**The OLPC XO, Intel Classmate and Asus Eee PC user study**

# Introduction

An increasing number of researchers regard education as the route to economic prosperity, the key to scientific and technological advancement, and the means to combat unemployment [Chimombo, 2005]. Education is also viewed by some researchers as a process that is enhanced by engagement with technology and the Internet [Wikia, 2009].

Information and communication technology (ICT) has become one of the crucial building blocks for a better education [Olakulehin, 2007]. Through its use, blended education is now possible. Blended education combines coursework in a traditional classroom setting with online information [ELearners, 2009]. When successfully integrated into teaching and learning, ICTs can ensure the meaningful interaction of learners with information. It has been postulated that ICTs can advance higher order thinking skills including: comprehension, reasoning, problem-solving and innovative thinking [RSA. Department of Education, 2003]. Successful integration of ICTs into teaching and learning has also been reported as ensuring that all learners are equipped for full participation in the knowledge society before they leave further education and training (FET) institutions [RSA. Department of Education, 2003].

However, ICTs are often out of reach for the poor and those in rural areas. There are various reasons why the application of ICT in education is problematic in less developed countries [RSA. Parliamentary Office of Science and Technology, 2006], including:

* Lack of appropriate products: Products are often not designed to meet the needs of the poor, or those in remote areas, for example some people face constraints such as lack of access to electricity. In 2002, a total of 1.6 billion people worldwide had no access to electricity, 80% of whom were in India and sub-Saharan Africa [Highbeam, 2002];
* Cost: The highest proportion of people living in poverty in the world are living in sub-Saharan Africa and can not afford ICTs [DFID, 2009];
* Education: Many people do not have the technical skills (such as basic computer literacy) needed to benefit from ICTs even where they are accessible [Mutonyi and Bonny, 2007]; and
* Language: Illiteracy can be a problem when using the Internet. The South African Parliamentary Office of Science and Technology [2006] stated that the Internet predominately contains English-language content while most people who can read in South Africa only know an indigenous language.

Due to the problems faced by less developed countries, ICT penetration in these countries is generally low. This is depicted by below as presented by the ITU [2007]. The graph depicts the differences in ICT penetration on different continents in 2007. Africa had the least ICT penetration rate as indicated by the small number of people using ICTs.

Figure : ICT penetration rate per 100 inhabitants, 2007



A number of computers have recently been developed to try and address some of the problems faced when attempting to integrate ICTs in education in developing countries, and these include: the Asus Eee PC, the Intel Classmate, OLPC XO laptop, and Inveneo Computing Station. This project aims to evaluate the usability of the Asus Eee PC, Intel Classmate and OLPC XO laptop within the context of education in previously disadvantaged schools in the Eastern Cape of South Africa.

This chapter is structured into four sections: In Section 2, I discuss past research of ICTs in education, specifically focusing on the South African context. Section 3 focuses on the types of netbooks under comparison in the research study. To get direction on how to conduct an unbiased, successful survey, a review of literature on user study research methodology is detailed in Section 4.

# ICT in Education

ICT has been referred to as an umbrella term that includes applications encompassing: radio; television; cellular phones; computers and network hardware and software; satellite systems; as well as services and applications associated with them, such as videoconferencing and distance learning [Rogers, Berg, Boettcher, Howard, Justice, and Schenk, 2005]. ICT in education is the application of technology within the context of education. This has emerged as a possible solution to problems associated with traditional pedagogies, where teachers are regarded as sources of data. A research group called “The Teacher99” [1999] pointed out that ICTs can be used in education in various ways, including:

* Computer assisted learning (CAL) which uses a computer to assist in the learning process;
* Engaging in more interactive learning methods like making use of music, videos and pictures;
* Assessing one’s knowledge through the use of online tests;
* Using email to communicate and collaborate with others;
* Using the Internet for research;
* Data logging to get more accurate results in experiments;
* Electronic registration of students; and
* Keeping learners records.

