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In the palm of your hand: supporting rural teacher professional development and practice through the use of mobile phones and other handheld digital devices.

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Abstract: Given the huge growth of mobile phone access in Sub Saharan Africa (Minges, 2004) some of the most innovative uses of mobile devices are now to be found in the development context (Economist, 2005). Reviews of the use of mobile technologies point to a range of current and potential development for learning in classrooms, homes and the community (e.g. Naismith et al).

This paper draws on the experience of two projects: a large scale project for SMS mediated school administration in Kenya and a small scale research project using eBooks and other digital tools for teacher professional development and practice, carried out in predominantly rural schools in the Eastern Cape, South Africa. This research is set in the wider context of the emerging theory, practice and evaluation of the use of mobile technologies for improving teaching and learning (Leach 2006, Power & Thomas 2006, Traxler & Kukulska-Hulme 2006).

The paper considers the potential of currently common mobile phones to aid communication and break down isolation amongst rural teachers and the design, use and evaluation of e-book learning resources on handheld mobile devices, such as current 'smart-phones', which the authors anticipate will soon be the 'normal' ubiquitous mobile phone.

Whilst there is only a small body of evidence on the application of mobile technologies to teacher learning, impacts on teacher development remain a matter for debate. Findings suggest that given the right conditions, uses of mobile technology can significantly enhance teacher professional learning and practice.

Keywords: teacher professional development, ICT, mobile technologies, e-books, innovative practices, work based learning, rural development

Introduction: surveying the landscapes

The use of mobile phones and other handheld digital devices to support the professional development and practice of rural teachers is a relatively recent innovation. This paper contributes two further case studies to the small body of research evidence emerging about such uses of mobile technologies.

We see this work arising through the interaction between three overlaid landscapes.

The Educational Landscape

“We resolve further:

To ensure that, by the same date [2015], children everywhere, boys and girls alike, will be able to complete a full course of primary schooling and that girls and boys will have equal access to all levels of education...”

(UN 2000)

“It is now accepted that the Millennium Development Goals are all about children.”

(UNICEF 2005)

“Between 1999 and 2004 the number fell by around 21 million to 77 million [primary school-age children not in school].... The global estimate... understates the problem... The children most likely to be out of school... live in rural areas and come from the poorest households. On average, a child whose mother has no education is twice as likely to be out of school...”

(UNESCO 2007)

Education lies at the heart of eradicating poverty; it is now recognised to be the crucial core of the Millennium Development Goals. In low-income countries, for instance, with each year of additional education, average earnings increase by 11%. People with literacy are best placed to start their own enterprises and increase wealth (UNESCO, 2005).

Globally, seventy seven million children, mostly in poor countries, still have no access at all to even the most basic schooling. Sub-Saharan Africa is home to half of the worlds out-of-school children; even of those who enrol in school, only one in three will complete their primary education. (UNESCO 2007)

In addressing the issue of providing universal primary education, the need for teachers is staggering. Sub-Saharan Africa as a whole will need to expand its teaching force by 68%. In some countries the crisis is even more severe – Ethiopia must double the number of teachers; Chad will need almost four times as many (from 16,000 to 61,000). (UNESCO 2006). It is calculated that 18 million teachers are still needed if the Millennium Development Goals are to be met (Global Campaign For Education, 2006)

It is not simply a matter of training new teachers for new pupils, but also of upgrading the knowledge, skills and qualifications of the existing teaching workforce. For example, a survey of eleven eastern and southern African countries indicated that a third were untrained (UNESCO 2000); a recent survey of seven Sub-Saharan African countries found some teachers scoring lower than their pupils in basic numeracy tests (UNESCO 2005a). The Commission for Africa Report (2005) underlines these issues in identifying teacher training, staff development and curricular relevance (p.44) as key priority areas for reducing poverty.

Whilst teacher education has been identified as a priority by both national governments and international organisations and donors, practical policies remain under-developed - traditional 'college based' methods of teacher education simply cannot meet this demand. Imaginative and robust solutions are required which are high quality, relevant to local needs and school and classroom-based (Leach & Moon, 2002)

These problems, of pupils not having access to school and schools not having access to sufficient trained teachers, are experienced much more acutely in the rural areas: 82 per cent of children not in school in developing countries are located in rural settings (DevInfo 2006).

