

A Qualitative Analysis to Determine the Readiness of Rural Communities to Adopt ICTs: A Siyakhula Living Lab Case Study

Sibukele GUMBO¹, Nobert JERE², Alfredo TERZOLI³

¹University of Fort Hare, P. Bag X1314, Alice, 5700, South Africa

Tel: +27 40 602 2464, Fax: + 27 40 602 2464, Email: sgumbo@ufh.ac.za

²University of Fort Hare, P. Bag X1314, Alice, 5700, South Africa

Tel: + Tel: +27 40 602 2464, Fax: + 27 40 602 2464, Email: njere@ufh.ac.za

³Rhodes University, P.O. Box 94, Grahamstown, 6140, South Africa

Tel: +27 46 603 8602, Fax: + 27 46 636 1915, Email: a.terzoli@ru.ac.za

Abstract: Rural schools have a pressing need for ICT and Internet services, for themselves and the surrounding communities. Educators can play a crucial role of fulfilling this need. But how ready are schools, educators and communities to engage with ICT and use it for their empowerment? This paper reports the findings of an e-readiness assessment and promotion drive by researchers from the Siyakhula Living Lab in parts of the Mbashe Municipality, in South Africa. The Siyakhula Living Lab is a multi-disciplinary, multi-year initiative to foster grassroots innovation in marginalized communities with the aim of improving their lives and economies. The drive was conducted to support the expansion of the network of Digital Access Nodes, i.e. ICT points-of-presence of the Living Lab in the community: this network represents the structural backbone on which all other activities rest. The assessment shows that, while the practical difficulties are many, the communities are very eager to engage with ICT and understand fairly well the connection between ICT availability and the possibility of improvement in their life conditions.

Keywords: ICT readiness, ICT education, ICT skills, Internet, living lab, rural

1 Introduction

Most African countries have identified the use of Information and Communications Technologies (ICTs) as the key foundation tool in building capacity and transforming economies. The spread of ICTs, accompanied by their usage, is broadly associated with poverty reduction and economic growth [1]. Initiatives spearheaded by NGOs, industry and government are working towards ensuring ICT-readiness (i.e. the support of the deployment of telecommunication infrastructure) and ICT-education (i.e. the ability to provide ICT capabilities). This, coupled with ICT use, contributes towards an impact in the form of a certain degree of e-readiness. e-readiness is defined as “the degree to which an organization (or community or country) is prepared and ready to engage in electronic communication via the internet and thus participate in the global knowledge economy” [2].

An e-readiness assessment conducted prior to deploying an ICT project may be used to:

- collaboratively identify opportunities and bring awareness to requirement definitions that require attention in order for a community to participate in the networked world;
- measure and formulate a coherent, achievable strategy design for both infrastructure integration and skills development, taking into account what is available prior to project deployment;

- provide a benchmark for gauging the future progress in terms of ICT adoption [3].

The level of complexity of ICT integration and skills development is different between urban and rural settings. South Africa urban centres, in most cases have been fortunate enough to have most of the basic infrastructure, such as electricity, proper facilities and telecommunication towers to support ICT deployments. On the other hand, South Africa's poor rural areas usually lack some of the above basic infrastructure, but still need support to ensure an e-ready society [4].

The Siyakhula Living Lab (SLL) is an example of an initiative currently engaged in extending its ICT infrastructure footprint, through the addition of eleven points-of-presence (PoP) in schools, in a rural community in the Eastern Cape province of South Africa [5]. The conditions of the schools in rural areas reflect the high inequality between the relatively wealthy urban areas and the rural areas in this province that contains some of the worst poverty in South Africa. Still, these rural schools provide simplified neutral access to ICT infrastructure to the learners, educators and surrounding communities, provide the best teaching and learning structures for marginalized communities and are usually the first to be connected to the national electricity grid.

SLL researchers travelled to the eleven schools prior to the extension, to discuss the project objectives with school principals, educators and community members. This exercise not only measured the availability of ICTs in the area, but also aided in understanding the community's social and cultural blocks, which will influence ICT adoption and use. Previous experience was used to help the communities understand the benefits of being involved in the initiative, so that realistic development goals were extended into the area. The researchers felt that the results could be used as a benchmark for ensuring ICT-readiness and ICT-education, and subsequent e-readiness in rural South Africa. This paper reports on the feedback and findings obtained from the various meetings with representatives from the schools and communities. The paper also documents the typical current state of rural schools, in terms of basic and ICT infrastructure, and also relates literature available from a national and provincial level, to ensure an e-ready society.