According to the findings from several researchers, ICTs have shown a positive impact in education making people aware of their own learning and motivation to learn [Cordis, 2009]. Sharmar, Nagar and India [2005] also noted that ICT is impacting on all dimensions of life including education, creating a distance-less world where communication is becoming instantaneous. Maximising the power of ICT will therefore contribute in addressing the issues relating to rural development and poverty.

Schooling is compulsory in South Africa between the ages of seven and fifteen and this contributes in ensuring all children have an opportunity to learn. Additionally, South Africa’s Bill of Rights ensures that both children and adults have the right to education [RSA. Department of Education, 2008]. In addition, the South African e-Education policy aims to ensure that every South African learner in the general and further education and training bands will be ICT capable by 2013 [RSA. Department of Education, 2003].

## The current state of ICT in education in South Africa

South Africa has made fair progress in the integration of ICTs in education. The National Department of Education in South Africa [2003] believes that developments in ICT in South Africa will create access to learning opportunities, redress inequalities, improve the quality of learning and teaching, and encourage students to become life long learners. ICTs can accommodate differences in learning styles and remove barriers to learning by providing expanded opportunities and individualised learning experiences [RSA. Department of Education, 2003]. In addition, former deputy president Phumzile Mlambo-Ngcuka stated on 17 April 2008 in Johannesburg that in order for South Africans to fully capitalise on the potential that ICT holds for education, ICT must be encouraged in schools [Khumalo, 2008].

Provinces in South Africa have different levels of ICT integration in education as depicted by Table 1 below. This is as a result of different development strategies adopted by provincial governments, together with the lingering effects of the past inequalities legislated by the Apartheid regime. Significant progress has been made by some provinces, for example, the Western Cape through the Khanya project. This project is an initiative of the Western Cape Education Department for education and curriculum delivery in the province [Khanya Project, 2008]. It was established in April 2001 to determine the contribution that technology could make towards addressing the increasing shortage of educator capacity in schools. Its objective is to empower every educator in every school of the Western Cape by the start of the 2012 academic year to use appropriate and available technology.

Table 1: South African schools with computers at provincial level in 2005 [RSA. Department OF Education, 2005]

|  |  |
| --- | --- |
| Province |  Percentage of Schools with computers for teaching and learning |
| Eastern Cape | 23 |
| Free State | 77.3 |
| Gauteng | 94.5 |
| KwaZulu-Natal | 43.6 |
| Mpumalanga | 52.9 |
| Northern Cape | 91.0 |
| Limpopo | 41.8 |
| North West | 67.6 |
| Western Cape | 97.0 |

The Gauteng Online project was launched by the Gauteng Department of Education [Ramon, 2007]. It is a leading technology access programme in schools in the Gauteng province. The programme’s access model involves establishing a computer laboratory with 25 work stations, Internet and e-mail access, to be used for curriculum delivery. The main goals of the programme are to:

* Contribute towards building the human resources capacity of the province and the country through the provision of quality education;
* Contribute towards stimulating positive economic activity in the country through the creation of a strong local ICT industry that has a capacity for ICT development and innovation;
* Enhance the efficacy of government for improved service delivery and a better life for all;
* Position the province at the cutting edge of change through technological innovation; and
* Bridge the digital divide.

The Connectivity Project in Northern Cape was launched by the former Premier of the Northern Cape, Dipuo Peters on the 5th of May 2005 [I4donline, 2009]. The project is an MTN Foundation initiative that creates multimedia centres in rural and disadvantaged schools throughout the country. By 2005, more than 10 schools in Northern Cape benefited from this project.

Despite some extreme variations, schools in Gauteng, Northern Cape and Western Cape have, on average, a better ICT infrastructure than schools in the Eastern Cape and Limpopo. Schools in Free State, KwaZulu-Natal, Mpumalanga and North West hold a middle position.

Additionally, the Internet Service Providers' Association of South Africa (ISPA) is also conducting a series of computer literacy training courses in several South African provinces including: Free State, Limpopo, North West, KwaZulu Natal and Mpumalanga [Pambazuka, 2008]. This is aimed at boosting the practical knowledge of educators in different schools.

