The Ulwazi concept – Virtual interactive and collaborative classrooms of the future

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Abstract

The purpose of the study was to demonstrate that two schools which were geographically separated could be digitally included using broadband radio connections, interactive whiteboards and other technologies to enable virtual interactive and collaborative lessons. The project was established to overcome a transport problem of bussing learners from Mamelodi to St Alban's College in the Tshwane area as part of an outreach project for them to receive supplementary tuition. The most significant finding was that the results of Grade 10 Science learners in a remote school improved over time.

INTRODUCTION

The Education Minister Naledi Pandor reiterated that: 'It is our view that proficiency with, and understanding of, information communication technologies should join reading, writing and arithmetic as one of the basic learning processes' (*Sunday Times* 2006),

The Minister went on in the same article to state that: 'I believe the task of bridging the digital divide is a crucial challenge because information technologies are emerging as the key driver of economic growth and social development. Failure to bridge the divide leaves those without access to information communication technologies in a developmental cul-de-sac.' This is further compounded by the fact that a significant number of schools do not have access to electricity as a basic requirement, let alone other infrastructure such as toilets or even text books.

Director-General Duncan Hindle (2005) also highlighted that reports of significant absenteeism on the part of teachers in some communities with pay-day syndromes and in some case extended absence without consequences, has a demoralizing effect on the educational community leaving the learners ill prepared for examinations and the lack of a culture of learning in general. Thirty one schools across South Africa did not have

a single matriculant pass in the 2005 senior certificate examination, while another 148 schools obtained a pass rate of below 20 percent, which, although down from 2004's figure of 183 was cause for concern and remained at an 'unacceptable level'.

To add further woes to the developmental cul-de-sac Seepe and Sibanda, (2006) in a recent study by the Human Sciences Research Council that was commissioned by the education labour relations council last year indicated that a minimum of 10 000 teachers living with Aids urgently need to be put on antiretroviral drugs. The Aids endemic in South Africa could see a growing number of classes loosing out on a basic level of education because teachers are dying on a daily basis compounding the problem of a lack of delivery in the educational sector.

The South African Education Department has produced a modern Outcomes Based Education curriculum which assumes that the approximately 12 million students have access to quality educational resources and highly qualified teachers. There can be little doubt that the current educational sausage factory is merely perpetuating an old paradigm where the vast majority of learners are being exposed to pure information transfer and regurgitation of factual information. The benefits that modern Information Communication Technologies (ICTs) have to offer is restricted to a minority of learners and even where there are computer centres these are clogged up with Computer Studies learners. Those learners who are provided access are therefore restricted to single lessons which may in some cases be once every two weeks.

THE PROBLEM IDENTIFIED

Over the past few years there have been a growing number of schools who have been willing to share their expertise and resources with those less fortunate than themselves. Whatever the motives of the well resourced institutions, many teachers and learners across the country have benefited from such interventions covering a wide range of subject areas. There were a variety of interventions ranging from extra lessons and training sessions in the holidays, etc. but the primary method of making contact was based on bussing learners and teachers to city school campuses.

St Alban's College, located on the eastern side of Pretoria, was one such organization where a number of interventions were arranged to meet the needs of the Mamelodi and Atteridgeville Communities. Mnguni (2006) reported that he Top Matric project bussed students to the campus for Mathematics, Science, English and Biology five days a week. This project produced a total of 107 students out of 126 who passed the Senior Certificate 2005 examinations. Fourteen A aggregates were obtained in the four subjects (i.e. English, Mathematics, Biology and Physical Science). In previous years some of the students who attended the outreach programmes on the College campus received tuition in certain subjects as their only form of formal lessons due to the absence of subject teachers in the township schools.

Apart from the fact that the supplementary tuition which these students received, it came at a huge price. Many students could barely afford the course fees but more

importantly they were prepared to sacrifice many hours spent travelling the 15 to 20 km to receive an education. Their desire to be given access to better education outweighed the personal sacrifices they had to make.