Concurrently, the scarcity of trained local personnel, including teachers, is also greatest in the countryside (Mulkeen, 2005). Experienced practitioners largely avoid poor rural placements, or relocate to towns and cities as soon as they are able (Hedges, 2005). Teacher shortages, compounded by the dearth of trained professionals means that members of poor, rural communities rarely participate in quality, relevant education.

The Educational Technology Landscape

Most governments in the global south are now investing heavily in new technologies, with strong arguments being made for the potential of ICT in education (e.g. Unwin, 2005; Selinger, 2005; Commission for Africa, 2005). New technologies orientated for educational development, such as the \$100 laptop, (MIT, 2006) will shortly be available. Within this context, teachers are seen as key to the success and sustainability of ICT related educational strategies (Dufborg, 2005).

Despite considerable rhetoric about the value of ICT in education, research shows that educational ICT programmes that do exist in the developing world make few linkages to issues of quality teaching and learning (Ngu and Zwedie, 2006; Unwin, 2005). Our own research has shown that such innovations largely mirror increasingly outdated practices of developed economies: de-contextualised, IT skills training in refurbished tele-centres and computer labs, based on a standard paradigm orientated to a resource rich, office-based practices (Leach et al, 2006; Power 2007).

Research shows such approaches to be both culturally irrelevant in rural communities (Heeks, 2005) and generally unconnected to poverty reduction strategies (OECD, 2005), leading to what Unwin (2005) has described as the 'computer tragedy': 'piles of hardware accumulating in dusty corners, and 'computers hidden under plastic covers that have rarely if ever been used' (p. 5).

It is not simply that such lack of educational outcomes from educational technologies is a failure to produce 'good' results; such outcomes can reinforce a sense of failure and foster a culture of blame in the very communities they were meant to benefit.

The mobile technology landscape

Mobile technologies are already changing the everyday lives of some poor communities in the developing world (Commission For Africa, 2005, p.32).

There has been an explosion in mobile phone use in developing nations, starting shortly before the new millennium; use in Sub-Saharan Africa grew 5000% between 1998 and 2003 (BBC News, 2005). This has had a phenomenal impact in the accessibility of communications networks to the worlds poor. For example, in Tanzania, it took just five years from the first mobile phone service for the number of mobile phone subscribers to exceed the number of landline phones in the country

(Developments.org); by 2005, 97% of the people surveyed in Tanzania said they could access a mobile phone, compared to just 28% with access to a land line (BBC News, *ibid*).

Seventy seven per cent of the world's population now lives within range of a mobile network (Economist, 2005) and the United Nations has set a target for 50 people in every 100 to be accessing such a network by 2015. In many respects Africa and Asia are at the forefront of such developments, leapfrogging to a wireless infrastructure (Minges, 2004).

In the worlds of business and health in particular, many innovative uses of mobile technologies are already supporting rural and developing communities. For example, Bangladesh's prize winning Grameen Bank, is now a globally recognized innovation. An impact study of a mobile network in a Laotian mountain community, where 80% of users earn less than 1 dollar a day, shows that substituting one journey per month to friends and family (or to gain information on government issues) with a phone call, generates an average surplus of USD 77 per year. In Ginnack, a remote island on the Gambia river, nurses use digital cameras to record patients' symptoms, sending pictures electronically to be diagnosed in a nearby town by a local doctor, or sending them abroad to get a specialist's view (Accenture et al., 2001).

The landscapes surveyed:

There are severe challenges in creating meaningful education for all; these challenges are most severe for rural teachers, pupils and communities.

The educational potential of ICTs are widely recognised, but the dominant models of implementation and practice seldom fulfil this potential.

There is a revolution in mobile ICT currently taking place in rural communities, but this is not commonly harnessed for enhancing education.

It is within these landscapes that we consider two case studies of mobile technologies being used to support rural schooling: one using ubiquitous SMS messaging to enable school administration and management at national level; one using ebooks (for handheld computers and smartphones) to support teacher professional development.