There was an overall increase of Internet access in South Africa during recent years as shown by Table 2 below. However, in the last three years there has been a dramatic slowdown in Internet access growth in South Africa as depicted by Table 2 below. Research by ICT Africa in 2009 found that 15% of the households in South Africa have working computers, while only 5% of them have access to an Internet connection [Kreutzer, 2009]. Cape Town students reported their intensive use of cell phones in place of inaccessible technologies such as desktop computers. They also indicated that they access the Internet via their phones for information, communication and games [Kreutzer, 2009].

Table : Percentage of people using the Internet in South Africa according to the Internet World Stats [Internet World Stats, 2008], since the year 2000

|  |  |
| --- | --- |
| Year | % of people using Internet |
| 2000 | 5.5 |
| 2001 | 6.2 |
| 2002 | 6.8 |
| 2003 | 7.1 |
| 2004 | 7.4 |
| 2005 | 7.4 |
| 2008 | 10.5 |

There are a number of motivational strategies being implemented to encourage the use of ICTs in education in South Africa. In 2009, Microsoft will stage the Innovative Teachers Awards. This event recognises teachers who make innovative use of ICTs to enhance teaching and learning. Several prizes can be won including laptops, mobile phones, interactive whiteboards as well as an opportunity to represent South Africa at the Pan-African and/or Worldwide Innovative Teachers Awards. This event will also provide a great forum for innovative teachers to network and share ideas.

Like many other developing countries, South Africa is also facing challenges integrating ICTs into education. Some of these challenges include the following:

* Electricity shortages: 30% of the people in South Africa have no access to electricity [Mbendi, 2008];
* Poverty: In 2006 the human poverty index was 22.6% [UNDP, 2008];
* Language: Approximately five million people in South Africa are totally illiterate [RSA. Parliamentary Office of Science and Technology, 2006]. This means that these people have difficulty with use of ICT as it is predominately English-based;
* Inaccessible Internet : 72.7% of Americans in 2009 used the Internet, however only 12% of South Africans have access to and use the Internet [Internet World Stats, 2008]; and
* Digital Divide: Bickner [2006] describes the digital divide as the gap between people with effective access to digital and information technology and those with very limited or no access at all. Martindale [2002] found that South Africa has one of the greatest divisions between rich and poor in the world, and that this divide is most evident in the technology context. The Gini Coefficient is used to measure inequality within countries. It varies between 0, which reflects complete equality and 1, which indicates complete inequality. In South Africa it is 0.578 and is depicted in Figure 2 below [Human Developments Report, 2008]. Socio-economic circumstances, imbalanced education policies under the Apartheid regime, as well as language barriers, are some of the factors recognised in this exclusion. Within South Africa, these imbalances are demonstrated even further when we consider the differences in ICT penetration at provincial level as depicted in Table 1 above. The table shows that there is greater ICT penetration in some provinces like the Western Cape and Gauteng. The Eastern Cape province and Limpopo have much fewer ICT resources for teaching and learning than other provinces.

 Figure : Gini Coefficient 2008 [Wikipedia, 2008]



A viable technological alternative for the poor are the rapidly developing netbooks (small form-factor laptops) which are very competitively priced. These are thought to be solutions to the failures of integrating ICT in developing countries, such as poverty and limited electric power. The three laptops that were identified by Computer Aid International [2009] as preferred low-cost, low-power computer solutions appropriate for rural settings in developing countries are under evaluation in this project.

# Netbook Computers

Bergervin [2008] defines netbook computers as small laptops that are designed for wireless communication and access to the Internet. Additionally, Horowitz [2008] mentions that they are new types of laptop computers, distinguished from other laptops by their small size, low price and low power consumption. Their seemingly obvious target market has been education and it is for this reason that they are evaluated in this project. They are believed to be of potential value to the education of the less privileged, which have limited electricity and money and are in need of a quality education..