The problem statement: Geographically separated classrooms linked by broadband radio connections to enable virtual interactive and collaborative lessons using SMART technologies (http://www.smarttech.com/) can provide a platform to explore solutions to digitally include remote learners.

The type of research for this intervention was based on a qualitative approach to this case study. The participating schools were selected on the basis of their long standing relations with St Alban's College. Data collections were based on interviews and observations which were conducted during the lessons.

THE BIRTH OF THE ULWAZI CONCEPT

In April 2003 a workshop was held between Richard Gerber from the Department of Communications, Leslie Hlengani and two pupils from Gatang Comprehensive, Ron Beyers and three pupils from St Alban's College. The meeting discussed theoretical possibilities of digitally connecting two classrooms and by chance Ronnie Seeber from Motorola South Africa happened to drop in.

The outcome of the meeting was a proposal to deploy a broadband Motorola Canopy network between the two schools which were situated 15 km away. A formal proposal was submitted to Independent Telecommunications Authority of South Africa (ICASA) and eight months later the Ulwazi project was given a three month temporary licence to transmit lessons. Application was made to renew the licence on a regular basis thereafter.

Technically the creation of the virtual interactive and collaborative classrooms was based on the deployment of the following equipment in each venue:

- Motorola Canopy – providing 11 Meg Broadband wireless connectivity
- SMART Interactive Whiteboards – providing the digital interface for the curriculum and other interactions
- 5 Channel sound card and speakers – to be able to hear lessons delivered
- Web Cam – to be able to see each other
- Microphone – to enable voice communications
- NetMeeting – standard on all Windows Platforms to facilitate the video conferencing.

The Motorola Canopy operates in the frequency band 5.725-5.875 GHz, that is allocated globally, in the ITU Table of Frequency Allocations (ITU Radio Regulations 2003) for use by industrial, scientific and medical (ISM) equipment. The band was originally opened up by the FCC (Federal Communications Commission) in the USA for so-called Unlicensed National Information Infrastructure (U-NII) devices (FCC Report

and Order No FCC 97-5 1997), of which Canopy is an example. The band in the US is for shared-spectrum use and there is no requirement for doing frequency coordination for telecommunications equipment, neither by the user or the telecommunications regulator. However, the equipment needs to meet certain technical criteria, such as maximum levels of radiated power. This shared, uncoordinated and unlicensed use has been so successful that this ISM band has now come into use for telecommunications in many other countries.

To overcome the requirement of direct line of site, Lynnwood Ridge Shopping Centre had to be used as a relay station between the valley in Lynnwood Glen and the township of Mamelodi. Using a combination of Access Points and Subscriber modules, a broadband radio communications network was established between two classrooms which was donated by Motorola. Seed funding in the amount of R44 000.00 from the Department of Communications provided the means to equip the second classroom and to provide for the development of the initial web based learning materials. See Figure 1 for a schematic representation of the Ulwazi network.