Case Study 1: Setting up the SEMA project: SMS for schools in Kenya

The Kenyan national ICT policy states that ICT should be used to improve the livelihoods of Kenyans. The government envisages education as the natural platform for equipping the nation with the ICT skills in order to create a dynamic and suitable economic growth (MOEST session paper No.1, 2005: 77). The policy recognizes that young people are earlier adopters of ICT (Ministry of Information and Communication ICT policy, 2004).

In the Kenya Education Sector Support Programme (KESSP), the section 'ICT for Educational Investment Program', puts a clear emphasis on developing infrastructure and capacity, in particular human resources, in order 'to develop the skills today which will be needed tomorrow'. This fits well with the ICT Scoping Study carried out by Digital Links in 2004 on behalf of MOEST and funded by DFID, which highlights the inadequate number and capacity of computers, as well as lack of access to the Internet.

The use of mobile phone to support learning can solve the issues to do with connectivity and lack of wired infrastructure. Quite a number of people in our society have no access to the Internet through landlines and computers; on the other hand, mobile communication is far more available and

accessible than any other ICT except radio. The mobile phone is ideal and appropriate for the vast and underdeveloped Africa: many more people are using much more mobile phones than the desktop computers! The MOEST study also shows that teachers are early adopters of mobile technology; estimating that 80% of teachers have mobile phones.

The Ministry of Education sessional paper (2005) identifies inadequate in-service programmes for teachers as a significant issue; in response, the MoE has recently piloted the use of SMS technology as mode of supporting in-service programmes.

The MoE has also established a major project using SMS text messaging as a reliable, cheaper alternative for collation of data from schools. The aim of this is to decentralize data collection and collation and facilitate learner support at grass root level.

Mobile technology offers a unique channel for the support of the teaching and learning process in such away that education outcomes in terms of retention and participation is achieved while minimizing attrition.

Advantages of using SMS technology include:

- cheaper way of communication
- rapid
- personal
- potential for immediate response
- supports data collection
- supports cluster meeting organisation
- accessed anywhere, any time

SEMA (School Education Management Application) focuses around a powerful database driven back – office connected to two mobile providers in the country. The main aim of SEMA SMS service is to support School Empowerment Programme – a teacher in-service program which used a blended approach in its delivery (use of distance learning modules, videos, audios and radio).

SEMA seeks to demonstrate that:

1. sms text can cost effectively improve teaching in Kenyan schools by providing support , continuity , guidance, reminders and peer coaching within clusters.
2. sms text can improve the efficiency, speed and accuracy of data storage and analysis.

In fulfilling these goals, the SEMA project aims to:

- Improve quality of in-service teacher training (INSET) through provision of information services
- Enhance communication among various cadres within the education system.
- Improve education data collection for EMIS (Education management information System)
- To improve the efficiency, speed, accuracy, storage and analysis of data by setting up a simple system.
- Cost effectively improves teaching in Kenyan primary schools by providing SMS content to in-service teacher trainees.

Case Study 1: Outcomes

To meet these aims, SEMA was created as a private network for the education ministry with the aim of improving the quality of in-service training though SMS technology

To date the program has registered 3500 schools and 16,350 teachers (5 teachers per school – graduate key resource teachers) – in phase one and two. It has also trained about 310 support cadres i.e Quality Assurance and standards officers and school advisors.

Issues experienced during the implementation

- Some teachers could not locate some of the special characters required for the syntax of SEMA messages, such as the hash key
- Gender issues - some lady teachers had problems with husbands wanting to own / control the mobile phone
- Negative Attitude toward the use of SMS
- Cascade training – “the lower level not getting wet as expected”
- Interpretation of the training materials
- Use of system for private purposes

