Innovative and Sustainable Mobile Learning in Africa

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Abstract

Mobile learning, based on the use of mobile and wireless devices to support, enhance and deliver learning, is rapidly gaining ground as a component of blended and technology enhanced learning in the developed countries of Europe, North America and the Pacific Rim. It grows out of the specific cultural, technological and organisational affordances of these countries. In the dramatically different affordances of sub Saharan Africa, mobile learning is developing in a noticeably different direction. This paper brings together accounts of two contrasting initiatives, both of which support in-service teacher training and novel but appropriate blended learning formats, in the region in order to illustrate the differences and the difficulties of mobile learning and in order to explore their potential synergy.

The paper also throws light onto a problem now confronting mobile learning in the developed countries; that of finding pedagogically attractive formats that are sustainable and equitable.

1. Introduction

'Mobile learning' is the term increasingly being applied to the use of small, portable, handheld and lightweight electronic devices used for educational activities in classrooms, in fieldwork, at home, at work and when travelling. Typical examples of these devices include Personal Digital Assistants (PDAs), mobile phones (also called 'cellphones' or 'handphones') and perhaps Origami and Tablet PCs. Laptop computers are sometimes included, but their size and weight means that they are less easy to carry around and their start-up times preclude the kind of spontaneity found in the other devices. The term now includes learning enhanced by personal media players such as iPods and perhaps also digital cameras and personal navigation systems.

Since the start of the current millennium, experience and expertise in the development and delivery of mobile learning have blossomed and a community of practice has evolved that is distinct from the established communities of e-learning. This community is at the moment visible through dedicated international conference series, of which WMTE is the most prestigious, rather than through any dedicated journal. These development and delivery have so far focussed on short-term small-scale pilots and trials in the developed countries of Europe, North America and the Pacific Rim. Each project and pilot is different but a categorization can be discerned, namely:

- Technology-driven mobile learning – some specific technological innovation is deployed in an academic setting to demonstrate technical feasibility and pedagogic possibility
- Miniature but portable e-learning – mobile, wireless and handheld technologies are used to re-enact approaches and solutions already used in 'conventional' e-learning, perhaps porting some e-learning technology such as a VLE to these technologies or perhaps merely using mobile technologies as flexible replacements for static desktop technologies
- Connected classroom learning – the same technologies are used in classroom settings to support collaborative learning, perhaps

connected to other classroom technologies such as interactive whiteboards
- Informal, personalised, situated mobile learning – the same technologies are enhanced with additional functionality, for example location-awareness or video-capture, and deployed to deliver educational experiences that would otherwise be difficult or impossible
- Mobile training/performance support – the technologies are used to improve the productivity and efficiency of mobile workers by delivering information and support just-in-time and in context for their immediate priorities [1].

In addition, there are regional differences, for example the absence of SMS as a mobile learning medium in North America. One over-riding concern is the problem of moving these projects and pilots into the mainstream of educational provision and finding secure and sustainable funding and support. Another over-riding concern is the speed of change in the platforms, systems and devices, presenting mobile learning educators with a constant dilemma in their efforts to understand, integrate and optimize how mobile technologies can be exploited within a wider system of educational delivery and provision.

There is also a small but growing body of mobile learning practice in the developing countries. This grows out of infrastructures and societies that differ dramatically from those encountered elsewhere by mobile learning practitioners. These initiatives trouble accepted notions of e-learning evolution imported from the developed countries but in doing so potentially trouble concepts of e-learning in the developed countries themselves. They are however beset by similar concerns as elsewhere, in looking to exploit the technologies as effectively as possible as and integrate them into education, and at the same point to embed and sustain their work. This paper describes two projects that throw some light on these issues in an African context.

