

Extending education and social benefits through 'hub schools'

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Abstract

The Meraka Institute is involved in researching and developing a number of affordable and sustainable solutions designed to meet the social and economic needs of communities. The realisation of the 'hub school' concept relies heavily on the use of many of these innovative solutions to layer additional value-added educational and social services on top of an information communication infrastructure, to deliver a broader service to rural communities.

The educational value of interconnecting schools can enable virtual interactive classrooms with access to shared resources, such as teachers and other digital content, other schools, and teachers and learners' homes, to create connected learning communities. The presence of digital doorways, using a minimally invasive approach and other technologies, can provide a platform for applying the concept of a living laboratory for research to unravel the inherent potential of communities.

INTRODUCTION

As the trend to do more on-line increases, the need for bandwidth also increases. The need for Internet availability is also increasing in all spheres of life, including education, where wireless access is removing many barriers, to create opportunities for a more ubiquitous service. The challenge – especially in education, and more specifically distance education – is to bridge the digital divide that is excluding the vast majority of learners in developing countries such as South Africa.

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A major challenge for the South African government is to ensure the development of a more effective ICT sector strategy and policy framework for the country in order to harness the potential of ICTs, ensure better governance, deepen democracy and accelerate growth and development, especially job creation and poverty alleviation for the country, the region and the continent and in so doing, create an information society that improves the quality of life for all citizens. (Mbeki 2001)

South Africa is emerging from a heritage where resources were unevenly distributed to the few, at the expense of the many. We are now entering a period where knowledge has become a critical input into the creation of wealth and economic progress.

The digital revolution and the power of knowledge it disseminates, does not have the constraints of tangible factors of production, such as land and capital. South Africa has an opportunity to not only allow all the people of South Africa to benefit from ICTs, but to establish an internationally competitive infrastructure in the new economy. This will result in bridging the digital divide locally and globally. (Mbeki 2002)

In order for individuals to benefit from this, they have to be exposed to a modern education system where they are given the tools to access information, generate new knowledge and use the skills to compete in the global economy. Technology can offer individuals and communities the opportunity to circumvent the limitations of a poor education system or poor teaching, in order to benefit from this digital revolution.

The euphoria of an emerging democratic South Africa has passed, and the time has come to address the harsh realities of meeting the needs of the people across all sectors of the economy. With the shift to a knowledge society, where ICTs are becoming more pervasive in the lives of all citizens, people should be better prepared to take full advantage of this by receiving opportunities to leapfrog the digital divide. The national education system has seen a significant change – from a teacher-centred behaviouristic mode of information transfer, to an Outcomes Based Education (OBE) approach which emphasises the acquisition of skills. The expected outcomes of the OBE approach are future employees with the right knowledge, skills, attitudes and values needed to cope with life in a technological world, i.e. people who can make a meaningful contribution to the local and national economy of the country.

The post-apartheid government's response to improving the plight of learners entering a future knowledge economy, saw a number of key initiatives being tabled. The *White paper on e-education* in a new ICT environment was meant to create new learning opportunities and provide access to educational resources well beyond those traditionally available. Telecommunications infrastructure was designed to 'gradually increase and enhance the quality of teaching and learning

as well as school management and administration' (Pandor 2003). A nation-wide education network, EduNet, designed to serve the goals of universal access for every e-school in South Africa (Department of Education 2004), has been made realisable through the Telecommunications Act 103 of 1996 and amended in 2001 (Republic of South Africa 2001). Two significant educational projects in South Africa that are piloting the mass roll-out of province-wide networks include the Khanya Project (2009) in the Western Cape and the Gauteng Online Project (Gauteng Online 2009). A further significant development has also been the Thutong Education Portal (Thutong Portal 2009), which makes provision for educational content to be disseminated to South African schools.

Of relevance to this article is the African Advanced Institute for Information and Communications Technology, commonly referred to as the Meraka Institute. It derives its mandate as a national strategic initiative from the 2002 State of the Nation Address. The main objective of the Meraka Institute is to facilitate national economic and social development, through human capital development and needs-based research and innovation, leading to products and services based on Information and Communication Technology (Meraka Institute 2009). Meraka is based at the Council for Scientific and Industrial Research (CSIR).

While this article is not exclusively based on *open and distance education* per se, it is necessary to indicate the relevance of the 'hub school' concept, and how it can be used to supplement distance education. An essential characteristic of open learning is the removal of barriers to learning, implying no need for prior qualifications in order to study; and for students with disabilities, a determined effort is made to provide education in a suitable form that overcomes such disability. Distance education, on the other hand, is less a philosophy and more a method of education. Students can study in their own time, at the place of their choice and without face-to-face contact with a teacher, meaning that technology is a critical element (Bates 1995).