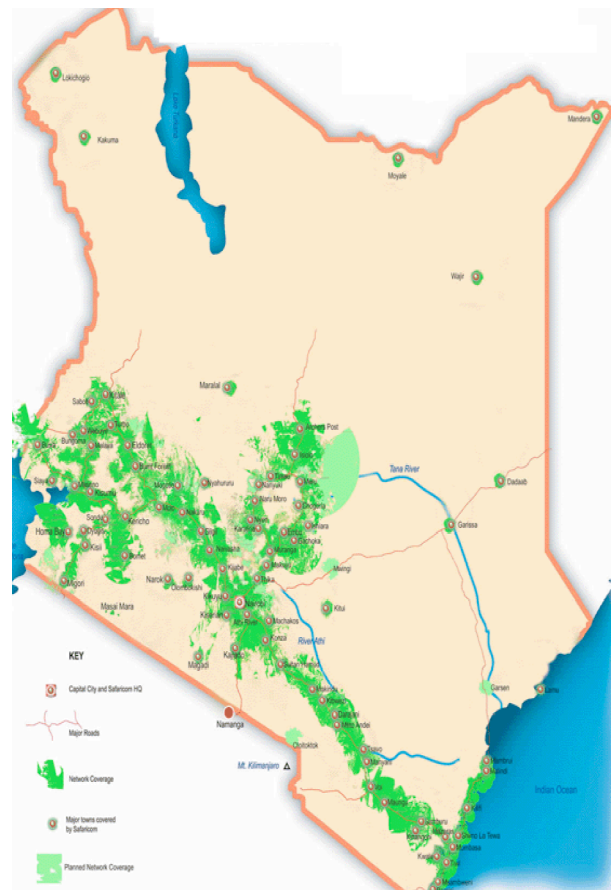
Challenges:

There is need have sound policies to promote access and utilization of basic technologies geared toward supporting teachers in-service programmes in order to improve quality of education. Many of the policy makers are still living “*yesterday*”, hence they fail to support innovations. There is therefore need to have proper sensitization programs geared toward winning the support of the policy makers.

The media selection should be linked with the availability of the intended infrastructure. ‘Access to connectivity remains one of the major challenges facing many developing countries Darkwa and Mazibuko (2000).

The network coverage / telephone communication infrastructure outside many of our major urban towns is limited and inadequate. Connectivity therefore becomes issue in developing and implementing ODFL.

A major concern in Kenya and most of the developed countries is to provide quality education to its larger population especially in arid and semi-arid lands. These are areas poorly and inadequately served with telecommunication systems. Most of the telecommunication (network coverage) in Kenya is often found along major roads and cities, basically leaving the rural areas with scanty network. Power grid tends to follow areas with high population densities. Lack of power supply means that teachers cannot charge their phones . Teachers through the use of solar changers have addressed this challenge innovatively. Typical schools have limited facilities, hence making telecommunication facility not an immediate priority. The map of Kenya demonstrates such possible scenario.



Network coverage has affected the rapid use of SEMA. This is because most schools in the rural areas do not get messages immediately as expected. In most cases they have to wait and go to a “hot spot “ (BOOTH) where they receive messages. Some teachers give phones to colleagues residing in areas with coverage to pick messages and return phones next day.

As stated by Margaret Haughey, educators are faced with questions about the use and promotion of learning technologies involving supposedly flexible systems that do not support the learner or provide the learner with choice. Innovative technology could be used to improve and enhance the quality and learning in schools.

Case Study 1: Conclusion and Summary Recommendations

SMS texts messages offers an alternative tool for teacher training support through the enhancement of communication strategies among teachers in clusters, encouraging peer support and enabling the rapid and accurate collection of data.

However there is need to carryout a further research on the role of the dynamic mobile phones technology in supporting effective learning.

Case Study 2: setting up DEEPER: eBooks for professional learning on handheld devices

The Digital Education Enhancement Project (DEEP www.open.ac.uk/deep) is a research and development project focusing on the potential of new information and communications technology (ICT) to improve teacher education and the quality of pupil learning in schools serving poor communities. Originally funded by the U.K. Department for International Development (DFID), DEEP is a partnership between the Open University (United Kingdom) and several project partners, working together since 2001 to address two over-arching research questions:

1. How does ICT transform the pedagogic knowledge and practice of teachers and the communities in which they live and work?
2. What is the impact of ICT- enhanced strategies on pupil achievement and motivation?