2. The African Context

2.1 Physical Infrastructure

This paper articulates the wider issues raised by using mobile technologies to deliver and enhance learning for dispersed learners in Africa. In order to understand the issues, it is useful to review the physical context of learning in Africa. This summary draws on our work in South Africa and Kenya but is more widely true. The physical infrastructure is characterised by:

- Sparsity, vast distances and low densities of population
- Schools, especially rural schools, in sub-standard buildings or none at all
- Poor roads, transport systems and postal services
- Poor landline phone networks, unreliable and often unprofitable
- Poor mains electricity, unreliable and concentrated in towns and cities
- Little or no Internet bandwidth outside major cities
    - Often just internet cafes or hotel business centres in cities
- Very few modern PCs or peripherals in the public sectors
    - And little user expertise
        - especially in smaller towns and rural areas.

These characteristics are often balanced by:

- Lively and energetic mobile phone networks
    - Carrying GSM but seldom GPRS
- The potential for solar power or local generation
- A regulatory and licensing system in a state of flux
- High levels of mobile phone ownership, acceptance and usage.

2.2 Education and Teacher-Training

Both the projects outlined in this paper are addressing the challenge of in-service teacher-training in African. The common background to such training is Education for All (EFA) and Universal Primary Education (UPE) as mechanisms for delivering the Millennium Development Goals (MDG). The challenges of teaching in Africa are large class size which often leads to problems attracting and retaining pupils; an un-trained or under-trained teaching force with only a limited repertoire of pedagogies: over-centralisation both within schools and across the schools sector and a short of adequate materials for both teachers and pupils.

3. DEEP Project

The Digital Education Enhancement Project's (DEEP) is researching the impact of new technologies on teachers' pedagogy and practice (http://www.open.ac.uk/deep) and has to date carried out two research studies specifically on the use of handheld technologies.

This aspect of the broader DEEP agenda focusses on the following research questions:

- What are the benefits of using the handheld computer in a professional development context? What are the limitations?
- Does the use of the handheld computer change teachers' professional practices?

Study 1

The first handheld study was implemented in twenty four primary schools in Egypt and Eastern Cape, South Africa, with 48 teachers (two per school) and over 2000 pupils [I] (Leach, 2006). Participating teachers carried out and evaluated a sequence of curriculum focused, school based professional development activities using a range of new technologies, including handheld computers. The intervention was funded by the Department for International Development (DFID); Hewlett Packard funded the handheld devices. The study was coordinated by the Open University (UK) in collaboration with the University of Fort Hare (Eastern Cape, South Africa) and the Programme, Planning and Monitoring Unit (Egypt) and carried out between January 2002 and March 2004. In this first study (see Leach, Peters, Patel, Power, Ahmed and Makalima, 2004) the HP Jornada 565 Pocket PC was viewed primarily as a source of personal support for project teachers. All were novice users of handheld computers. A range of professional development activities, created as illustrated e-books, was installed on the handhelds. Videos, audio clips, web links and classroom resources related to these activities were also provided.

Study 2

A second study (October 2004 to present) is currently involving 28 teachers in 14 schools in the Eastern Cape and is facilitated by a grant from the NGO, bridges.org (see http://www.bridges.org/ipaq_competition/winners.html). New professional development activities have been devised specifically for this study, orientated towards handheld use for the Eastern Cape context and e-books developed with the local culture, literature and environment in mind. Each teacher has an iPAQ (with access to the following software: Pocket Excel, Pocket Word, Pocket MSN, i Task, Outlook, Microsoft Reader, Calculate, Games, iPAQ image zone) and professional resources including:

- Science and Literacy Professional Activities & related materials (as e-books)
- Poetry
- Xhosa Bible (at participants' request)

Contexts, schools, participants

Eastern Cape Province is one of the former homelands of South Africa, where poverty remains at its most severe [ii]. South Africa's population overall is 45.3 million; GDP per head is $2,500. Eastern Cape Province's population share is 6.4 million; GDP per head is $432. The range, type and intake of the project schools typify Eastern Cape demography: most serve largely remote and disadvantaged locations where unemployment is high, agricultural opportunities limited and resources scarce. These schools have negligible resources, apart from a small number of text books and storybooks. Many of the classrooms have poor natural lighting and fragile furnishings. None are heated, although temperatures can fall below zero in the high ground during winter and many have no windows. Several of the schools' classrooms have dirt floors and children sometimes have to stand during lessons because there are not enough desks or chairs. In one school, floorboards from some of the classrooms have been removed by members of the community to provide firewood during a cold winter or for building materials for makeshift housing.