The hub school concept can go a long way towards enabling learners from isolated communities to benefit from the concepts inherent in open and distance learning. This includes having access to digital resources ... but therein lies the dilemma. Access is one thing, but computer literacy is another. It is imperative that learners are able to make use of the technologies, in order to benefit from the courses that are made available in a digital format. The world is operating in an information age where many individuals and companies make full use of the knowledge economy. In South Africa, like many other developing countries, a significant proportion of the population is excluded from the benefits of the digital age, as a result of the digital divide.

Merely teleporting individuals to the other side of the digital divide through the provision of access and computer literacy is no longer sufficient, as they will not be able to make full use of the benefits of the digital age. An alternative philosophical approach to the concept of the digital divide is to rather view the situation as a *technological ladder*, as represented diagrammatically in Figure 1.

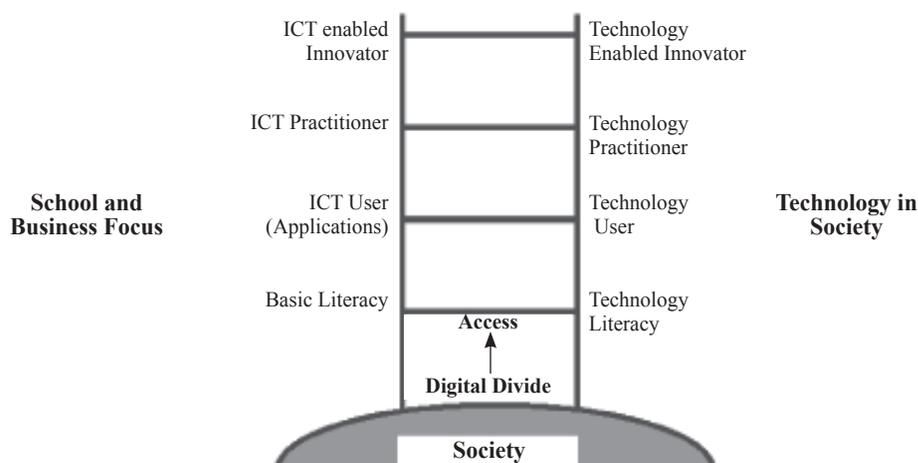


Figure 1: A schematic representation of the concept of a technological ladder (Beyers 2008)

The importance of the Digital Divide is not diminished in this model, as it is seen as the initial step to be overcome through the provision of access to technology. The concept of a Technological Ladder implies the need to continue to provide ICT developmental targets further up the ladder for the learners to aspire to. Unfortunately many learners will either remain on the first rung or even slip off as they are often not provided with additional support or access time to develop their newly acquired skills.

Once basic literacy has been achieved, users need to be encouraged and supported in mastering a variety of packages in order to become competent users. Beyond that is the mastery of the tools where ICT constitutes the main part of their future professions. The ultimate goal is utilizing the power of ICTs to conceptualize and realize their creative talents in the form of innovations (and ultimately patents). By providing challenges for ICT and other technology users they need to be afforded the necessary support and vision of what can be achieved rather than be left as casual users of products. (Beyers 2008)

Developing digital literacy in learners can no longer be a 'nice to have' for the more advantaged schools. This will ensure that those individuals who emerge from the education system are better prepared to participate as effective citizens

of a digital world, and to make a productive contribution to the economy. Simply put, students who create ‘documents’ to be saved in ‘folders’ and placed on a ‘desktop’ are learning how to speak a corporate language (Burniske 2008). If this is the case, then learners on the wrong side of the digital divide will find it increasingly difficult to compete for jobs in the corporate environment.

BUILDING BLOCKS OF THE HUB SCHOOL CONCEPT

In order to conceptualise the hub school it is necessary to highlight a number of essential components, and it must be noted that each of the proposed components has been piloted within the Meraka Institute at the CSIR and reported on in various research papers. The concept entails the layering of these additional value-added services on top of an existing information communications infrastructure, to focus on meeting the educational, health and social needs – specifically of rural communities – through the provision of access as the first step in bridging the digital divide in these areas. Open and distance education can be seen as an additional value layer on top of the hub school service.

The components of the hub school concept originated with the Meraka Institute. These include Digital Doorways, Wireless Africa with the First Mile First Inch Project, The Ulwazi Project, and the Young Engineers and Scientists of Africa.

