedagogical changes necessary to make most effective use of ICT, and it is here that ITE and CPD can play a major role. Transforming traditional classrooms in SSA from static environments, where a one-way flow of information from teacher to student typically occurs, into dynamic, learner-centred environments in which learners interact with peers in teams and teachers take a more facilitating role, is a major challenge for practitioners and teacher educators. Many teachers are intimidated by technology and are very comfortable with their established teaching styles. To effect change, the pedagogical and educational gains that use of the technology might bring need to be made explicit. Teachers need support, exemplars of new practice, leadership from their school managers and necessary time for their own professional development and trialling of new approaches. Many initially feel threatened by the perceived loss of control in the classroom as students, who are usually more adept at using technology, can quickly access information and challenge the teacher’s role as the primary source of knowledge. Teachers who engage in appropriate professional development, however, learn how to manage their classrooms more effectively and to use the technology to create a more stimulating learning environment (Olakulehin, 2007).

So what do successful programmes look like? A recent evaluation of the national in-service initiative a few years ago to train all school teachers in England to use ICT in teaching (widely regarded as a failure, albeit with notable pockets of success) yielded some important messages concerning the inadequacy of centralised skills-focused approaches, especially those with online access to trainers (Davis et al., 2009). The most successful model proved to be an ‘organic’ approach that provided school-based training designed to support the evolution of each teacher’s classroom, school and region, and the training of the ICT teacher educators. Training was provided largely in face-to-face mode for teachers, and included a module assisting teachers in evaluating the impact of ICT on learning. For the majority of teachers, the training was located in their own school using the school’s equipment and resources. It was supplemented by teacher use of workbooks and groupwork on assignments in their own classrooms, plus case studies of good practice. The cultural context was very different to that in Africa, particularly in terms of ICT provision in the schools beforehand and a greater level of technical proficiency. Its principles were, however, derived from successful characteristics identified in the literature and validated in many studies and cultural contexts. These are incorporated in our synthesis below, and are expected to be more widely applicable.

Further insight is derived from the work for the UK government’s Department for International Development (DfID) carried out over three years by Unwin (2005). He has presented a highly pertinent and critical analysis of previous initiatives, and developed a practical framework for teacher training in Africa. The framework outlines the fundamental issues for ICT programmes to

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<sup>10</sup> <http://www.elearning-africa.com/newsportal/english/news172.php>

be coherent and effective, including the damaging duplication of effort and lack of integration in many ongoing activities. A damning Schoolnet-commissioned snapshot report of all (English medium) ICT teacher training initiatives in Africa by the Commonwealth of Learning (COL) (2004) corroborates the largely fragmented, regional, under-funded and inadequate nature of initiatives to build teachers' ICT capabilities. The key recommendations of Unwin (2005), COL (2004) and Davis et al (2009) are synthesised in the bullet points below. We also include some additional features of successful programmes for teacher education in ICT use distilled from our review of the literature in this area. Such programmes have the following characteristics:

Pedagogically principled, through:

- integrating ICT use into subject teaching rather than as a discrete subject in school;
- infusing technology use into an entire teacher education programme, not providing a “bolted-on” course or separate ICT topics within a course (Society for Information Technology and Teacher Education, 2002);
- developing confidence with ICT and awareness of its potential through a hands-on workshop approach (Society for Information Technology and Teacher Education, 2002);
- modeling interactive and participatory, rather than transmission-based pedagogy, in teacher education programmes;
- employing external stimuli for change and innovation, including video-stimulated reflection and discussion of teachers' own (Jones et al., 2009) and others' practices (Bowker et al., 2009);
- offering sustained, collaborative and active learning opportunities for teachers working together within a supportive professional community of practice (Davis et al., 2009).

Culturally contextualised, through being:

- based in teachers' own schools and classrooms, incorporating tasks linked to participants' professional practices (Davis et al., 2009);
- tailored as far as possible to individual teachers' attitudes, knowledge levels, subject disciplines and pedagogical approaches;
- locally developed with cultural, linguistic and curricular relevance (Commonwealth of Learning, 2004; Unwin, 2005);
- supported by champions throughout the system who can enthuse and inspire others (see experiences of SchoolNets in Uganda<sup>11</sup>).

