Ict And Teacher Education In The Global South: Costing The Benefits Of Learning

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ABSTRACT

The Digital Education Enhancement Project (DEEP - www.open.ac.uk/deep) has been working with teachers and teacher educators in South Africa and Egypt, to explore the potential of open learning, enhanced by the use of ICT, for the professional development of teachers in the Global South: aiming to improve teaching and learning in literacy, numeracy and science.

This work takes place against a background of the growing gap between the numbers of trained teachers in low-income countries, and the demand therein for primary education. It is clear that bricks and mortar institutions, offering full-time, centre-based teacher education, will be unable to close this gap alone. If applied appropriately, open learning approaches, fully availing themselves of the power of ICTs, may make a significant contribution to the millennium goal of Universal Primary Education.

We believe such approaches provide a powerful tool for the professional development of teachers: elsewhere we have reported the positive outcomes of such a programme, in relation to both subject knowledge and pedagogic practices; to pupil motivation and achievement.

In this paper, we consider a cost / benefit analysis of the range of resources required, contrasting the model of state-of-the-art mobile technologies for teachers with the more typical model of IT suites of refurbished computers.

The question this paper seeks to address is this: are the approaches explored by the DEEP project a cost effective means for the nations of the global south to rise to the challenge of creating a teaching workforce, sufficient in numbers, knowledge, skills, practices and professional dignity, to provide meaningful Universal Primary Education?

WHY ICT FOR TEACHER EDUCATION?

"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…"

The United Nations Millennium Declaration (UN 2000)

"Of the 113 million children out-of-school in 1998, 42 million lived in sub-Saharan Africa. The less developed regions as a whole account for 97 per cent of the 113 million children not in school."

"Since 1990, sub-Saharan Africa has had the second largest population of primary school-age children of all the regions of the world. This region recorded a substantial rise in this age group from over 82 million in 1990 and rising to 106 million in 2000. In spite of the deceleration of the rate of increase in the population of children of primary school-age the projection for 2015 is 139 million."

(UNESCO, 2000)

"An estimated 860,000 children in sub-Saharan Africa lost their teachers to AIDS in 1999. Children in Kenya, Nigeria and South Africa are most seriously affected by these losses…. Zambia, for example recorded 1,300 teacher deaths in the first ten months of 1998, twice the number of deaths in 1997 and two thirds of the number of new teachers trained annually."

(UNICEF, 2000)

The Digital Education Enhancement Project (DEEP – www.open.ac.uk/deep) has been exploring the possible contribution of ICT to the professional development of teachers in the Global South, within a framework of school-based professional development: was it possible for ICT have a meaningful role in teachers professional development and practice in such contexts?

The reasons for exploring such a question arises from a pressing need: if the goal of Universal Primary Education (UPE) is to result in meaningful educational experiences for children, the nations of the global south require many more

teachers than they currently have (UNESCO 2000; UNICEF 2000); and those teachers need to be personally and professionally equipped to provide a purposeful education for their pupils.

In this context the use of ICT in school-based settings is being seen as potentially more effective in improving standards of classroom instruction than more traditional (often infrequent) modes of face-to-face campus-based support. Creative and radical solutions to the problem of teacher education in the Global South need formulating (Moon 2000; Dladla and Moon 2002; Leach and Moon 2002). It seems inevitable that new, school and community based forms of training, exploiting recent developments in communication and information technologies will have to be developed and implemented.

"In 1999 there were 1.5 billion telephone lines worldwide, for example, while today there are nearly 2.5 billion. In just four years we have added 1 billion lines to the 1.5 billion we had connected in all the years before – and 75% were installed in the developing world. (Utsumi, December, 2003) Africa now has twice as many telephones as Tokyo and these are becoming more sophisticated in their use every day"

(Gourley, 2004)

In the light of such developments, the UNESCO World Summit on the Information Society declaration of principles (UNESCO, 2003) asserted: "Everyone should have the necessary skills to benefit fully from the Information Society. Therefore capacity building and ICT literacy are essential. ICTs can contribute to achieving universal education worldwide, through delivery of education and training of teachers, and offering improved conditions for lifelong learning, encompassing people that are outside the formal education process, and improving professional skills."

THINKING AS USUAL ABOUT ICT?

What *kind* of ICT is likely to be most effective in meeting these needs? Cawthera (2001 p.12) identifies three categories of ICT provision for schools in developing nations:

- Basic, using second-hand equipment, without training or support;

- Basic plus, using refurbished second-hand equipment , with some training or support; and
- Deluxe, using new equipment.