Each of the above components will be discussed briefly, to highlight their role.

Digital Doorway

Digital Doorway, which is a joint project involving the South African Department of Science and Technology (DST) and the Meraka Institute, is aimed at the promotion of computer literacy and associated skills in Africa. The assumption is that people have the inherent cognitive ability to learn computer skills with minimal external intervention. However, computers must be easily accessible to potential learners in an environment conducive to experimentation. Apart from the ability to read text, literacy involves image and screen literacy and, particularly, information navigation. The information provided by the Digital Doorway enables learning by ‘discovery’ rather than by ‘lecture’ (Cambridge, Smith and Gush 2008).

Digital doorways make use of the concept of the hole-in-the-wall (Mitra 2009), where it was demonstrated that groups of children could learn on their own without any direct intervention, given access using minimally invasive education (MIE). MIE uses children’s natural curiosity and focuses on providing an enabling environment where they can learn on their own. Children, in the process of freely experimenting with the learning station, pick up critical problem-solving skills.

In a collaborative setting, children can share their knowledge, and in the process develop better group dynamics – all in a highly natural environment. The aim is to provide people in rural and disadvantaged areas with freely accessible computer equipment and open-source software, enabling them to experiment and learn without formal training and with minimal external input.

The Digital Doorway project offers access to a multi-terminal multimedia computer system, which provides access to information as well as various applications – something which could introduce alternative mechanisms for computer literacy in South Africa (Digital Doorway 2009). At the same time, this concept has the potential to enhance the goals of open and distance education through the provision of access to course content for rural communities. Figure 2 represents a more recent version of a digital doorway.



Figure 2: A photograph of a three-terminal system

The latest three-terminal configuration is based on a server running the Xubuntu Linux distribution, and two 'fat clients' without hard drives, which rely on the server for file access. The server also acts as one of the terminals, making a total of three terminals. The hardware is housed within a rugged steel enclosure with vandal-proof metal keyboards, LCD screens (protected by reinforced glass), webcams, speakers and uninterruptible power supply (UPS).

Digital doorways can potentially operate in a content delivery mode, with information stored locally and being downloaded from time to time. Connection to a network can enhance their flexibility, providing greater access and the freedom to do so beyond the restrictions of being locked up after hours in a classroom or store.

First Mile, First Inch (FMFI)

Access to information and communication technologies (ICTs) remains one of the biggest challenges to Africa in leapfrogging the development chasm (Morris 2007). First Mile, First Inch (FMFI) is a multi-disciplinary network of projects exploring the technological and social consequences of low-cost telecommunications implemented in remote schools, clinics and telecentres. As well as developing applications, research teams are exploring how people interact with the new technologies, and how their daily lives may be changed through such interaction using open-source, easy-to-use applications in local languages (Morris 1999). Their aim is to develop solutions that are affordable and applicable to rural communities.

Large communications infrastructure service providers, such as Telcos, often refer to the end point of their distribution networks as the ‘last mile’. This is usually the most challenging and least desirable part of their network as it is often the most expensive and most difficult part to manage. This is particularly challenging in rural environments as this concerns the interface with rural communities. Finding the proper solutions to reduce these connection costs could increase access opportunities in rural areas. (FMFI 2008)