2 History of the Siyakhula Living Lab

SLL is a large multi-stakeholder operation that consists of academia, industry, government and marginalized communities to facilitate user-driven innovation in the ICT for Development domain. It was pioneered by the University of Fort Hare (UFH) and Rhodes University (RU) in 2005, and is based in the vicinity of the Dwesa-Cwebe Nature Reserve in the rural Eastern Cape Province of South Africa. The choice of Dwesa was a logical one as some previous work had been done by RU in the area; which simplified the initial connection with the community. SLL operates in the context of historical underdevelopment and marginalization, and seeks to empower a community through harnessing its innovative potential for integration into the provincial and general national system of innovation [6]. Also, it provides an entry point into an untapped, immature telecommunications market in rural South Africa. The idea is for all four aforementioned parties to practically investigate various methodologies that can be used by rural areas to catch up with urban areas, seeing that there is rapid development of broadband communication services, convergence of telecommunications and advances in the field of communication through the World Wide Web (WWW) [7].

From 2005 to 2010, SLL established the first five PoPs, equipped with computers, the Edubuntu operating system and open source software for community access, at Mpume, Mtokwane, Ngwane, Nondobo junior secondary schools (JSS) and Nqabara, a senior secondary school (SSS). These PoP were connected to each other through state of the art, long distance wireless telecommunications infrastructure that forms a large star topology broadband island and provides shared internet connectivity to the communities.

Telecommunication technologies such as fixed WiMAX/ VSAT/ WiFi were deployed for proof of concept in a deep rural context, where wired networks are currently impractical and where technologies such as WiMAX are yet to reach [8]. Naturally, computer training, an ongoing operation was initially conducted by the participating researchers but has now evolved to include local champions.

Through the support of Saab Grintek, SLL embarked on a major expansion of its network infrastructure in 2011. This expansion included the addition of a mobile WiMAX base station and a redundant backhaul VSAT connection to the fixed WiMAX/WiFi/VSAT network. Also, the expansion in 2011 saw the addition of eleven PoP to the wireless broadband island, at Ntubeni, Ngqeza, Lurwayizo J, Ngoma, Mevana, Hlabizulu, Nquba, seven JSSs, Badi, Zwelidumile and Lurwayizo S, three SSSs and Kunene, a senior primary school (SPS). Ngwane and Badi were chosen to each host a WiMAX base station and a VSAT, while the rest of the schools each host a Customer Premises Equipment (CPE) which connect to the respective base station creating two linked 'cells' [5].

ICTs are perceived as being able to facilitate the integration of rural areas and also enable the enhancement of a number of sectors including education, health-care, small-medium and macro enterprises, local content development and more participative government [9]. As such, the ICT hardware and software deployment in SLL has focuses on supporting grassroots activities through proof of concept of eService applications such as e-commerce (to stimulate local entrepreneurship for the dormant art, craft and micro tourism SMME activities by creating a localised service that is directly managed by local producers of goods), e-government (which allows less costly and more efficient for people living in the community to communicate with various levels of government, from local and national), e-health and e-judiciary [6].

3 Regional ICT Support for ensuring an e-ready Society

3.1 - ICTs in South Africa

In 2011, the population of South Africa is approximately 49 million, with a 6.8 million (or 13.9%) Internet penetration. This ranks South Africa as the 4th highest internet-using country in the continent [10]. Like others in the African continent, South Africa is embracing the New Partnership for Africa's Development (NEPAD) programme which requires individual countries to formulate strategies for the deployment of ICT infrastructure to enable their citizen's access and to formulate legal and regulatory frameworks to support ICT use [3]. The entrance of five of the seven African undersea cables directly through South Africa is helping in changing the access landscape considerably, promising an increase in internet access and broadband penetration [12].