The majority of the teachers participating in the studies are female; IsiXhosa is their mother tongue. Their experience of ICT use was limited prior to the studies and none had used a handheld computer. Most of their families and communities have never touched a computer / laptop / handheld/ digital camera, and most have never seen or heard about any of these technologies. For many pupils the pictures they took during the project with digital cameras were the first pictures of themselves or their environment they had ever seen. The brief case

study that follows gives an introduction to the typical experience of teachers within the project.

Findings

The handheld is highly popular in the Eastern Cape. The majority uses the device both at home and in the classroom and some use the device whilst travelling. The majority also reports that the handheld helps their 'ICT skills' and 'understanding of the language and concepts of ICT'. Overall the device is seen as 'very useful' and viewed as of 'equal value' as other computers, '[I] can do anything I may do with the other computer'. This is in a context where 56% of teachers and 75% of the school communities have had no prior experience of any form of computer technology (i.e. both hand-held and shared laptop PC were being used for the first time). The handhelds are so popular that more than half of the teachers would be willing to buy one with their own funds (if the price was affordable).

Technical limitations

The first study found that when the handheld was regularly recharged, or backed up to a computer, data was retained without problem. However, there were occasions where teachers suffered data loss due to a loss of battery power, where the data had not been synchronised with another machine. These instances were far more apparent in the rural schools than the urban Egyptian context. In the Eastern Cape, half of the project schools have no electricity supply and in many schools that have electricity it is not available in every classroom. At one remote rural project school, where teachers live almost entirely without electricity in the settlement surrounding the school, they walk a few miles down an unmade track to the local hospital to recharge project equipment. Many of the Eastern Cape teachers used their handheld computers extensively, so those who discovered their lost data was irretrievable were particularly grieved; one teacher in a school without electricity reported being extremely upset when their data was lost.

Anytime, anywhere learning

Size and weight was viewed as being a very important aspect of the handheld (particularly in the rural context) and this was usually linked to the sense of its portability. This view surfaced strongly in the qualitative data. 'It is useful because you can carry it everywhere you need it'. 'Since the Jornada is always in my bag it is easy to reach'. '[The] Jornada is user friendly because it is not too heavy'. The majority thought the weight and size 'just right'. It should be noted that in both contexts security is of major concern. Handhelds are easily concealed, deftly popped into pockets or handbags at the end of lessons and are not conspicuous when travelling. Teachers reported feeling safe when carrying this 'invisible' device, where they felt more conspicuous and vulnerable carrying a laptop bag. Teachers reported on the expansion of their capabilities as they used and got used to the handheld computer; many consider that there is something quite new and unique about the opportunities provided by such a flexible device in their particular context. It has offered possibilities in terms of access to 'anytime, anywhere' professional activity. It can be used at home, in the classroom, in friends' homes, on fieldtrips or at a special event. It can be taken from classroom to classroom and within classrooms be handed from pupil to pupil, thus enabling it to be integrated with ease into the flow of daily activity, including in some instances, fieldwork outside the classroom. In this sense it is the computer that moves with the learner as directed by the teacher, to serve particular pedagogic tasks. It has not disrupted the normal layout of the classroom or required special furnishing.

New tools enable new learning activities

The diary, calculator, camera and games are the most popular functions and these are used both at home and in school. Every teacher mentioned taking photographs when describing its use; 5 made use of the audio and recording functions 'frequently' ('Using the instrument in taking photos and in recording information'). Word is well used by a significant number of teachers, particularly for lesson preparation. Half of the teachers have used the handheld to access the DEEP professional development resources; 11 have made use of the multi-media resources.