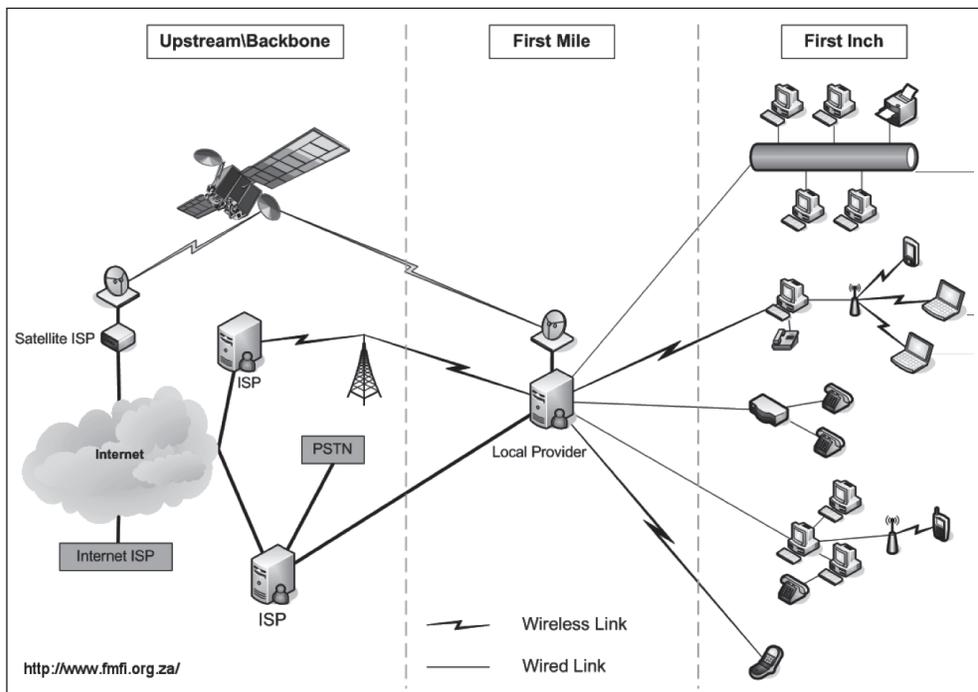


Figure 3: A schematic diagram of the *First Mile, First Inch* concept

Subsequent to the FMFI project, Wireless Africa was constituted as a research group of the Meraka Institute to research ways and means to develop sustainable information and communications technology in developing countries (CSIR 2005).

Providing connectivity to under-serviced rural areas comes with a unique set of challenges such as the high cost of installing equipment, lack of reliable power, skill shortages and high cost of providing Internet connectivity which is mostly satellite based. The recent emergence of low-cost commodity wireless 802.11 devices and the use of mesh networking as a key enabling technology for rural areas could see a new wave of connectivity in these areas. (Johnson and Roux 2008)

The Meraka Institute's first 'Cantenna' (an antenna made from a metal can, such as a coffee tin, and a section of bicycle spoke soldered into a special connector) was installed in a rural setting. It was mounted on the house of Agnes Mdluli, a health worker in Peebles Valley, near White River in Mpumalanga (as shown in Figure 4). These small, self-constructed antennas, which are made from locally available material, are connected to a low-cost WiFi card plugged into a computer. A small wireless router is placed in a weatherproof casing on a pole to which several community members can connect and form a community mesh network. This mesh networking technology allows the wireless installations to configure themselves automatically to find the optimal routes through the network, and very little configuration is needed to set them up. (CSIR 2005)



Figure 4: A photograph of the installation of a cantenna as part of a mesh network

The Peebles Valley mesh network is deployed over an area of about 15 square kilometres, in a rural district near the Kruger National Park in South Africa. The network was built to explore cost-effective internet connectivity (802.11 network) to an AIDS clinic. This connects to surrounding schools, homes, farms and other clinic infrastructure through the mesh network. The AIDS clinic, which is a non-governmental organisation (NGO) funded by a pharmaceutical company social grant, has brought hope to over 700 patients in the area over the four years it has been running. The VSAT Internet connectivity was provided free of charge by a sponsor. The spare capacity is shared with users on the mesh network, free of charge, but has to be carefully managed by a firewall to ensure that its usage does not affect the clinic's Internet availability.

The lessons learnt from the deployment of mesh technologies, are that it is an affordable solution to address connectivity in rural communities. The added bonus is that it is possible to train a local entrepreneur to set up and maintain the network for the benefit of the whole community. The implication of this is that additional access points can be established, ranging from community centres, police stations, learners' and teachers' homes, libraries, district offices, etc providing more community members with access to information that may be deployed on such a network (adapted from Wireless Africa 2009).

The Ulwazi Project

In a separate initiative the *Ulwazi project* emerged in 2001 out of a need to address a digital divide that was further exaggerated by a transport divide. Learners from Mamelodi and Atteridgeville attending outreach classes at St Alban's College in the eastern suburbs of Pretoria from the early 1990's made huge personal sacrifices to receive essential supplementary tuition having to rely on inefficient bus services. (Beyers 2007)

In 2001, a partnership formed between the Department of Communications (which supplied seed funding), Motorola (which supplied the broadband Canopy radio network) and Edge Interactive (which supplied SMART Interactive Whiteboards) to wirelessly connect Gatang Comprehensive School in Mamelodi and St Alban's College some 15 km away. Each classroom was equipped with a PC, speakers, a microphone, data projector and a webcam. This facilitated two geographically separated classes being taught simultaneously, with a common digital curriculum interface in the form of a SMART interactive whiteboard, as shown in Figure 5.