There have been a number of connectivity projects that government has implemented largely in rural areas, as guided by the Broadband Policy of South Africa and the National Information Society and Development (ISAD) Plan [4]. Through the Department of Communication (DoC), the country has the intention to establish itself as a world leader in the development and use of ICTs for educational inclusion and socio-economic development. It launched an e-Skills Plan of Action in 2010 to use the potential of ICTs to deliver 'equitable prosperity and global competitiveness'. For South Africa 'e-Skills' means 'the ability to use and develop ICTs within the context of an emerging South African Information Society and global Knowledge economy, and associated competencies that enable individuals to participate in the world in which ICT is a requirement for advancement in government, business, education and society in general' [13]. SLL has been involved in the setting up of the Eastern Cape e-Skills knowledge Production and Coordination Hub which focuses on ICT for Rural Development.

3.2 - ICTs in the Eastern Cape

The Internet usage in the Eastern Cape Province was 14.3% with 7.1% household penetration in 2010 [14]. In 2007, the provincial Department of Education (DoE) decided to support the fragmented ICT efforts of schools and communities, fulfilling both the national e-Education White Paper and the provincial e-Education Business Plan that is targeting the capacitation of 6,300 schools with ICT resources and skills by 2013. Of relevance to this paper, is the policy imperative, contained in the e-Education Business Plan, to ensure access to ICT infrastructure, connectivity to the internet, shared ICT knowledge through literacy training and community ownership. The development of schools as community centres for also meant to contribute towards building small community businesses which provide ICT technical support. In an ideal situation, 2011- 2013 would be the years in which the final phase of the plan would take effect i.e. a mass roll-out into the schools. However, the DoE has faced many challenges which include a backlog in the replacement of mud classrooms, lack of electricity in some schools and a possible (if debatable) need to further invest in security measures for the equipment [15].

4 The Siyakhula Living Lab Expansion Methodology

Prior to the rollout of ICT infrastructure in 2011, the SLL team needed to:

- Interact with representatives from the communities to select a list of eleven schools to be considered in the network expansion: Consultations were made with the district DoE office and twenty educators taking part in the Advanced Certificate in Education (ACE) in ICT course held through the collaboration of the district DoE and RU, and partially hosted by the SLL since 2009. Through questionnaires and class discussions, a list of schools to be included in the SLL expansion was drawn [5].
- Conduct a network feasibility assessment using the list of schools drawn: The SLL technical researchers conducted a desktop survey using Google Earth and Radio Mobile to simulate the Radio Frequency (RF) propagation of signals of the eleven suggested schools' WiMAX broadband island. In order to achieve this, GPS coordinates from all schools were plotted, and elevation above sea level and antenna clearance (from the ground) determined. The next step was to physically locate the suggested schools to replicate the simulated network in real life and to determine whether there were other factors to be considered before finalizing the list [5]. Through this step, the initial plan was developed and improved.
- Conduct an e-readiness assessment of schools and communities: The SLL researchers formally approached representatives in the eleven selected schools, to introduce the SLL concept and determine their current level of ICT-readiness and ICT capabilities. The methods used to collect e-readiness data were predominantly qualitative. A qualitative approach provides rich textured knowledge to elaborate on the exact information on ICTs at the schools. Therefore the researchers conducted:
 1. Telephonic interviews: The principals of the eleven schools were interviewed by cellphone, and asked to set up appointments with representatives and to understand the schools' existing operations;
 2. Focus groups discussions: The SLL team formally met the school principals, educators and community representatives and their views were gathered;
 3. Photography, audio recording and observations: The SLL team took photographs of the meeting together with the schools and their existing resources. All the contributions made were voice recorded then later transcribed to support the collection of data during discussions. Also, this study included a variety of personal experiences of the authors, based on their visits and interaction with the community.