In the initial research, DEEP teachers participated in a series of professional development workshops and school based professional development activities and classroom tasks, focusing upon their subject, school and pedagogic knowledge (Banks, Leach & Moon 2005) and practice. Teachers used a variety of forms of ICT (including ICT suites, laptops, internet cafes, digital cameras and digital video cameras, scanners, printers and a motorbike mounted digital cinema) depending on their contexts, with a range of resources, both for their own personal and professional development, and for the teaching and learning of literacy and science. The initial DEEP research findings are published in the project report (Leach et al 2006 www.dfid.gov.uk/pubs/files/ict-teacher-education-no58.asp) and elsewhere.

In addition to the selection of appropriate digital tools mentioned, all project teachers were provided with a then ‘state of the art’ handheld computer. Professional development resources were installed on these devices in the form of illustrated e-books, case studies, exemplar lesson plans, video clips and illustrated poems.

The original research showed that teachers:

- used the handheld computers regularly, in and out of class
- used the handhelds ‘anytime, anywhere’ for professional learning

- said they would buy such devices with their own money, if they were affordable
- found the handheld equally useful as desktop or laptop computers; most of those who expressed a preference for one or the other said the handheld was the better tool for their professional practice.

These findings suggested that further study was required to focus particularly upon the use of handheld computers for teacher professional development, in the teaching of literacy and science at primary school level.

Case Study 2: Outcomes

Subsequent eBook research was carried out in the Eastern Cape of South Africa, between March 2005 and July 2006, in partnership with the University of Fort Hare and the Nelson Mandela Institute for Rural Education and Development. The research was facilitated by the provision of 25 iPaq H4150 ‘pocketPC’ handheld computers awarded by the charity Bridges (www.bridges.org). All schools and participants were located in the Eastern Cape Province; most served disadvantaged rural communities.

The eBook research explored the possibility of using only the tools and resources made available through handheld digital devices to support and extend primary teachers professional development and practice in literacy and science. In contrast to earlier research, the ‘course materials’ and resources were only made available to teachers electronically on the handheld devices, stored on a postage-stamp sized memory card.

The research methodology and early user experiences with the handheld computers are reported elsewhere (Power & Thomas, 2006); here we focus upon the eBooks produced for this project, which are amongst the first examples of rural teacher professional development materials designed specifically for use on smartphones and handheld computers. The science and literacy eBooks may be downloaded from <http://www.open.ac.uk/deep/Public/web/projects/extending.html>; the eReader software may also be downloaded from a link on this page.

Why eBooks?









The eBooks were conceived to be both the teachers ‘study guide’ (leading pairs of teachers through a series of professional development activities) and their ‘reader’ (providing additional material such as book extracts, ecological fieldwork guidance, examples of interviewing techniques, questionnaire design, case studies of teacher practice and examples of pupils work).

eBooks were chosen because they had a number of pedagogic advantages over alternative forms of presentation (such as locally stored web pages, or word-processor documents).

Just as with ‘books’, the eBooks can:

- have a recognized narrative structure and linear progression
- use bookmarks to remember position or important passages to return to
- be annotated by the reader, making their own reflections explicit
- use highlighters to mark up important passages of text.

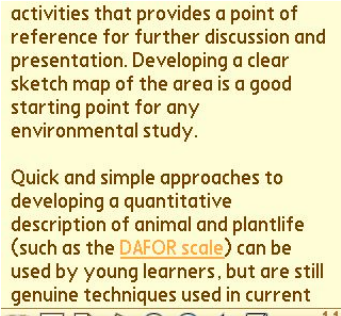
The literacy and science eBooks were written to a common structure, which had been used as a framework for course materials in previous DEEP research. Where possible, images, case studies and resources were drawn from previous fieldwork with DEEP teachers, so that the books were both authentic and related to the experiences and contexts of the teachers.