Ongoing and aligned with national and local policy interests including:

- school/community-led agendas and participation, hence increasing sustainability;
- national policies and standards for ICT use (Davis et al., 2009), plus broader educational reforms (Hawkins, 2002) – through strategic leadership and early involvement of relevant stakeholders and potential partners (Commonwealth of Learning, 2004; Unwin, 2005).

Finally, the reported growing gap between the numbers of qualified teachers in SSA countries and funded places in institutions offering full-time, centre-based ITE and CPD means that ICT itself

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<sup>11</sup> <http://www.schoolnet.na/>

may offer a useful medium. Cawthera's (2001) study for DfID suggests that in such contexts (i.e. without the capacity to train huge numbers of teachers), cheaper, school-based, computer-supported teacher development might be part of the solution. Such programmes, already operating in Kenya, Uganda and Tanzania, allow teachers to learn independently and at their own pace. Hence open and distance learning approaches to both ITE and CPD using technology may increase the numbers of teachers in SSA (Dladla & Moon, 2002; Leach & Moon, 2002).

## 9. Conclusions

Recent research shows that new digital technologies in SSA have the potential to revolutionise the quality of subject teaching and learning when carefully integrated into the classroom. The role of the teacher is utterly critical here. Yet a primary barrier to teachers' readiness and confidence in using ICT, despite general enthusiasm and belief in benefits for learners, is their lack of relevant preparation, either initially or in-service. Research indicates that, until recently, training opportunities have remained limited in availability and inconsistent in quality. This has resulted in demonstrably low proficiency in using ICT, and a general lack of knowledge about technology in teaching and learning. There are some recent examples of successful practice in developing ICT use in SSA schools through its integration in teacher education. However, according to Unwin (2005), provision has often been characterised by 'well intentioned, but misplaced, supply-driven initiatives' across the continent to provide teachers and students with ICT skills (p. 122). These have proved 'wasteful and inappropriate' (p. 126), with limited impact. Moreover, the recent global economic downturn has amplified the shortage of public funds to devote to the already expensive business of training teachers to use ICT (Commonwealth of Learning, 2004). Increasingly, large school classes and the designation of ICT as a discrete subject, lead to a dire lack of subject teachers trained to integrate technology into learning in their areas. These are fundamental challenges to be overcome before ICT capacity building can become a reality in African education.

In conclusion, this paper identifies a need for teachers and teacher educators to integrate ICT into subject teaching and learning using contemporary pedagogical approaches. Ideally teachers will be assisted to work collaboratively over time with peers, and to learn from one another's innovations and experiences. This requires prioritisation of ITE and CPD that is pedagogically sound and aligned with wider policy interests, and means offering sufficient support and time for teachers to get to grips with new technologies. Underpinning these recommendations is development of locally produced, contextually relevant course content for both teachers and learners.

The situation is already changing somewhat via programmes such as Intel Teach<sup>12</sup>, that has reached over six million teachers in 40 countries worldwide. The development of databases for open educational content tailored for individual SSA countries, such as TESSA,<sup>13</sup> SchoolNet Africa<sup>14</sup> and Commonwealth of Learning<sup>15</sup> are also making an impact. Hennessy and colleagues are currently exploring the potential for creating and integrating locally produced or adapted digital open educational resources through school-based, subject-focused professional development in the OER4Schools project. A pilot in Zambia is being conducted by a schools-Ministry-academic-NGO-private sector partnership.<sup>16</sup>

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<sup>12</sup> <http://www.intel.com/education/teach/>

<sup>13</sup> <http://www.tessafrica.net/>

<sup>14</sup> <http://www.schoolnet africa.org/english/index.htm>

<sup>15</sup> <http://www.col.org>

<sup>16</sup> <http://www.educ.cam.ac.uk/centres/cce/projects/ictzambia/>

While it must be acknowledged that the above recommendations are demanding, given the current state of play, we believe that striving towards bringing SSA schooling into the 21<sup>st</sup> century in these ways will help educators and policy makers to harness ICTs in support of their countries' future educational and economic development.