SLL researchers met and interviewed representatives from each of the eleven schools to engage them in the excitement and purpose of the project. The interactions between the researchers and representatives were held mainly in Xhosa, but English was used whenever necessary. These open consultations were also intended to build a foundation of trust and common vision that could be turned into practical steps that fit the local rural context. These meetings were attended by a total of eighty nine people including principals, teachers or community members, as determined by the principals of each of the schools. The authors defined some key characteristics to interrogate, in order to determine the e-readiness of the schools to receive ICTs. The following key characteristics were included in the list:

- The school and communities' level of interest in joining the SLL: The SLL team felt that this question would reinforce the telephonic conversations previously held with school principals, and provide more feedback from a larger group of individuals. The number of the teachers and the community members who were available for the meeting at each school was captured. It was also important to determine the community's awareness of the benefits and challenges of hosting a PoP, capturing all the majority and minority opinions raised during the consultations;
- The availability of physical space and basic infrastructure for telecommunications equipment: Rural schools do not always have adequate basic infrastructure to support ICTs. Thus, it was necessary for the authors to do a physical check on the number of computers (laptops or desktops) available, the availability of electricity, furniture for the computers and space in a secure room to ensure the safety of the equipment;
- Confirming the number of ICT literate educators: The researchers felt the importance of confirming the number of computer literate educators, besides those taking the ACE course, to assist with training. Identifying key teachers with ICT experience was useful in order to know whom remote technical troubleshooting would be conducted with;
- Collection of physical location information for the schools: The location of each of the schools in relation to the school hosting the base stations was noted. It was necessary to explain, in brief, the schools involved in the project and the topological structure of the telecommunication network so that everybody was aware of the network dependencies.

5 e-Readiness Findings and Discussions

The findings based on the e-readiness checklist are shown in Table 1, and are further discussed below.

Table 1: e-readiness assessment statistical data collected from eleven SLL schools

School name	Total school learners	Total meeting attendees	Total literate educators	Total school computers	Electricity available? (Yes/No)	Furniture available? (Yes/No)	Security available? (Yes/No)	Straight line (km)	Distance by road (km)
Schools connected directly to the Ngwane mobile WiMAX base station and VSAT									
Ntubeni	227	12	2	5	Yes	No	Yes	5.54	17
Ngqeza	50	5	5	3	Yes	Yes	Yes	3.80	4.50
Ngoma	112	14	2	0	No	No	No	9.29	20.4
Lurwayizo J	243	12	1	2	No	No	Yes	11.70	27.2
Lurwayizo S	76	4	0	2	No	No	Yes	10.94	27.6
Schools connected directly to the Badi fixed WiMAX base station and VSAT									
Badi	512	14	1	33	Yes	Yes	Yes	0	0
Mevana	255	9	2	3	Yes	No	Yes	1.34	1.30
Kunene	120	9	1	0	Yes	No	Yes	3.41	4.2
Nquba	312	3	1	2	Yes	No	Yes	8.55	12.3
Hlabizulu	260	2	1	0	Yes	No	Yes	10.46	13.9
Zwelidumile	429	9	1	2	Yes	Yes	Yes	9.20	26.3
Totals	2596	89	17	52	8/11 Yes	2/11 Yes	10/11 Yes		

A discussion of the statistical data and views from the principals, educators and communities, according to the key characteristics defined, is as follows:

5.1 The school and communities' level of interest in joining the SLL

All the attending community members appeared thoroughly motivated by the potential arrival of Internet infrastructure in their communities. As a result, they had a lot of views to air. At Ngoma school an elderly person, older than 70, stated that he was interested in understanding what the Internet is. An example was given of the use of the Internet to obtain the Department of Home Affairs requirements to obtain a national identity document, without having to go to the physical office located approximately 50km away. Other elders enquired if community members would be able to use these computer resources, especially considering the English literacy challenges and the low education levels in the community. When the capabilities of computers and the Internet were explained to the community members, especially the facts that anyone interested was welcome to receive the free literacy training and one could use Xhosa on computers, this got the community elders excited. They concluded that "Perhaps this computer infrastructure will shine a light in this dark, previously forgotten, out-of-the-way area. This gives us hope". They felt that this project would mean the most to the youth who had not gone far education-wise and were currently unemployed, in terms of them gaining a computer literacy skill.

An elderly community member from the more advanced Kunene community said that "I would like to come for training too, to aid my business. There is a need for people to learn to use the devices that are being produced in this century". He also felt that there was a great demand for computer literacy in his area as some of the youth, including his daughter, were currently undergoing computer literacy training at Ngwane, about 20km away. Other elders at Kunene suggested that they felt that computers could bring a better understanding between teachers and students.