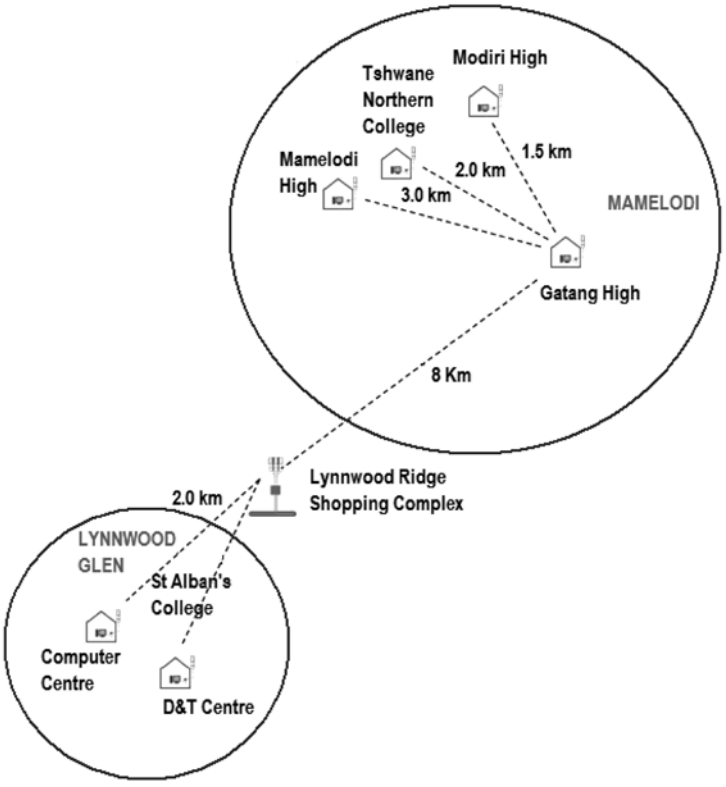


Figure 1: A schematic representation of the Ulwazi Network Diagram

The initial aim of the project was to demonstrate that it was technically possible to connect two schools using a wireless broadband backbone. Lessons were delivered to students at Gatang on a weekly basis as supplementary education where each group of approximately 30 students were invited once every three weeks in order to increase the exposure of the educational approach to more learners.

It soon became evident that the learners readily adopted the extra lessons even though they were voluntary. Application was made to the Motorola Foundation for US$30 000.00 which enabled the project to be expanded to Mamelodi High, Modiri High and Tshwane North College. A server was also added to the network to enable the Ulwazi Project Web Site (www.ulwaziproject.co.za) material to be shared by the local community as the IP based network operated as a closed loop with no external internet access.

In describing the Ulwazi Concept, it is based on the following principles

- A community that is ready to adopt technology to help uplift its members
- A champion from the community who will coordinate and drive the project
- Connecting of schools and homes in a local geographical area which can provide the benefits of a connected learning community (Connected Learning Communities 2007)
- Broadband with greater than 5–10 Meg interschool connectivity which is preferably IP based
- Access to 'video conferencing' equipment that can facilitate virtual interactivity and collaboration
- Access to shared resources
- Options of providing email and internet access.

Pinder (2004) emphasises that: 'digital inclusion is not about computers, the internet or even technology. It is about using technology as a channel to improve skills, to enhance quality of life, to drive education, and to promote economic well-being across all elements of society. Digital inclusion is really about social inclusion, and because of this, the potential for technology to radically improve society and the way we live our lives should not be underestimated.' To put this into perspective, the total cost to the employer for running the project in terms of man power was virtually zero. The reason for this was that during the normal course of the week extra lessons for the fee paying students at St Alban's College were available. Through a process of digitally including the learners from Mamelodi there were no additional expenses in terms of man hours as well as no 'transmission time' costs usually associated with satellite connections.

A suitable definition of the Ulwazi Concept could be reflected in 'Connecting geographically separated schools using wireless broadband technologies to enable remote and interactive teaching and learning'.

SOME OUTCOMES OF THE PILOT PROJECT

The advantages of digitally including additional classes were astounding and included:

- More 'cost effective' use of the presenter's time whereby the learner to teacher ratios were increased
- Quality education was available to both groups of learners
- Both groups of learners reported that they felt included in the lessons
- High levels of virtual interactions were achieved
- The SMART Interactive Whiteboards provided an invaluable digital curriculum interface
- Lesson material that was developed after hours, including animations and clip art, was able to capture the imagination of both groups of learners and delivery of captivating lessons
- A 'hidden curriculum' provided a cultural bridge for learners on opposite sides of the digital divide to meet and exchange ideas
- Many concepts embedded in the teaching of computer skills were smuggled in the lessons without the learners being aware of it.

What started out as a simple connectivity project has provided an invaluable proof of concept that it is technically possible to use broadband wireless connections linking two virtual interactive and collaborative classrooms which are geographically separated. The exciting part of the exercise is that the Ulwazi Concept has evolved into some form of social transformation process with further potential for not just the classroom environment.