Organizing and Planning

In rural and resource challenged contexts where teachers have hitherto had to rely solely on notebook, chalk and chalk-board as their only means of planning and storing information, the handheld has modified the way teachers organize, think about, and indeed carry out aspects of their work, as well as the way in which they work with others. Highly suited to

organizational tasks, data collection and planning is much easier to carry out. It is ready to hand, when any one of a range of applications is required. Project teachers have been observed using the handheld for professional purposes such as preparing lessons and making notes on pupil progress. They reported using it to: record appointments; take pictures of students; summarize some lessons; note take during lessons; take photographs for curriculum use; make calculations; set reminders for tasks; record events (e.g. Mark Shuttleworth lecture) to use as the focus of a lesson; record and photograph pupil work, presentations and music to show parents; teach peers basic ICT skills and concepts (i.e. terminology, handling the stylus, moving between programs'). The handheld has enabled effective organisation, including re-use and storing of resources.

Collaboration and shared professional learning

The use of the handheld facilitates new forms of collaboration between project partners and local cluster groups. Teachers can use infrared 'beaming' to exchange resources. In the cluster sessions researchers attended, teachers were observed sharing lesson plans, photographs, recordings and presentations that they or their pupils had made. The ability to store and then share ideas, plans and resources at a later date was a major breakthrough in project teachers' experiences. When teachers from several schools exchange materials at cluster meetings there is a sense of real excitement. The project team is also able to transfer new professional resources to the handhelds at training sessions. Such activity encourages shared learning and the possibility for professional updating.

New Classroom practices

Pupils in the Eastern Cape have been observed using the handhelds for a wide variety of activities including: literacy activities; peer tutoring; mathematical games; group work; photography; field work; language practice (recording and listening to conversation). The researchers accompanied pupils from two of the project schools on a fieldtrip focusing on the use of solar power. Pupils were observed sharing the handheld to take photos, record interviews and make notes. They were fluent users of the device.

Dignity and self-esteem

Many project teachers have provided testimony to the way in which their self esteem and professionalism has been raised by the use of the handheld computer, together with the adjacent technologies within the DEEP project. Ownership of the handhelds marks a change in status and professional competence. Many teachers in the Eastern Cape use the personal pronouns 'my Jornada' or even 'my companion' when talking about the device. Several mentioned 'we use it everywhere'. There is a strong sense of ownership; the device is not alien, appearing to be fully appropriated into daily practices.

This sense of professional affirmation is not limited to project teachers alone, but extended to colleagues and parents: 'Great excitement from parents and teachers ... so there has been great enthusiasm' [School principal interview, 2002]. 'The view is that they are no longer in the shadow of the 'model school' in their town or city. There are a lot of computers in the model schools. It's appropriate technology ... Even other parents now want their children to come to our school' (Interview, 2003).

4. SEMA Project

In January 2003, the new democratically elected Government of Kenya placed the highest priority on education, announcing the introduction of Free Primary Education (FPE) from January 2003. This led to an increase in primary enrolment of nearly one million, with the number of pupils increasing in individual schools between 10% and 25% and placing great demands upon the Ministry of Education (MoEST) at all levels. The subsequent fall of the school population pointed to a retention problem aggravated by over-crowding. A major challenge was the need to rapidly increase the numbers of trained teachers whilst at the same time improving the quality of the school system and using it as a vehicle for radical social and cultural transformation across issues including child-marriage and other tribal practices, endemic corruption, poor communications, an over-centralised education system and widespread adult illiteracy (and general poverty and disease). Underpinning this was the need to monitor and manage school enrolment numbers at a local and national level.

In the course of 2003, the World Bank offered a grant of $55m to assist the implementation of FPE. The World Bank's Free Primary Education Support Programme (FPESP) had four sub-components:

- school based teacher development
- school accounting system
- education management system (now called EMIS)
- system design and programme preparation

Part of this, the School-based Teacher Development program (SbTD), used distance learning, with face-to-face support to train:

- 35,000 additional Key Resource Teachers (KRTs) in Kiswahili and in Guidance and Counselling
- 54,000 already trained ('graduate') Key Resource Teachers
- 7,500 Head Teachers (HTs)
- 1,500 Teacher Advisory Centre (TAC) Tutors and Zonal Inspectors