Most of the educators were also motivated by the arrival of the SLL at their schools. They were familiar with the concept, as some of their colleagues had received ACE training to help in integrating computer literacy into the school curriculum. They were willing to embrace the concept too. Some educators requested for the SLL researcher's expertise in fully involving the community in the initiative. Schools like Ntubeni and Lurwayizo JSS told the researchers that despite there being no community members present at these meetings; they had been made aware of the intention of the SLL to expand to their respective communities and had given their blessings. These educators said they were happy to introduce the SLL concept to the surrounding community and inform them of the advantages of hosting such a project. Collectively the educators felt that the use of the internet would improve teaching and learning resources, making the SLL rural schools comparable with urban schools and also, it would aid teachers and community members doing distance courses by providing on-the-ground access to the internet.

5.2 Availability of computers

As shown in Table 1, there were variations in infrastructure available at the eleven schools. As the Saab Grintek sponsorship is for the mobile WiMAX backbone infrastructure, the two universities pledged to try to assist with a few computers at the schools with very few or no computers.

There is a drive, usually from the junior secondary schools, to purchase computers and printers from the money saved from the 'paper budget' allocated by the DoE. Some schools have already done this, while others plan to do it in the very near future. Zwedumile has instead approached companies to assist with funding to purchase computers, and have at this point received commitment for funds to purchase 30 computers. Zwelidumile hopes to

introduce a computer literacy course in 2012. Schools like Badi, supported by the national DoE, through the Dinaledi programme, have a fully equipped and fully furnished wireless computer laboratory and overhead projector which was set up at the beginning of 2011 in the hope of incorporating computer literacy into the school curriculum by the beginning of 2012. A school like Lurwayizo SSS has not considered purchasing computers in the past, and asked “Is it not possible to donate at least five computers to us?” The more organized schools’ were rather asking whether the educators and community would be allowed to connect their personal computers onto the SLL network.

Not all the schools utilize the computers they have. Ngqeza school does not use their computers as “they have a problem”. At present, technical challenges usually remain unsolved due to lack of local technical expertise. (The SLL team investigated the problem later on and discovered that the school was supplied with faulty keyboards by the DoE suppliers.) Lurwayizo on the other hand could not use the computers and printer they have because they do not have electricity at their school.

The researchers clearly indicated the open source inclination of the SLL, meaning the operating system to be installed on any of the computers would be Ubuntu Linux, rather than proprietary software whose licence needs to be purchased. Very few attendees understood the differences between open source and proprietary software.

5.3 Availability of electricity

The rollout of electricity to some of the intended SLL schools is yet to be completed. There is no clear indication as to when this will happen, but everybody remains optimistic that it will be connected soon as all the electrical poles, wires and boxes are in place. Other schools, like Hlabizulu and Nquba, have electricity, although their surrounding communities do not. A school like Badi had a fully equipped computer lab which could not be used until recently because there was no electricity from the central meter box to the computer lab.

Ntubeni was the first school approached to host SLL infrastructure in 2005, but they had no electricity or proper school buildings at the time. Naturally they were considered in the 2011 expansion, as they have managed to electrify their school.

A feature common to most computer rooms in rural schools is the presence of only one electrical socket which is expected to power all ICT equipment deployed to the school. There is no use of solar power in these areas since there is a very high probability of the theft of the panels. Most schools noted that they might not singlehandedly be able to afford the electricity bill to keep the computers on for the school and community. Some schools felt they would overcome this by charging the community members a nominal fee (such as ZAR2) for usage. The adaptive cost model for charging Internet users, developed by Fort Hare researchers could be applied.

5.4 Availability of furniture

Most rural schools have very sparse furnishings in the classrooms, if any. Table 2 shows that only Badi and Zwelidumile (which had looked for external funding) had any furniture to host SLL computers. The universities undertook the responsibility of buying solid ‘picnic-like’ tables to place the computers.