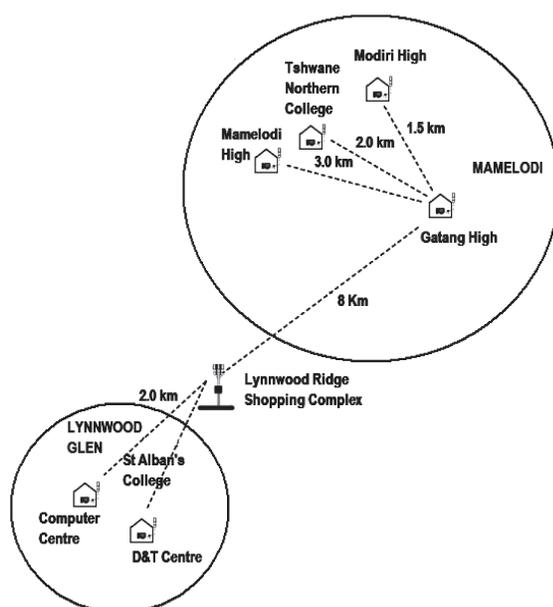


Figure 5: A schematic representation of the original Ulwazi network (Beyers 2007)

The lessons learnt from the establishment of the Ulwazi concept (Beyers 2007) demonstrated that

- cost effective inter-school connectivity could be achieved;
- virtual interactive classrooms could be established which did not rely on expensive satellite or other communication technologies;
- schools could be given access to shared digital resources to promote digital and social inclusion;
- educators could also be regarded as a sharable resource;
- interactive science lessons and experiments could be delivered across such a network;
- the success of such a project is reliant on the presence of a champion in the community.

The project was extended to include a further three schools in Mamelodi township outside Pretoria, thanks to a small grant from the Motorola Foundation.

The same concepts are inherent in the Ligbron e-Learning Project, a school community project that shares mathematics and science lessons with rural,

disadvantaged and underperforming schools by using video conferencing and desktop sharing (Ligbron Academy of Technology 2009).

Young Engineers and Scientists of Africa (YESA)

Moving away from connectivity issues, the Young Engineers and Scientists of Africa (YESA) was conceived out of a need to stimulate the Science, Engineering and Technology (SET) pipeline from as early an age as possible, and to supplement the shortage of skills in the areas of SET. During the launch of the Joint Initiative on Priority Skills Acquisition (JIPSA) in 2006 (Mlambo-Ngcuka 2006), it was announced that ‘professional skills in engineering, science, finance and management, as well as technical and artisan skills, were critically needed as the South African economy moves into higher gear.’ The belief was that ‘nothing short of a skills revolution by a nation united will extricate us from the crisis we face’.

The Accelerated and Shared Growth Initiative for South Africa (Asgi-SA) ‘identified the shortage of skilled labour as one of the six constraints to its goal of boosting economic growth to 6%’ (SouthAfrica.info 2006) and the government has acknowledged that ‘the single greatest impediment to its public infrastructure programmes – as well as private investment programmes – is the country’s shortage of skills’. As South Africa moves more towards a knowledge economy, there is an increased need for innovation and associated production, infrastructure development and maintenance. The time is now right to make a long-term investment in future generations, by introducing interventions that will contribute positively to the nurturing of graduates with the right knowledge, skills, attitudes and values.

YESA was incubated within the Meraka Institute, where a range of interventions (as portrayed in Figure 6) was piloted in preparation for the formation of a national delivery vehicle aimed at reaching all schools in the country. The assumption is that more learners need to be exposed to the wonders of a world of SET, in the hope of convincing an increasing number of individuals to pursue careers in related fields, ultimately producing more PhD graduates. This will potentially also have a knock-on effect with the National System of Innovation.

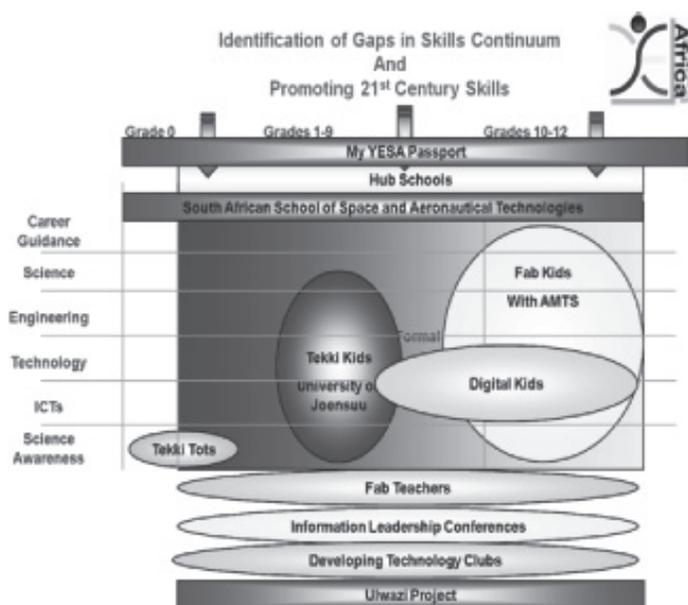


Figure 6: A schematic representation of various YESA interventions highlighting the focus areas across the different grades

The assumption is that the range of interventions should be catering for a broad continuum of SET skills, while providing meaningful career guidance opportunities. Figure 6 illustrates a number of key gaps in this continuum of skills, where further interventions will be sought to address these identified gaps.