TRANSFORMATIONAL OUTCOMES

This paper focuses mainly on the pedagogical aspects of the Ulwazi Concepts which certain aspects of social transformation were also noted. Although the project did not set out to measure the effect of the impact in any way as the main focus was on connectivity, Hlengani (2005) in an interview reported that there were improvements of up to 15 per cent in the Science results of many of the students attending the extra lessons in comparison with other learners in the same grade. These results were attributed to the application of the Ulwazi Concept between these two virtual classrooms.

South Africa in general is undergoing a process of social transformation which has accelerated in the post apartheid era. The education system has seen significant change at the policy level in order to align it with current international standards as well as providing equal access to all citizens. One of the critical challenges is to implement this across the broad range of schools, especially in the township and deep rural areas.

Ensor (2006) indicates that current thinking even raises the issue of teachers needing licences renewable every five years to overcome the problem of poor quality of teachers. The basic intention is to introduce a framework to develop teachers' competence and ensure that they had the ability to perform in their profession. Needless to say, the relevant teacher unions rejected the suggestion.

In the process of social evolution the power of ICTs in education hold enormous potential if it can be successfully unleashed. Earley suggests that 'since fundamental change is needed, social change activities must go far beyond traditional political activism'. He goes on to add that 'a spectrum of social change activities are needed, including confrontation of destructive policies, personal growth, public education, community organizing, reform, creating alternative institutions and technologies, and much more'.

Earley adds that 'To build a healthy society we need change at both the personal and societal levels. Without personal growth, we won't have enough citizens who have the consciousness required to co-create a healthy society. However, some of our social structures, especially our current global corporate economy, are not only destructive to our society but also tend to constrain our consciousness and drive it into certain narrow ways. Therefore we need to work for change at all levels simultaneously.'

Although the Ulwazi project initially focused on connectivity by 'chasing champions', the resultant positive incidental changes were noticeable. In a video interview one learner summed up the situation when he stated that the students had access to technology, access to a good educator and access to information. They no longer had an excuse to fail. Fundamental changes in society must begin within individuals and the biggest change must certainly be in personal attitudes. A positive attitude of 'I can do Science' was very evident and a significant number of learners who participated in the project were intimating that they were considering careers in the hard sciences.

The old model of Outreach programmes is loosing flavour rapidly as more companies would like to see greater returns on the corporate social investments. Fund raising for Outreach projects over the years showed a decline from many institutions. The impact of channelling scarce resources into a bussing model sees a significant proportion of the budget being consumed rapidly even before any education starts and the process is certainly not sustainable. The Ulwazi Concept negates this effect immediately by reducing the 'transport' cost to zero. The added advantage of digitally transporting learners and educator to remote classrooms is that it can be achieve virtually instantaneously and can operate 24 hours a day at virtually no additional cost. It also overcame an inherent fear that learners and teachers from the cities being reluctant to travel into local townships. There is no longer an excuse for not reaching out to disadvantaged communities as the hardware and software barriers are dwindling rapidly. Beyers (October 1998) states that the biggest problems are the warmware issues or human factor.

An issue of strategic importance to the educational use of the Ulwazi Concept must certainly be the regulatory issues surround the use of the operating frequency band. Dasgupta (2005) sums up the situation. 'If you think education is expensive, try igno-

rance!' The regulation of the airwaves is important but the Ulwazi Concept is based on the principle of a zero-rated education licence as not many schools can afford a monthly fee to access the wonderful resources that the internet has to offer, let alone an additional expensive of connectivity to receive supplementary tuition. The engine room of a developing world countries economy has to involve an investment in future generations. A system that does not promote free access to information and information services will severely hamper any development of human capital especially in the science, engineering and technology sectors. The knock-on effect will be individuals who are unable to cope with life in a technological world.