5.5 Availability of security

Due to the high level of crime in rural areas, highly influenced by the high levels of unemployment, each school has invested in securing the rooms in which computer equipment is hosted. In reality, the need for securing a computer installation in a school is debatable, but the local community feels strongly about it. The security systems seen include iron bars on windows, security fences around the school perimeter, wire gauze's in

ceilings or the employment of night time security guards. Most schools have at least one classroom secure enough to host the SLL infrastructure, although one school, Ngoma, without any security iron bars on windows wondered if the SLL would be responsible for securing the room where the computers would be hosted. Of course, the communal ownership of the existing SLL equipment has contributed in minimal loss of computer equipment so far, and it is hoped that this sense of ownership will extend to the new schools.

5.6 Number of ICT literate educators

There was a need for the SLL researchers to ascertain how many of the educators have received any ICT training, formally or informally. Seven of the meeting attendees had received training through the ACE course offered since 2009 within the SLL. At a school like Nquba, where no teacher had received formal literacy training, the principal said that “There were some teachers interested in taking part in the pre-ACE course that was conducted at Ngwane 27km away but were unable to do so at the time as the capacity was 20 people”. Still, they would like to be considered in the next intake for ACE. The researchers observed that there was great enthusiasm amongst the teachers and community in literacy training, especially if some form of certification could be presented to the trained individuals. The researchers informed the attendees that at present, the informal free training for community, teachers and learners had not been accredited, thus only Certificates of Attendance could be offered.

6 Conclusions

This paper presented the results of an e-readiness assessment and promotion drive in the Mbashe municipality of South Africa. The findings show that rural communities are ready and willing to learn to use ICTs and internet by partnering with the target community and avoiding traditional top down interventions. The community is also keen to support the ICT project and participate in the infrastructure setup as they see the benefits of the ICT projects and the internet to their community. They are also keen to receive ICT training and education after the deployment to enable the sustainability of the project. Meeting the community members, and interacting in their local Xhosa language, allowed them to fully understand the ideas of the project and clear all the questions which they had during the visits. However, we noted that ICT in almost all the rural schools visited needs to be improved as the schools mostly lack basic infrastructure to support ICT resources. Still, we were motivated to extend the SLL project to all these schools as all the people are keen to be part of the project.

References

- [1] Economist Intelligence Unit, Digital economy rankings 2010 - Beyond e-readiness, 2010.
- [2] H. Wesso, Broadband Connectivity in South Africa. In SITA GovTech 2010, 2010, Durban, South Africa.
- [3] World Bank, Information for Development Program (infoDev) Annual Report: 2001, 2001.
- [4] South African Department of Communication, Towards an Information and Communication Technologies (ICT) rural development strategic framework, 2007.
- [5] L. Dalvit, I. Siebörger, H. Thinyane, The expansion of the Siyakhula Living Lab: a holistic perspective. In Africomm 2011, 2011, Zanzibar Islands, Tanzania.
- [6] H. Muyingi and A. Terzoli, THRIIP Application: Multi-function, distributed, community communication centre, 2006, Telkom Centre of Excellence, University of Fort Hare.
- [7] International Telecommunication Union (ITU), Broadband Mobile Communications towards a converged world. Emerging Technology Scenario: What are the Future Broadband Mobile Services? In ITU/MIC Workshop on shaping the Future Mobile Information, 2004, Seoul, South Korea.
- [8] I. Siebörger and A. Terzoli, WiMax for Rural SA : The experience of the Siyakhula Living Lab. in SATNAC 2010. 2010. The Spier Estate, South Africa.

- [9] S. Moshapo and HE. Hanrahan, ICT Services for Poor Rural Community Development – What is Missing in Current Implementations?. In SATNAC 2004, 2004, The Spier Estate, South Africa.
- [10] Internet World Stats, <http://www.internetworldstats.com/africa.htm> (last accessed 30 November 2011).
- [11] ITWeb, Broadband dearth. In IWeek 07 September 2011, Available : <http://www.iweek.co.za/special-report/broadband-dearth>.
- [12] Department of Communication e-Skills Institute, National e-Skills Plan of Action (NeSPA), 2010.
- [13] ITWeb, South Africa's Internet usage surges. In ITWeb 10 May 2011, Available: http://www.itweb.co.za/index.php?option=com_content&view=article&id=43451:sas-internet-usage-surges&tmpl=component&print=1
- [14] Eastern Cape Department of Education, E-Education Business Plan for the Eastern Cape, 2008.