## Asus Eee PC 701w

The Asus Eee PC 701w was first released in 2007 and is well known for its light weight, solid-state drive and relatively low cost [Linuxlinks, 2008]. The newer models have added the option of a Windows XP operating system and traditional hard disk drives, with these models priced above the initial price. According to Asus, the name Eee stands for: "Easy to learn, Easy to work, Easy to play".

This netbook has a 7 inch display that uses an active matrix LCD which does not fill the top panel. Its keyboard is 83% of the normal keyboard and the keys, including the delete and return keys are tiny. The Eee PC has the Celeron M 900 MHz processor and 512KB L2-cache which is thought by researchers to be a problem if the user wishes to run numerous applications simultaneously. This netbook has a power input; an RJ-45 LAN port (10/100 Mbit) for wired connectivity; 802.11 b/g wireless network interface; three USB ports which are compatible with both USB 1.1 and USB 2.0 devices; a 3.5mm microphone jack; and a headphone jack. Because this netbook is usable by children, the manufactures thought that this type of netbook will be vulnerable to knocks and drops, and is supplied with a 4GB solid state drive (SSD). This netbook was purchased for R2200 and has no camera, as originally designed [Linuxlinks, 2008].

## Intel Classmate

This netbook is described by Intel as an effective personal learning device for primary students in emerging markets. It was developed specifically to enhance teaching and learning [Intel, 2007]. They are said to be rugged, affordable and child-friendly netbooks [Intel, 2008].

This netbook has a 10 inch LCD display. It has a 900MHz Intel Celeron Mobile processor, 512MB RAM and typically, 2GB Flash storage but are also sold with standard laptop hard disks. The classmate used in this study has a 60GB hard disk as no solid state models could be sourced at the time in South Africa. The Intel Classmate also has 2 USB ports and a RJ-45 LAN port (10/100 Mbit) for wired connectivity and an 802.11 b/g wireless network interface. The Intel Classmate has a unique cycle touch pad with left and right buttons. The outside cover of this netbook is much thicker, with more plastic bumpers to keep internal components safe from damage if dropped by users (typically children) [Ackerman, 2007]. Some models of this netbook have a dual mode capability in that they can operate in a tablet mode and a traditional laptop mode, adjusting to the changing needs of users. When opened like a traditional laptop, the screen swivels 180 degrees and it allows sharing with peers [Classmate PC, 2009]. Unfortunately the models we were able to source for this project did not have these two capabilities and only operate in a traditional laptop mode. This netbook also comes with a webcam.

## OLPC XO

The one laptop per child (OLPC) foundation is a non profit making organisation launched by Nicholas Negroponte in 2005 [Laptop, 2009]. The founders hoped that it would advance education in the developing world. The OLPC describes the XO as a powerful learning tool designed and built especially for children in developing countries, living in some of the most remote environments. Negroponte’s idea was influenced by the work of Seymour Papert and others who believed that computers are uniquely able to encourage children in "learning learning” and also provides a platform for children to teach themselves and instil a personal commitment to lifelong learning [Stern, 2007].

The netbook’s interface uses Sugar, an open source software environment. The XO has built-in wireless and a unique screen that is readable under direct sunlight for children who go to school outdoors. The screen "swivels" around, making the computer into a tablet or e-book, energy-efficient, and fun [Laptop, 2009]. It has a carry handle and a liquid-crystal display of 7.5 inches which has a dual-mode thin file transistor liquid crystal. Users can switch between colour and black-and-white viewing modes to save energy. The XO has a 1 gigabyte flash drive. It has integrated WiFi, video camera, microphone, three USB ports and speakers. The integrated colour video camera has a resolution of 640 x 480. The CPU clock speed is 433 MHz. The XO laptops can form a **mesh network**; XO computers in the same neighbourhood can connect and share contents and collaborate on activities.

## Comparison of Netbooks

Table 3 below provides a, mostly hardware, comparison of the OLPC XO, Intel Classmate and Asus Eee PC according to Wikipedia [2009].