Imfundo, a unit within the Department for International Development (DfID) set up to use education and ICT to address extreme deprivation in sub Saharan Africa, supported the implementation of FPE by the Ministry of Education Science and Technology (MoEST) and helped the MoEST build capacity, specifically in the development of the School Empowerment Programme (SEP), the successor to SbTD. SEP aims to strengthen management structures within each school and to develop a shared ethos and school vision amongst its staff. SEP is a blended learning package. Nine themes form the focus of a distance learning module for the Head Teachers and an INSET package for the KRTs to deliver to the whole school:

- School Leadership
- Ethics and Integrity
- Special Needs
- Alternative Teaching Approaches
- Guidance and Counselling
- Capacity Building
- Teaching and Learning
- Effective Use of Resources
- School Health and Nutrition

Embedded in these broad themes, SEP tackles child-marriage, corruption, over-centralisation, bullying, HIV/AIDS, retention, women teachers and over-crowding, building around a theme of 'leading from the middle'.

Both SEP and SbTD are in-service distance learning programmes with content and delivery specifically tailored to Kenyan needs. The BBC WIL supported Kenyan video, radio and sound studios to produce video cassettes, audio cassettes and radio broadcasts, whilst the Centre for Educational Leadership (CEL) at Manchester University worked with local writers on print material. SEP, now being delivered, is designed to develop the capacity of the whole school by training Head Teachers and Key Resource Teachers to deal with the challenges of Free Primary Education in Kenya. The programme is mainly delivered through print-based material and supported by multi-media (audio, video and radio). The material is designed to meet the needs of two key groups:

- The Head Teacher materials reflect the areas relevant to them in bringing about change in the school, working with the community, management, leadership *etc*.
- The Key Resource Teacher material support classroom practice and delivering this training on to the rest of the teachers.

Imfundo continued its support to MoEST INSET unit by assisting the preparation of deliver training through new ICT platforms and this now includes SMS mobile technologies in collaboration with the University of Wolverhampton. The University has also been assisting in monitoring developments in handheld computers and mobile learning. SMS came late to SEP but had considerable potential to catalyse, reinforce and complement the other strands of the project. The attractions of an SMS component within SEP identified by a University of Wolverhampton consultancy included the fact that the costs of SMS were sustainable: capital (but this was negligible, unlike other ICT interventions, because teachers buy or already own the necessary hardware) and running (minimal, just discounted bulk SMS messages).

The University was instrumental in drawing up the specification and requirements documents for the SMS component of SEP and for commissioning Cellulant, a Nairobi VAS company, to develop and deliver it. This SMS component was to be called SEMA! ('speak out' in Kiswahili) and is based around a unique toll-free short-code (5225) available to all authenticated and registered users. In general, SMS will be used for delivering

- Study guide material, giving week-by-week support, maintaining momentum, contact, morale and continuity
- Content such as hints, tips, outlines, lists, summaries, revision

- Reminders for assessment, contact, broadcast, discussion, video, meeting
- Discussion in the form of feedback, seminar, query
- Pastoral work giving support, encouragement
- Urgent messages about errata, cancellations and changes
- ….. and acting as a managed targeted bulk messaging system.

Because many events in SEP occur at predictable dates (starting a new module, assessment due, seminar to be arranged for example), much of the SEMA traffic can be written and stored on the system in advance and broadcast at appropriate pre-determined times with no human intervention. Any traffic that is by its nature unpredictable (cancellations or errata, for example) could be entered into the system by local officials or national organisers using their mobile phones. They would merely need to send the proposed SMS text with codes identifying the target groups to a prescribed number. Some technologies are also developed to supplement the basic SMS broadcasting and messaging functionality. This will include SMS seminars/forums (where the message of any participant will automatically go to other participants) and SMS-based polls and quizzes. Whilst the use of SMS to support a model of teaching and learning based around the transmission and delivery of content (the 'didactic' model) is unremarkable (it gathers together and consolidates existing global practice, and parallels a large national project at the University of Wolverhampton, www.wlv.ac.uk/celt/melas), its use to support a model of teaching and learning based around collaboration and discussion (the 'discursive' model), and also around interactivity is more novel, exciting and challenging. Its success will depend on the training, commitment and imagination of local tutors. The SMS technologies themselves being developed and used within the project are widely used in the private sector and in this respect the project is innovative in bringing these into the public sector in a large-scale and sustainable fashion.