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## References

- Afe, J. O. (2002). *Reflections on becoming a Teacher and the Challenges of Teacher Education*. Paper presented at the Inaugural Lecture Series 64 of the University of Benin.
- Anderson, J. (1997). Integrating ICT and Other Technologies in Teacher Education: Trends, Issues and Guiding Principles [Electronic Version]. *Infoshare: Sources and Resources Bulletin*, pp. 33-35. Retrieved 7 March 2010 from [www.unescobkk.org/fileadmin/user\\_upload/ict/e-books/.../4integrating.pdf](http://www.unescobkk.org/fileadmin/user_upload/ict/e-books/.../4integrating.pdf).
- Banks, K. (2008). Mobile learning in developing countries: present realities and future possibilities. In D. Harper (Ed.), *Education for a Digital World. Advice, Guidelines, and Effective Practice from Around the Globe*. Vancouver: BCcampus and Commonwealth of Learning.
- Bowker, A., Hennessy, S., Dawes, M., & Deaney, R. (2009). Supporting professional development for ICT use in mathematics using the T-MEDIA multimedia resource. In M. Joubert (Ed.), *Proceedings of the British Society for Research into Learning Mathematics* (Vol. 29, pp. 19-24). Cambridge.
- Cawthera, A. (2001). *Computers in Secondary Schools in Developing Countries: Costs and Other Issues* (No. 12831): Department for International Development (DFID) (UK).
- Commonwealth of Learning. (2004). *Towards a strategy on developing African teacher capabilities in the use of information and communication technology*.
- Cox, M., Webb, W., Abbot, C., Blakeley, B., Beauchamp, T., & Rhodes, V. (2003). *ICT and Pedagogy: A Review of the Research Literature*. London: Department for Education and Skills.
- Cox, M. J., Preston, C., & Cox, K. (1999, 2-5 September). *What motivates teachers to use ICT?* Paper presented at the British Educational Research Association (BERA), University of Sussex, Brighton.
- Davis, N., Preston, C., & Sahin, I. (2009). ICT teacher training: Evidence for multilevel evaluation from a national initiative. *British Journal of Educational Technology*, 40(1), 135–148.
- Dladla, N., & Moon, B. (2002). *Challenging the assumptions about teacher education and training in Sub-Saharan Africa: a new role for open learning and ICT*. Paper presented at the Pan-Commonwealth Forum on Open Learning from <http://www.open.ac.uk/deep/why/PanCommonwealth.doc>.
- Futurelab. (2003). *Literature Review in Primary Science and ICT*. Belfast: Graduate School of Education, Queens University.
- Glazer, E. M., & Hannafin, M. J. (2006). The collaborative apprenticeship model: situated professional development within school settings. *Teaching and Teacher Education*, 22(2), 179-193.
- Hansen, N., Postmes, T., Bos, A., & Tovote, A. (2009). *Does technology drive social change? Psychological, social and cultural effects of OLPC among Ethiopian children*. Paper

presented at the The ICT for Development Collective. Retrieved 15 July 2009, from [www.gg.rhul.ac.uk/ict4d/NinaandTom.pdf](http://www.gg.rhul.ac.uk/ict4d/NinaandTom.pdf).