YESA's primary focus is on stimulating creativity and innovation, rather than on training and information transfer. Through a process of hands-on interventions it is also possible to identify talent amongst learners as they participate in a variety of activities. YESA strives to achieve the ideal of having each learner participate in at least one SET intervention per year, throughout their school career, and to track this involvement via a national portal. In order to achieve this, YESA has aligned itself with the Youth into Science Strategy (YiSS) (Mangena 2007) of the DST. YESA is also a member of the Federation of Engineering, Science, Technology Olympiads and Competitions (FESTOC 2009).

During the pilot phase of these interventions, the need to extend the reach to all schools became apparent, as did (more importantly) the need to extend these opportunities to rural communities. The ideal situation would be to have all approximately 28 000 schools in South Africa sufficiently resourced and interconnected to achieve this goal, but this is unlikely to happen in the near future, as the current government has higher priorities to attend to. The next logical step is to explore opportunities of capitalising on the lessons learnt from

the Ulwazi Project, to digitally include remote schools in YESA-type activities. This will add an additional layer on top of providing surrounding schools with access to shared resources for teaching and learning, including the digital sharing of educators.

e-Education plays a key role as the foundation stone of most YESA interventions, though the focus is much higher up the technological ladder, spawning high-level skills critically needed for the economy. Computer literacy is assumed, where the emphasis is on utilising technology as an enabling environment, and learners are encouraged to operate outside the box of traditional education.

PRINCIPLES OF THE HUB SCHOOL CONCEPT

The hub school concept is reliant on the availability of an information communication backbone such as a mesh network, where there is a point of presence in a community (as shown in Figure 7).

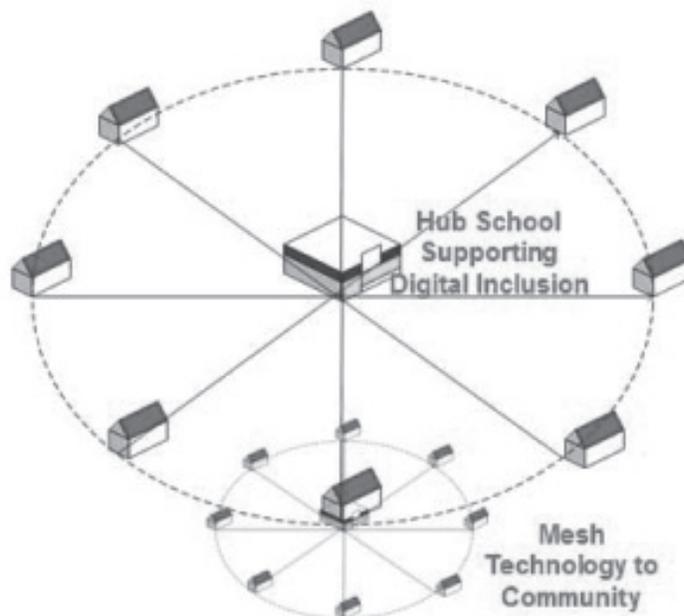


Figure 7: A schematic representation of the hub school concept, using mesh technologies to remote schools and distributing further to local communities

These points of presence can provide schools with access to shared resources on the network, thus reducing the geographic and information isolation currently experienced by many schools across South Africa, but more so in deep rural

areas. The concept of the hub school is the realisation of the principle of the e-school, as embodied in the *White paper on e-education*. The term 'e-school' has the tendency to retain the focus on activities within the school, and does not necessarily imply that the community can play a significant role in the lives of these organisations in their midst. On the other hand, the concept of a hub school implies that it is the focal point radiating outwards to the broader community. In the case being presented here, it involves digitally interconnecting the whole community to the school, so as to share both the physical and digital resources available, with as many local inhabitants as possible.