 <p>Introduction This professional development activity focusses on Natural Science, and ways in which you might develop scientific practices and knowledge through studying the local</p> 	<p>Each eBook has an introductory section that explains which curriculum area is being addressed; why this area has been chosen as an important aspect of professional development; what subject knowledge and pedagogic practices will be developed.</p> <p>In literacy, the focus was how a handheld computer / smartphone could be used to focus on spoken and visual texts; in science, how such devices could be used for out of classroom study of local ecology.</p>
<p>What do I know?</p>  <p><i>Activity One: an audit (15 minutes)</i> With your project partner, make a list of any of the local resources for Natural Science you have used in the</p> 	<p>In order to connect with current practice, the first activity teachers are asked to engage with is to reflect upon the strategies, resources and knowledge that they currently employ in this curriculum area. For example, in the literacy eBook, teachers compare Mandelas' account of village life in Qunu to learners experiences now, looking at how they draw upon such experiences in their classroom. In science, teachers consider issues relating to the resources they currently use to study the environment.</p>
<p>Curriculum Focus</p> <p>Curriculum 2005 asserts that 'language, literacy and communication are intrinsic to human development and central to lifelong learning'. It requires learners to study a wide range of texts.</p> <p>The term "text" is defined very broadly, to refer to 'a unit of spoken, written, or visual communication, including Sign</p> 	<p>The next section of the eBooks is intended to refresh and extend the teachers subject knowledge.</p> <p>In the literacy eBook, this is a consideration of the different forms of 'text' and how these are approached in the curriculum. In the science eBook, teachers are presented with a range of ecology field work techniques that can be adapted for a broad range of ages and abilities, requiring minimal equipment (e.g. a length of string / wire squares).</p>
<p>How can ICT help?</p>  <p>We will focus on two of the project tools that particularly lend themselves to environmental field</p> 	<p>Having considered issues of current practice and curriculum knowledge, the eBooks next invite teachers to consider how ICT might be used appropriately to make learning more efficient, or to extend or transform the it.</p> <p>In both the literacy and science eBooks, the focus is upon using handheld computers / smartphones and digital cameras to support curriculum practices. Case studies and exemplar resources provide starting points for teachers to build from.</p>
<p>Classroom Task</p> <p>Pair activity Now try out these activities and consider how you would use and adapt them with your own learners</p> <p>Look at Document 2 Growing up Questionnaire. Complete it together. Think about someone who you can interview, either in your school, or better still from the local</p> 	<p>The final activity in each eBook is a classroom task / preparation for teaching – in which pairs of teachers work together to plan and put into practice some of the new ideas they have engaged with.</p> <p>In literacy, the eBook invites teachers to prepare their learners to interview members of the community, studying the oral history of the village. In science, the teachers are invited identify a suitable location and activity for beginning ecology fieldwork with their learners.</p>

Advantages of the eBook format

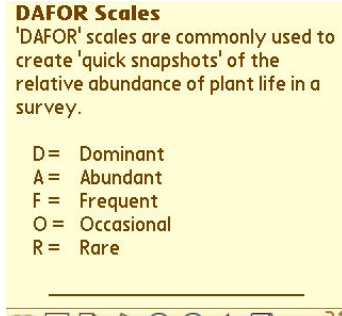
In addition to the familiar pedagogic features of ordinary books, eBooks have a number of other beneficial characteristics.

eBooks provide the ability to hyperlink between sections. This means that the narrative text can be quite tightly written, but use hyperlinks to take the reader to further explanation and back again as desired. This is shown in the science eBook screen shots below, referring to the DAFOR scale.



activities that provides a point of reference for further discussion and presentation. Developing a clear sketch map of the area is a good starting point for any environmental study.

Quick and simple approaches to developing a quantitative description of animal and plantlife (such as the [DAFOR scale](#)) can be used by young learners, but are still genuine techniques used in current



DAFOR Scales
 'DAFOR' scales are commonly used to create 'quick snapshots' of the relative abundance of plant life in a survey.

D = Dominant
 A = Abundant
 F = Frequent
 O = Occasional
 R = Rare

narrative text
further explanation

If a reader is unclear of the meaning of any word in the book, the eBook can automatically call up a definition from any installed dictionary, as is shown in the screenshot below. In this project, for primary teachers and pupils, a simple 'school and office' dictionary was provided.