Cawthera also notes that deluxe provision is usually found either as a result of a relatively wealthy school, or from centrally financed state provision.

Studies that focus on implementing ICT in schools in developing countries (Bakia 2002; Moses 2004; Perraton and Lentell 2004) (Cawthera 2001) (Osin 1998) tend to focus heavily on cost issues. This has not been the focus of DEEP. However, we have been interested to note that all attempts to lay-out costs work on the assumption that schools will be equipped with computer suites. One rationale for this is given in Cawthera's recommendations:

"As the provision of equipment is only a part, often a small part, of the costs of total provision, where sufficient usage can be generated computer labs and telecentre [sic] should have *a minimum of 20 computers*. In this way the high fixed training costs are spread over a larger number of users and so drive down costs". (p.45, emphasis Cawtheras)

We believe this notion is part of a broader conceptualisation, that, over the course of the project, we have begun to discern; the conceptualisation defines the expectations and assumptions about *what* ICT might mean and look like, in the contexts of schools in developing nations. The nature of this conceptualisation includes the cost, numbers and arrangement of equipment, but also goes beyond such things – it also includes the affordances people hold about the ways such tools might be used. We have begun to term this conceptualisation *thinking as usual* about ICT.

For us, there are a number of features that typify *thinking as usual* about ICT:

- The equipment imagined is almost always desktop computers
- The equipment would usually be what Cawthera identifies as Basic, or Basic plus.
- There would almost always be large numbers of machines (typically 12 – 24)
- The physical location imagined would almost always be a computer suite, or dedicated classroom
- The classroom organisation envisaged is almost exclusively individual (or occasionally paired) work

- The expectation of pupils work with the computer tends to be narrowly defined: accessing the internet; sending email; word-processing; learning 'about computers'
- There is rarely an expectation of making use of the rich multi-media capacities of computers, except possibly as passive recipients
- Pupils are unlikely to be envisaged as creators / collaborators / co-constructors: poets, authors, researchers, presenters, scientists, artists, linguists, musicians and dancers; the work they do with the computer is seen as separate, at a distance
- The computer is almost an alien artefact, a thing disconnected from the rest of the tapestry of their lives, culture and society
- The computers, physically and conceptually, remain 'within the school'; they are not accessible to the broader lives of the teachers, pupils and community.

We have found *thinking as usual* to be very pervasive – it sits behind most published work on ICT in the global south; and it is so ingrained that challenging its assumptions is often met with a swift rebuke or incredulity. Until you can show that it doesn't have to be like that…

We want to challenge *thinking as usual* about ICT for education in the global south.

THINKING DEEP ABOUT ICT

For many years schools in the northern hemisphere have invested large sums in ICT suites. Yet recent research from the UK and elsewhere suggests that ICT can be used far more effectively for teaching and learning, in a range of curriculum areas, when a smaller number of computers are integrated into the 'normal' classroom environment. For example, ImpaCT2 (a major UK study) observes:

There is recognition among teachers that a more flexible approach is required… Changes in lesson style to allow a less formal classroom atmosphere, greater pupil autonomy, differing modes of teacher/pupil interaction, and flexible study space are all recognised as key success factors for effective use of ICT.
(Harrison, Comber et al. 2003)

In such a context:

- the ICT becomes literally one-of-many pedagogic means;
- teachers and learners are more likely to see the subject as centre stage;
- teachers and learners are more likely to use computers to support collaborative work, as well as individual computer use.

ImpaCT2 also found that pupils (and teachers) are quick to acquire ICT skills when they are able to explore the available ICT tools in the process of meeting their own learning needs. In other words, it is better to use ICT for some purposeful endeavour (learning about literacy, numeracy, science or other subjects, pursuing your own interests, researching and communicating things that matter to you) and pick up the ICT skills on the way, rather than 'learn about computers' for their own sake

DEEP DEVELOPMENT

DEEPs model is described fully elsewhere (Leach and Moon 2002; Leach, Moon et al. 2002; Leach, Patel et al. 2003; Leach, Peters et al. 2004), but some key points are highlighted below:

- The main agenda, and the prime reason for the use of ICT, is the professional development of teachers
- The training is tightly focussed on subject and pedagogic development (rather than ICT skills) – all activities have a classroom practice component.
- A range of technologies and media allow flexible and creative uses of the technology
- There is a strong emphasis on collaborative work and peer teaching
- Some equipment is personal (the hand held computer) whilst most is shared, between partner-teachers within school, and between groups of schools.
- Whole community involvement and out of school use are actively encouraged

This model is resulting in effective approaches to learning, good learner support, as well as quality learner outcomes (Leach and Moon 2002; Leach, Moon et al. 2002; Leach, Patel et al. 2003; Leach, Peters et al. 2004).
Whilst DEEP did not set out to research issues of cost, we have found that cost is usually the first question raised by those who are used to *thinking as usual* about ICT.