- Hawkins, R. J. (2002). Ten lessons for ICT and education in the developing world. In G. Kirkman, P. K. Cornelius, J. D. Sachs & K. Schwab (Eds.), *Global Information Technology Report 2001-2002: Readiness for the Networked World* (pp. 38-44). New York: Oxford University Press.
- Hennessy, S., & Onguko, B. (Eds.). (forthcoming). *Developing use of ICT to enhance teaching and learning in East African schools: a review of the literature*. Cambridge and Dar es Salaam: Faculty of Education, University of Cambridge and Aga Khan University Institute for Educational Development - Eastern Africa.
- Jones, S., Tanner, H., Kennewell, S., Parkinson, J., Denny, H., Anthony, C., et al. (2009). Using video stimulated reflective dialogue to support the development of ICT based pedagogy in mathematics and science. *Welsh Journal of Education*, 14(2), 63-77.
- Karsenti, T. (Ed.). (2009). *The PanAfrican Research Agenda on the Pedagogical Integration of Information and Communications Technologies: Phase 1 National Reports*. Ottawa: IDRC.
- Kozma, R., McGhee, R., Quellmalz, E., & Zalles, D. (2004). Closing the digital divide: evaluation of the World Links Program. *International Journal of Educational Development*, 25(4), 361-381.
- Lankshear, C., & Snyder, I. (2000). *Teachers and Technoliteracy*. St. Leonards, NSW: Allen & Unwin.
- Leach, J. (2005). Do new information and communication technologies have a role to play in achieving quality professional development for teachers in the global south? *Curriculum Journal*, 16(3), 293-329.
- Leach, J. (2008). Do new information and communications technologies have a role to play in the achievement of education for all? *British Educational Research Journal*, 34(6), 783-805.
- Leach, J., Ahmed, A., Makalima, S., & Power, T. (2005). *DEEP IMPACT: an investigation of the use of information and communication technologies for teacher education in the global south*. London: DFID.
- Leach, J., & Moon, B. (2002). *Globalisation, digital societies and school reform: realising the potential of new technologies to enhance the knowledge, understanding and dignity of teachers*. Paper presented at the 2nd European Conference on Information Technologies in Education and Citizenship: A Critical Insight.
- Lei, J., & Zhao, Y. (2007). Technology uses and student achievement: A longitudinal study. *Computers & Education*, 49(2), 284-296.
- Liverpool, L. S. O. (2002). Information and communication technology in teacher education. In *Teacher Education in Nigeria: Past Present and Future - Proceedings of the First Teachers' Summit*. Kaduna: National Teachers' Institute.

- Muijs, D., & Lindsay, G. (2008). Where are we at? An empirical study of levels and methods of evaluating continuing professional development. *British Educational Research Journal*, 34(2), 195-211.
- National Universities Commission. (2005). *Review of statistics on universities in Nigeria*.
- Olakulehin, F. K. (2007). Information and communication technologies in teacher training and professional development in Nigeria. *Turkish Journal of Distance Education TODJE*, 8(1), 133-142.
- Pelgrum, W. J. (2002). *The effectiveness of ICT in schools: Current trends and future prospects discussion paper*. Paper presented at the OECD Japan Seminar: Teachers, teacher policies and ICT.
- Reeves, T. C. (1998). *The impact of media and technology in schools: A research report prepared for the Bertelsmann Foundation*.
- Ringstaff, C., & Kelley, L. (2002). *The Learning Return on Our Educational Technology Investment: A Review of Findings from Research*: For full text: [http://www.wested.org/online\\_pubs/learning\\_return.pdf](http://www.wested.org/online_pubs/learning_return.pdf).
- Society for Information Technology and Teacher Education. (2002). *SITE position paper: statement of basic principles and suggested actions ('Ames White Paper')* [Electronic Version] from <http://site.aace.org/position-paper.html>
- Tella, A., Tella, A., Toyobo, O. M., Adika, L. O., & Adeyinka, A. A. (2007). An Assessment of Secondary School Teachers Uses of ICTs: Implications for Further Development of ICT's Use in Nigerian Secondary Schools. *Online Submission*, 6(3).
- Traxler, J. (2009). *Making good use of mobile phone capabilities (eLA 2007)*. Paper presented at the 4th International Conference on ICT for Development, Education and Training.
- UNESCO. (2008). *ICT Competency Standards for Teachers - Implementation Guidelines, Version 1.0*. Retrieved 28th September 2009. from <http://www.unesco.org/en/competency-standards-teachers>
- Unwin, T. (2005). Towards a framework for the use of ICT in teacher training in Africa. *Open Learning: The Journal of Open and Distance Learning*, 20(2), 113-129.
- Venezky, R. (2004). Technology in the classroom: steps toward a new vision in education. *Communication and Information*, 4, 3-21.
- Zwart, R. C., Wubbels, T., Bergen, T. C. M., & Bolhuis, S. (2007). Experienced teacher learning within the context of reciprocal peer coaching. *Teachers and Teaching: Theory and Practice*, 13(2), 165-187.