RECOMMENDATIONS

The pilot phase of the Ulwazi project is now complete and plans for the next phases are already on the drawing boards. As has been mentioned previously, access to technology and more importantly, information are critical, but a common problem with the deployment of any computer laboratories is the question of security. The 'theft' value of computer equipment unfortunately demands that a significant portion of scarce financial resources have to be allocated to securing the laboratories. In essence, this translates to poor physical access to the equipment on the part of the teachers and especially the learners. Computer laboratories in general, remain locked up for a significant proportion of the school term for fear of losing the equipment.

An initiative that has been launched by the Meraka Institute (www.meraka.org.za) at the CSIR involves the development of a community network and to empower locals to deploy and maintain a mesh network (http://en.wikipedia.org/wiki/Wireless_mesh_network) as part of an entrepreneurial opportunity. The network is part of the community and must therefore be owned by the community. A classic example of this is the use of cantenna (http://en.wikipedia.org/wiki/Cantenna) which is a directional waveguide antenna for long-range WiFi used to increase the range of (or snoop on) a wireless network. Originally built using a Pringles potato chip can, a cantenna can be constructed quickly, easily, and inexpensively using readily obtained materials. The use of tin cans to make the antennas reduces the cost of the equipment as well as the expertise needed to maintain it in such a community network. A group of learners from Gatang High have displayed an interest in taking on the challenge of developing a business in the local community. Currently there are plans to provide two teachers and two learners with access to the Ulwazi network from their home PCs and to explore the education possibilities of such a community network linked to educational resources.

As part of the shared resources the server will house a version of the Wikipedia as internet access will not be provided due to cost factors. Coupled to this will be the inclusion of:

- a Wiki
- Wikipedia

- Content management and delivery system
- Pod casting capabilities.