In order to physically realise this, it is proposed that mesh technologies currently being researched and deployed by Wireless Africa be used to disperse the points of presence of the radio networks, from a school to the broader community. While drawing on the digital resources provided by access to the provincial wireless backbone, mesh technologies can provide the infrastructure needed to connect the likes of

- other schools in the immediate area;
- the homes of teachers and learners;
- educational district offices;
- local community centres;
- police and fire stations;
- local libraries;
- local on-line entrepreneurial businesses, etc.

From an educational perspective, the concept of a hub school implies that there is an investment in a central point, rather than dispersing scarce resources across a wider area. A good example of this would be the proposed investment in the concept of a Fab School located at the hub school. It is not financially viable to invest in technology to equip a FabLab in every school in the country to provide hands-on training of FabKids. The hub school would assist in managing these resources, with the responsibility of sharing them with other schools as well as the local community through organised training sessions at the central venue.

To ensure that learners continue to develop their creative and innovative talents, they will be encouraged to take the Open Office (open source) software home with them to install on their personal computers, where available. In the absence of home computing and/or computers in outlying schools, it is proposed that digital doorways be installed in schools and community centres. Access to the hub school through the use of mesh technologies will ensure that learners

can continue ‘innovating’ and accessing information beyond the confines of the hub school. The option of participating in digital manufacturing exists, where learners could email their designs to the hub schools to be manufactured, for future collection.

Negroponte wrote in an e-mail interview that ‘one of the saddest but most common conditions in elementary school computer labs (when they exist in the developing world), is that children are being trained to use Word, Excel and PowerPoint. I consider that criminal, because children should be making things, communicating, exploring, sharing, not running office automation tools’ (Vota 2007). There is a need to overcome the ‘ignorance-is-bliss’ factor by clearly demonstrating the power of ICTs as a tool, and encouraging learners to think and operate outside the box of traditional education.

EDUCATIONAL BENEFITS OF A HUB SCHOOL

Figure 8 represents a schematic diagramme of how the different elements of the hub school concept are interlinked.

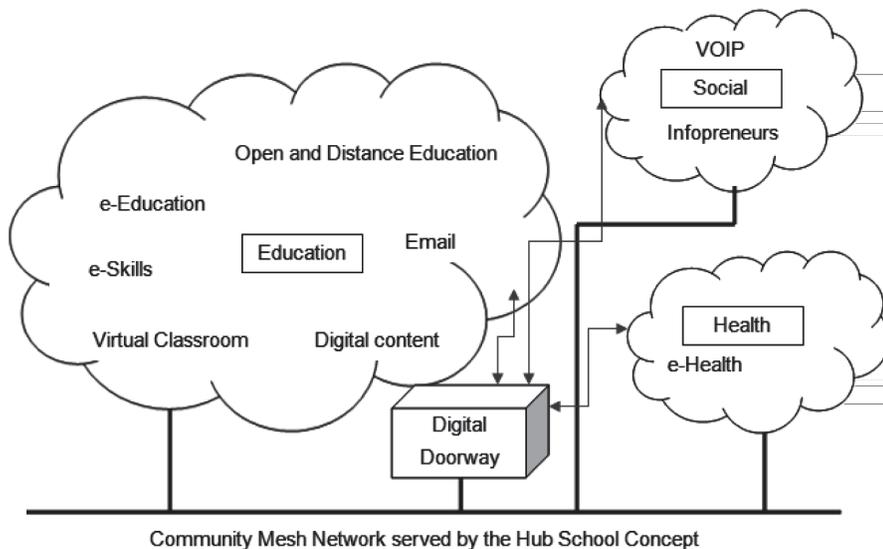


Figure 8: A schematic representation of the interrelationship of education, health and social benefits within a connected hub school community

The point of the presence of a radio network backbone located at a school, is a strategic decision to empower schools to become the centres of their communities. Possible benefits of such an infrastructure could be listed as follows:

- Schools and classrooms have cost-effective access to shared digital resources. The network could either have open access to the Internet or be closed, depending on the funding model. The positioning of a server anywhere on the network implies that digital content would be accessible virtually on demand. The type of digital resources could range from static Web pages to content management systems, wikis and blogs, and even digital videos on demand. Collaboration with learners and teachers at other schools can provide an essential catalyst for learners to utilise ICTs in a different mode from that of basic literacy, while making provision for collaborative projects;
- The content management systems could be used to supplement normal education and to make provision for accredited courses, where available. This will go a long way towards promoting the concepts inherent in distant education, by making provision for more learners to access information to further their education;
- Video conference and application sharing tools, coupled to shared timetables between schools in the community, can provide the opportunity to share educators within a region – especially in scarce key subjects like Mathematics and Science. At the same time, schools with additional resources would be well positioned to share them virtually with other schools as centres of excellence, especially in the sciences (as demonstrated in the original Ulwazi Project);
- Teachers and learners may be provided with free access to shared resources from home, through the use of cantennas attached to a mesh network which is either purchased or developed by a local entrepreneur. This will go a long way towards breaking down the phenomenon of 'strong-room technologies', where computer equipment is often locked away in the school's strong-room for fear of it being stolen. 24-hour connectivity to this content means that it becomes a resource outside of the confines of the school building and normal school hours;
- The presence of an IP-based network implies that teachers and learners will also have access to a minimum of email connectivity. This can be operated internally within the network, or, if circumstances allow, full email connectivity to the Internet. This is an important tool that learners need to interact with, in order to develop essential communication skills as part of a process of globalisation and accessing information. Yes, many learners are already communicating via cell phone text messages, but they also need to acquire the netiquette of utilising additional business tools for the real world;

- When planning for the establishment of such a network, it is important to include the option of publishing information in the form of web pages, blogs and wikis. Web 2.0 tools can play an important part in collaboratively generating new knowledge, and learners need to be exposed to the process of authenticating information as well as addressing the realities of plagiarism;
- The presence of computers in schools can be used to automate the capturing and processing of school administrative data, as well as test and examination results. By centralising the software for the school's administration systems at a strategic point on the network, district officials can data mine the collective records of all schools, in order to make real-time decisions for the benefit of the whole community. School attendance, trends in subject results, numbers of students per grade or subject, etc., can be made available to senior management;
- The distribution of circulars can be enhanced and monitored more effectively by email. This could be coupled to a free IP-based telephony system over the network, empowering principals and officials alike to communicate with all network-linked institutions in the district;
- The concept of a hub school could also be deployed at other institutions, such as FET colleges. Learners in these environments could be provided with the academic background to electronics, networking, computers, etc., and then tasked to set up and maintain mesh networks linking schools and other centres in their immediate vicinity. This would enhance the notion of a true OBE approach, where learners potentially enter the job market with skills that could be applied immediately. The presence of a FabLab within FET colleges could further stimulate creativity and innovation, thus promoting the concepts of manufacturing within these institutions;
- The presence of a hub school in a community can provide the framework for Living Labs.

The lack of a proper understanding of what triggers innovations and which innovations prove to be successful in different environmental, social and cultural contexts poses a big threat to the design of real-world innovation. This is in particular true for South Africa. Being a 'society in transition' facing the challenge of social change and social innovation South Africa needs to understand how to do advanced African innovation research. Designing real-world innovation in an African way might therefore differ from the indigenous tradition and might not be similar to the western world as well; however, what's similar is that its start is community-driven and co-creation of innovation where all stakeholders are involved. (LLISA 2009)

This article is confined largely to the educational benefits of a hub school, where the presence of such infrastructure can go a long way towards community empowerment. Local entrepreneurs could be invited to set up and maintain the infrastructure, to the point of purchasing the equipment within the community as well. Interconnecting a number of businesses within such communities has the potential to spawn additional new industries, thus providing further employment opportunities.

As part of the way forward, it is proposed that is an appropriate instrument be developed to evaluate and validate the effectiveness of the hub school system in communities. This will provide invaluable research to determine the multi-layered impact of such an intervention.

CONCLUSION

There is a great deal of untapped potential amongst the South African Net Generation, and the challenge is therefore to unleash it by providing more individuals with tools in their 'tool-bags for life'. The deployment of hub schools, as part of community networking opportunities, can benefit from large-scale connectivity projects. At the same time, the concept cannot be seen as just an educational solution, but rather the layering of additional services on top of a communications infrastructure that can be scaled up, should bandwidth consumption demand it.

The presence of a hub school in a community, together with more and more technologies emerging in rural communities, provides opportunities for the e-skills debate to be expanded further, for the benefit of more individuals. The focus shifts more towards how to utilise the technologies for social gain, rather than just skills training. In terms of the technological ladder, it creates opportunities for more individuals to move up towards the ICT practitioner and innovator level.

This multi-disciplined approach to deploying a range of solutions can provide a test-bed for some real African research, in order to come up with an African solution. This approach in no way attempts to circumvent the important role of teachers in the education process. On the other hand, it can provide the mechanism to supplement this process by providing greater access to information.

ICT provides hope for overcoming barriers of social and geographical isolation, increases access to information and education, and enables the poor to participate in the making of decisions that have an impact on their lives. (Department of Education 2003)

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