Reference ▼ School and Off...

en•vi•ron•ment (en vī'ran mən, in-) *n.* [[see **environs**]] **1** surroundings **2** all the conditions, etc. surrounding, and affecting the development of, an organism, food chain, etc. — **en•vi•ron•men'tal** *adj.*

▼ Word: ↑


environment environment

environmentalist

environs

Done

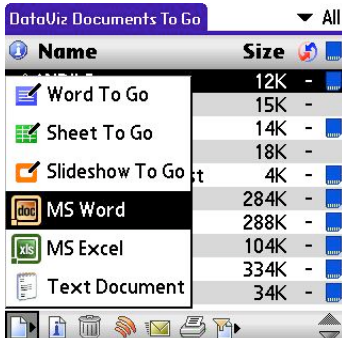
Being a digital text, users are able to copy key passages and incorporate these into their own documents, spreadsheets or presentations, all on the handheld / smartphone, to create their own learning or teaching resources.



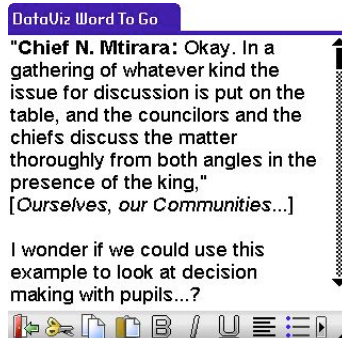
remember Mandela as a young boy.
From:
<http://www.pbs.org/wgbh/pages/frontline/shows/mandela/interviews/chiefs.html>

Chief Joyi, you first met Mandela in 1935. What kind of young man was he in those early days?

Chief Joyi: Mr. Mandela was promising... a hale fellow... even



Name	Size
Word To Go	12K
Sheet To Go	15K
Slideshow To Go	14K
MS Word	18K
MS Excel	4K
Text Document	284K
	288K
	104K
	334K
	34K



DataViz Word To Go

"Chief N. Mtirara: Okay. In a gathering of whatever kind the issue for discussion is put on the table, and the councilors and the chiefs discuss the matter thoroughly from both angles in the presence of the king."
 [Ourselves, our Communities...]

I wonder if we could use this example to look at decision making with pupils...?

eBook text
creating a new document
incorporating the text

Case Study 2: Conclusions and Summary Recommendations

The project team settled on eBooks as the medium of instruction for a variety of reasons.

Firstly, the software provided all the pedagogic devices we wished teachers to use, such as the ability to:

- combine text and images within the book
- easily navigate to different sections of the book by chapter and other headings
- highlight passages of text in various colours
- annotate the text with comments and reflections
- navigate to related sections through hyperlinks
- copy selected quotations
- look up dictionary definitions automatically

Secondly, the software (both to author and view eBooks) was relatively cheap, easy to use, and available for a variety of desktop / laptop / handheld computer and smartphone platforms (www.ereader.com/product/browse/software).

With a very gentle learning curve, it was possible to publish, share and update eBooks at minimal cost.

Given that even a very large book like the Bible only takes 1.5MB of storage space, a small, cheap postage-stamp sized memory card is capable of storing an entire ‘pocket library’ of books, which can be accessed ‘any time / anywhere’ by a teacher with a handheld computer / smart-phone.

The most problematic issue with the wide-scale use of such ebooks would have to be that, currently most teachers in poor rural communities do not possess appropriate handheld devices to read them on. However, it is likely that within the very near future (e.g. 24-36 months) almost all mobile phones sold will be smart-phones capable of accessing eBooks as well as the internet and email.

Even today, one might argue that such devices represent a more cost-effective form of ICT for such teachers than desktop or laptop computers: in the near future many teachers will routinely carry in their pocket a computer significantly more powerful than the cast-off desktops now being dumped on Africa.

A recent advert for a smart phone carries the tag line ‘It’s what computers have become’.

Given the rapid growth of mobile technologies and infrastructures in Africa and Asia, the research, education and development communities should further explore the potential of such computers in supporting teacher professional development and practice.

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