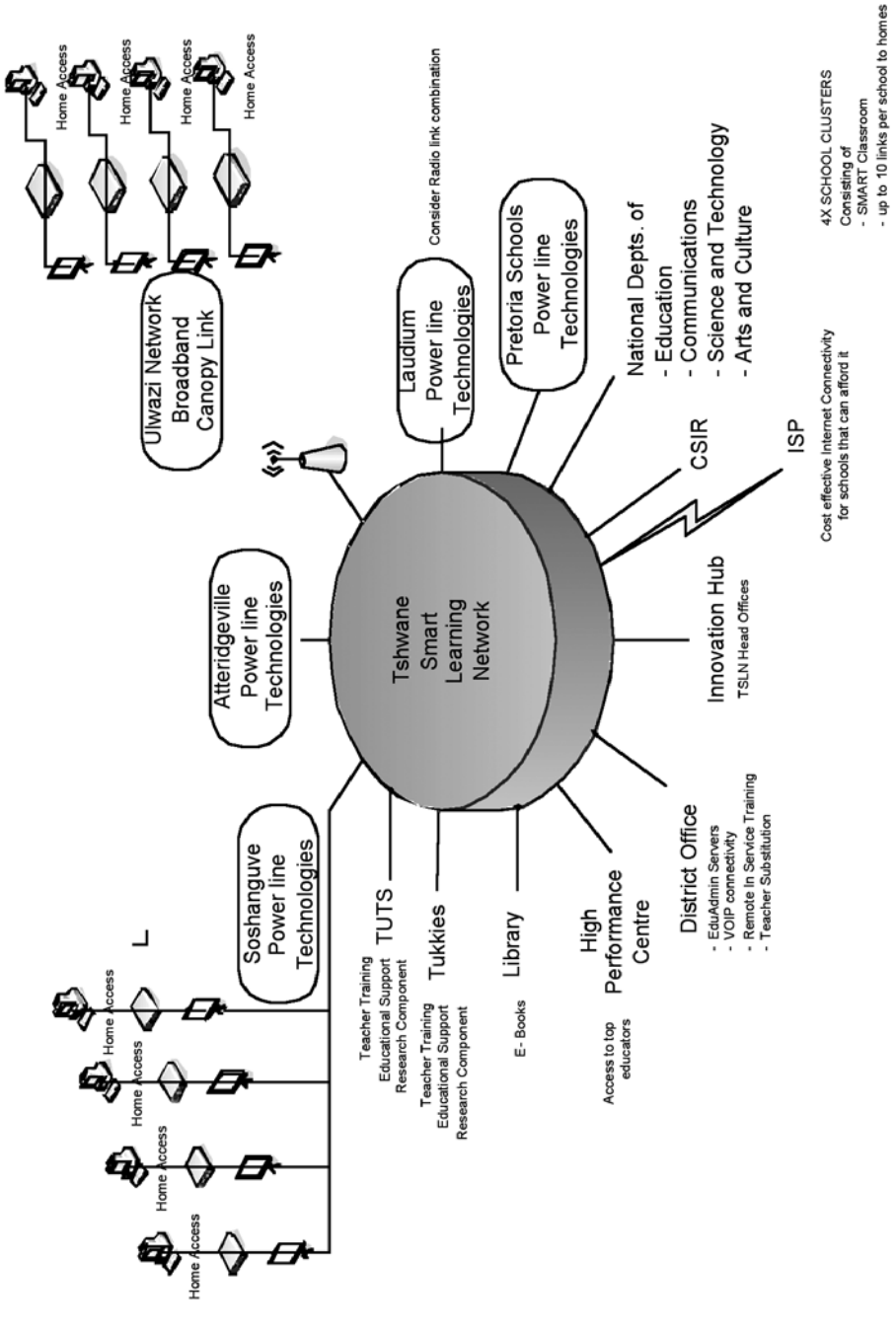
The use of the mesh network is in line with the Wireless Africa's (http://www.meraka.org.za/wireless.htm) initiative to implement ways in which technology barriers can be removed or minimized to enable bottom-up creation of wireless access infrastructure. The group is performing research in the areas of mesh networking, low cost voice/messaging devices, low cost access points and antennas, and network security. Mesh networking research is particularly interesting in that a community can grow a wireless network in an ad-hoc manner without the need for large capital investment in radio masts. Two experimental test bed mesh networks have been installed in Pretoria and Mpumalanga and are continually increasing in size to understand issues such as scalability and quality of service as stated by Wireless Africa.

The proposed Ulwazi Tshwane Smart Learning Network (TSLN) is the next expansion step in the process. It is intended that the Tshwane Global Digital Hub (http://www.tshwane.gov.za/business.cfm) will provide access to the fibre optic backbone covering the whole of the Tshwane area providing access to all the schools in the metropolitan area. The educational implications of such a digital network are enormous and can play a significant role in addressing many of the negativities that are hindering progress in the educational sector. See Figure 2 for a proposal on Ulwazi Tshwane Smart Learning Network Diagram.

The following are just some of the educational advantages that could emanate out of such a proposed network. Some of the following recommendations could be turned into further areas of research.

- E-enabling additional processes in order to maximize on the deployment of expensive equipment. This would include connecting all the health clinics to enable the realization of an e-health strategy as well e-municipality and e-government.
- In setting up a metropolitan wide network it is important to identify the champion individuals and schools to act as change agents. The first phase will be to roll out to them in order to facilitate an organic growth model for the dissemination of best practices. By investing in champions it is possible to empower them to act as catalysts and to overcome the 'ignorance is bliss' syndrome that prevails in many schools which is hampering the early adoption of technologies in classrooms.
- The deployment of low cost mesh types of technologies has the potential to spawn entrepreneurial opportunities for groups within the community to maintain and deploy such a network. This community empowerment process can go a long way to initiating additional components of sustainable social transformation through digital empowerment. An extension of this concept could be the initiation of a call centre on the network which uses Voice Over Internet Protocols (VOIP). This service to the educational community would be a value added service and could also be extended to the e-health and e-municipality concepts as well.
- Another key concept that the deployment of the proposed TSLN can demonstrate