This is a brief description of some of the SEMA functionality. The system is now in use in about 300 schools in two District, Nairobi and Kajiado, and later in the year will be rolled-out to ten further Districts. The evaluation and monitoring will start in July 2006 and will look at issues of acceptance and take-up alongside technical issues of usage and performance and business issues of cost and efficiency. These issues reflect the concerns of the major stakeholders and champions, who are interested in SMS in the wider context of teacher training, distance learning and programme delivery. This account specifically picks out that background.

5. Issues

These two projects illuminate several issues and raise several questions

- Sustainability/Scale – both projects face challenges as their champions seek to extend their scope and their impact
  - Technology – mobile hardware and technology continue to be fluid and expensive and there is a technology hurdle to sustainability and increased scale. SEMA uses simple GSM phones, in part because they are a stable and widely available technology. They do not however have the functionality of say GPRS phones and so do not offer a very interactive or media-rich learning experience. The DEEP project on the other hand uses PDAs but these are not only expensive to buy but also generally prohibitively expensive to manufacture. Currently there is no stable and widespread handheld platform to support large-scale and sustained mobile learning. The geometry and marketing of mobile devices make it unlikely that a general-purpose 'converged' handheld device (*ie* one embodying the convergence of phone technology and PDA technology) will emerge, certainly not in the way that the PC platform emerged amongst desktop computers and so mobile learning in Africa will have evolve formats that work across multiple platforms.
  - Infrastructure – many aspects of African geography and infrastructure militate against mobile learning in Africa.

However the use of generators and solar power, increased GPRS coverage and the uniquely vigorous mobile phone networks give mobile learning a considerable advantage over conventional e-learning in the immediate future and the current projects point to a sustainable complementarity of methods and technologies. A mobile learning format that exploits GSM networks and simple PDAs may be viable in many parts of Africa.

- Equity and Exemplars – developing technologies and delivering educational projects raises concerns about their precise role and rationale. This would be true anywhere in the world but is doubly significant in Africa where many divides and disparities already exist. The SEMA project is based on the near-universal ownership, acceptance and use of GSM phones but even so there is understandable concern about the 20% - 30% of the population, mostly in the already under-privileged arid/semi-arid lands, who are outside network coverage. Where the balance is so obviously in favour of the project it is easy to argue that the success of the project reinforces the case for increased network coverage. If a successor project were to look at exploiting GPRS and WAP technologies (with a much lower ownership and take-up), this argument would be less convincing and WAP pilots would become exemplars of potentially good practice but not ones that could be easily rolled out nationally. In the case of DEEP hardware costs mean that extending the project is a systematic way is problematic in spite of its clear benefits.
- Policy and Projects - there is a shift in the organisation of development programmes away from small-scale and possibly uncoordinated bilateral projects to an approach where the donor communities work with national ministries to embed change within policy across entire sectors. Whilst this is clearly an improvement in terms of coherence and sustainability, it may make it more difficult for innovative pilot projects, for example mobile learning, to gain the necessary first footholds. The current projects have started from different positions in this respect. The SEMA project is well embedded in the national educational priorities and units but has to work according to specific procedures and practices that are not necessarily well suited to developing and deploying a technical and pedagogic innovation. The DEEP project on the other hand has been orientated to developing and deploying technical and pedagogic innovation. It now has to work to show how the approach can be embedded into national educational policies and priorities,

This review of two projects based in Africa throws considerable light on issues that currently affect mobile learning anywhere in the world. Both projects are reaching some point at which it is possible to report on their wider significance and on their relevance to hurdles facing mobile learning globally.

6. References

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