The first response needs to be not about the nature of the equipment or it's cost, but about the learning and development that is occurring, and the freedoms (Sen 1999) that are being achieved: we would argue that much of the dynamic and purposeful learning that we have reported (see references above) would not have been possible without the creative multi-media technologies that were placed in the hands of the teachers and their pupils. How each of the technologies has supported the development of teaching and learning is detailed in table form in the forthcoming publication for DFID (Leach and Power 2004), and is also available on the project web site (http://www.open.ac.uk/deep)
But that said, it is still necessary to address the issue of costs head on. Is thinking as usual the only way forward for ICT for schools in developing nations, or can the use of state of the art mobile multi-media technologies be an affordable alternative?

TOTAL COSTS OF OWNERSHIP

Total Cost of Ownership (TCO) is an important concept in understanding the costs of any technology – considering all of the costs involved from the point of purchase to retirement from active service. Moses helpfully provides a number of 'ball-park' costs for considering TCO for ICT in the context of schools in developing nations (Moses 2004), suggesting the following as a guide to annually recurring costs:

- **Maintainance**: 15% of the original purchase price (even if donated) of hardware and software (ideally 20%);
- **Supplies**: 8-10% of original purchase price, (even if donated) for printer ink, floppy disks and CD-ROMs etc.;
- **Electricity**: 10 cents per kilowatt hour, with computers running 1,600 hours (8 hours a day, for 200 days a year), with 400W being a typical desktop power consumption.

Moses also points to two other areas of cost that need to be considered in a TCO model, the first being *Professional development*: cast in the limited sense of training people to use the computers. Osin gives the following salutary advice:

"Don't start your project by buying computers. It is true that installing computers is very attractive from a political standpoint: they can be shown; they are modern; they give a feeling of progress; there are highly sophisticated demonstration programs; parents are happy; the school principal will declare

that his or her school is computerized; but . . . when buying the equipment is the first step, the second step will be to discover that the teachers are not prepared to integrate the computer activities with their current educational practice."
(Osin 1998)

Professional development should not be seen as a costly ancillary to the provision of equipment; rather the equipment should be seen as an ancillary cost in the development of teachers, schools and communities - directed by real human needs: for information and communication that affects peoples lives: for learning and literacy; for opportunity and agency. Therefore we will not cost 'professional development' separately in this analysis, as that seems to put the cart before the horse.

The final component of Moses TCO analysis is *Retrofitting*, or "the cost of modifying buildings, space, electrical wiring and network connections to make a computer useful", to which list, we would add making the location secure. Retrofitting is a much more significant issue when *thinking as usual*, as a computer suite is dominated by the computer equipment, and it's associated wiring, benches, power supplies, cooling, window shades and security. Moses makes no estimate of the cost of retrofitting, as there are too many variables to allow any general figure to be put forward; we will simply point out that the cost is likely to be significant for a computers suite, but negligible by comparison, when modest numbers of mobile technologies (laptops and hand held computers) are being used in a conventional classroom, as the room requires little or no modification.

A TCO COMPARISON

If we accept Moses' figures for ongoing costs without criticism, and use them as a basis for costing the two models of ICT use, how does the Total Cost of Ownership (TCO) compare?

Before we can answer, it is necessary to make a few assumptions.

We assume in 'thinking as usual' that a school has been donated 20 second-hand machines, and that these each consume 400W. For calculating costs of maintenance and supplies, we will assume these were budget computers at new equivalent cost of $1000 each.

In ‘thinking deep’ we assume one new laptop (at $1,500) and two new handhelds (at $500 each), and that the laptop and handhelds together consume a maximum of 40W.

The calculations and their outcomes are shown in the following table.