APPENDIX A : Ulwazi Phase 2 - Tshwane Smart Learning Network – Concept Diagram



is the distribution of internet access to multiple schools using a single entry point. This could provide the benefits of free district wide interschool connectivity with access to shared resources anywhere on the network. The expensive part of connectivity could be shared through a managed entry point which is scalable depending on the demands. It is foreseeable that as the Ulwazi Concept is deployed in other cities with centres of excellences as the main hubs, it is conceivable that the role out of national schools educational network or EduNet would be greatly enhanced without the need to connect individual schools. The Telecommunications Act 103 of 1996 and amended in 2001, as stated in the Draft White paper on e-Education (2003), makes provision for the development of a network for education (EduNet) that will connect all schools to each other and to the Internet through multi-media laboratories. There is growing pressure to ensure that EduNet is deployed early in the next century which is an enormous task given the remoteness of many of the schools as well as the lack of basic facilities in many institutions.

- An important consideration when creating the proposed learning communities that are connected, it to deploy the appropriate technologies which may range from ADSL, ISDN, V-SAT, Wifi, WiMax, etc. While addressing the issue of connectivity the policy makers must also take into consideration the importance of defining the bandwidth for such connections. With the rapid escalation in hardware and software innovations, coupled to the variety of formats that digital information can be captured and delivered, it is imperative that the connections do not restrict future information pipelines by allocating poor bandwidth. The Ulwazi pilot project operated with a bandwidth of approximately 10 Meg which enabled the establishment of a virtual interactive and collaborative classroom. It is for this reason that connections should aim for an interschool bandwidth associated within a given closed network to be in the region of 20 Meg. Internet connectivity can then be chocked down to an affordable level.
- Access to a metropolitan wide school administration package can greatly enhance the management of a key administrative function of all schools. It is proposed that such a system is browser based with the server residing at the head offices of the local educational district offices. The system should make provision of such essential elements as learner and teacher administration, basic financial administration, capturing and process of marks, printing of reports, etc. District offices should have access to the database in order to data mine the information on a daily basis in order to make more rapid and informed decisions based on the patterns of information that emerge.
- The TSLN proposal also takes into account providing universities with access to the network. The motivation for their inclusion is based on providing the in service teacher training departments with the opportunity of exposing the teachers to a living laboratory to gain invaluable hands on experience. The real value lies in the contextualization of learning for the would-be teachers while providing learning opportunities for the learners in the schools as well. The proposal is therefore based on a move away from thumb-suck education to real education which is relevant.

CONCLUSIONS

Given the scenario described previously with teacher absenteeism, coupled to poor teacher training and a lack of delivery, it is conceivable that classrooms in different parts of an educational district could be digitally merged for varying periods of time. There would no longer be the excuse that no teaching was taking place or that the quality was not up to standard. Modern technologies are mature enough to provide stable broadband connectivity which could digitally transport the best educators to any school in the district. It is also conceivable that with further enhancements in the internet connectivity that top educators could even be available digitally to any school in the country in the near future. The mind boggles at the educational opportunities that could be leveraged in such scenarios.

There are many more permutations of the TSLN proposal that could have a dramatic influence on the educational outcomes should such a network be deployed, including the open source debate. The challenge must therefore be to provide a holistic solution to digital inclusion for communities in disadvantaged areas. The Ulwazi Concept is one possible solution that has demonstrated proof of concept on a small scale and with further piloting could play a significant role in the deployment of EduNet in the coming years while providing more learners to draw benefits from a learning community that is connected.

This paper clearly adopts the position that argues that the latest generations of ICTs are a panacea not for all the problems facing education but certainly has the potential to circumvent some of the critical stumbling blocks that are hindering progress, especially in the areas of content and teaching where there is a lack of delivery. It has been clearly demonstrated that it is possible to establish a learning community that is connected which can lead to social transformation which could lead to long terms effects on the economy.

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