TCO comparison over 3 years

	Thinking as usual		**Thinking DEEP**	
Cost type	*Description*	***Cost***	*Description*	***Cost***
Initial purchase cost (I.P.C.)	20 free computers (new equivalent price $1,000 x 20 = $20,000)	**$ 0**	2 hand-helds 1 laptop Total:	$ 1,000 $ 1,500 **$ 2,500**
Maintenance (15% I.P.C. p.a. x 3 years)	15% of $20,000 p.a., x 3.	**$ 9,000**	15% of $2,500 p.a., x 3.	**$1,125**
Supplies (9% I.P.C. p.a. x 3 years)	9% of $20,000 p.a. x 3	**$5,400**	9% of $2,500 p.a., x 3.	**$675**
Electricity (10c per KWhour, running 1,600 hours p.a. x 3 years)	20 machines @ 400W = 8,000W = 8KW 0.1$ x 8 x 1,600 x3	**$3,840**	1 machine1 @ 40W = 40W = 0.04KW 0.1$ x 0.04 x 1,600 x3	**$19.20c**
Total Cost of Ownership		**$18,240.00c**		**$4,319.20c**

1 40 W is an upper estimate of power consumption for most laptops. The power drawn by the handhelds, which can be recharged via the laptops, is negligible, and has been amalgamated in with the laptops power consumption.

The DEEP model also makes use of a number of multimedia devices – a high-resolution camera, and a digital video camera, shared between 12 schools. Over the course of the project, there have been no ongoing costs associated with either of these devices – the IPC would be $1200 for both items together; spread over the 12 schools, this would add an additional $100 to the TCO for the deep model.

In both models, a printer would also be required; old and donated printers are not likely to function well, due to mechanical nature of the devices, and the high volume of use they usually experience in a corporate environment. Unlike computers, where printers are replaced from an office, it is usually because they have reached the end of their useful life. The all-in-one device used in DEEP would add $140 to TCO in both scenarios (the cost of paper and ink is already included in *supplies*). In *thinking as usual*, a network printer might be more appropriate. These are usually significantly more expensive to purchase and power, although 'ink' is cheaper. Because of these variables, I have left printers out of the table above.

DISCUSSION

The use of a TCO model for costing ICT seems simple and obvious, but is only just beginning to be taken up in the context of schools in developing nations. SchoolNet Africa, long having supported the *'thinking as usual'* model of ICT for schools, has recently published the results of a major review of the use of refurbished computers, noting that:

"…the solution to Africa's digital divide is not as simple as excess supply of second-hand PCs in the developed world meeting excess demand in the developing world. Not every second-hand computer is suitable for re-use and, by sending un-usable second-hand PCs to Africa, the developed world is simply dumping its environmental problems (relating to the disposal of toxic substances in PCs) on Africa. Some practitioners have argued that the total cost of ownership of a refurbished PC could be higher than that of a new PC owing to its additional maintenance costs and shorter lifespan."
(SNA 2003)

It is interesting to note that, using the figures provided by Moses, and accepting those assumptions, the TCO over a 3 year period for accepting a free suite of donated computers may be in excess of four times more costly to a school than purchasing brand new 'state-of-the art' mobile technologies.

Indeed, the situation is likely to be starker than the un-modified assumptions would suggest because the percentage of IPC set for maintenance has been kept the same in each scenario. In practice, the second-hand (possibly refurbished, possibly not) machines are much more likely to require frequent maintenance; further, the new machines will all be covered by a warranty for at least one of the three years. Accordingly, the figures maintenance should be substantially adjusted down for the new machines, and up for the 'free' machines, resulting in a further gap between the two models; a five-fold TCO difference in favour of the DEEP model seems a more realistic assessment, and perhaps even more if the costs of retrofitting are also taken into account.

Of course, in reality, poor schools in remote regions do not spend $18,000 to keep their second-hand computer suites running for three years, because they do not have $18,000 to spend. But it would seem that the inevitable implications of this are that either the machines are not used anywhere near as much as Moses suggests they might be, or they fall into disrepair, or both.
It may be argued that more pupils have access using a suite, than the smaller number of machines available in DEEP, but because the DEEP machines are always available in the classroom, and shared between two teachers, levels of usage are very high; pupils are likely to have more access than they might through occasional visits to an ICT suite. Another concern has been around survivorship of 'fragile' mobile equipment – but of the 149 digital devices (18 laptops; 52 handhelds; 24 all in one printer/ scanners; 52 add-on cameras; 3 digital cameras) 143 remained in working order at project close.

Amongst the South African schools we have visited, we have come across two that have had 'free' computer suites. In one, the computers were in a vice-principals office, never being used by staff or pupils, because they did not know *how* to use them for their curriculum purposes; in the other, a supermarket chain had donated fourteen ageing desktops to a school, amid a flurry positive media coverage, but only three of the machines were useable, because various cables had not been provided with the machines. The argument that using 'free' suites of ageing PCs is the most appropriate (even the *only*) response to the information needs of the Global South needs to be approached with some caution.

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