Table 3: Comparison of the OLPC XO, Intel Classmate and Asus Eee PC [Wikipedia, 2009]

|  |  |  |  |
| --- | --- | --- | --- |
| Model | Asus Eee PC 701 | Classmate | OLPC XO |
| Manufacturer | Asus | Intel Mobile Processor ULV 900 MHz | OLPC |
| Weight in kg | 0.92 | 1.45 | 1.45 |
| Display size | 7 | 10 | 7.5 |
| Processor | Celeron-M ULV 353 | Celeron-M | AMD Geode LX-700 |
|  Processor Speed | 0.9 | 0.9 | 0.43 |
| Storage type | SSD | NAND | NAND flash |
| Storage size in GB | 2-8 | 2 | 1 |
| RAM in GB | 0.5-1 | 0.25 | 0.25 |
| Battery life in hrs | 2:45 |  |  |
| Keyboard size | 83 % |  |  |
| Operating system | Linux Edubuntu | Linux Edubuntu | Red Hat Fedora |
| Connectivity | 10/100M Ethernet WLAN 802.11b/g/n | 10/100M Ethernet WLAN 802.11b/g/n WLAN with antenna, fMesh support (Linux only) | Integrated 802.11b/g (2.4GHz) interface; Mesh 802.11s networking supported |
| South African price | ~ R2200 | ~R3200 | ~R3000 (if it were available |

Comparative studies of netbooks carried out by other African university researchers and Computer Aid International [2009] rank the Asus Eee PC netbook as a better choice for emerging economies. In their research, they analysed which one was best-equipped for use in developing countries. It is said to offer an ideal compromise between power consumption, performance and portability in both Linux and Windows-equipped versions [Computer Aid International, 2009]. The Intel classmate was shown by researchers to be the least preferred solution due to its higher power consumption and low battery life as compared to Asus Eee [Computer Aid International, 2009].

OLPC XO has been touted by some as the solution to Africa's technology problems. Research conducted by Computer Aid International [2009] ranked it best in terms of power consumption. However, it was the slowest of all tested systems, and the operating system didn't include office applications. Technologists have pointed out that the XO is mainly for children and not for teachers interested in computerizing all aspects of a school's operations. Performance analysis conducted by the Computer Aid International group was based on:

* Start up time;
* Time to start the web browser;
* Time taken to use the word processor; and
* Time taken to copy a file.

In this research study, I hope to achieve an in-depth comparison of the three netbooks with possible recommendations regarding their use in educational environments. An evaluation of the intuitiveness of these three netbook will be done through the inclusion of a user study, to evaluate whether the products meet the needs of the users in an educational environment.

# User Studies

Kujala [2002] defines a user study as “a practical approach to user involvements for gathering user needs and requirement”. An increasing number of researchers agree on the fact that user studies are, by definition, about people, behaviour and contexts [Banwell and Coulson, 2004]. They need both quantitative and qualitative approaches to be combined to produce both a holistic view and the robust data needed to triangulate and thereby validate the collected data.

## User study rationale

This project involves a user study used to access the user's preference and opinions with regard to the netbooks. Kujala [2002] states that user studies contribute in identifying user requirements. User requirements are functions, constraints and properties that must be provided to satisfy the user needs. Similarly, Rogers, Sharp and Preece [2007] view user studies as an evaluation to check whether users can use the product and what they like about it. Users want interactive products to be easy to learn, effective, efficient, and safe to use. In addition, entertaining, attractive, challenging and enjoyable systems are of critical importance. Usability refers to how well users can use a system’s functionality and includes:

**Learnability**: this is evaluating how well the netbook supports both initial orientation and deeper learning. Jordan, Draper, MacFarane and McNulty [1991], define computer learnability as the amount of time and effort needed to reach a user peak level of performance with the system.

**Memorability**: this evaluates how easy it is to remember what you learned about the computer. Rogers, Sharp and Preece [2007] argue that a computer interface should be easy to remember such that a casual user is able to return to the system after some time of not using it, and use it again with no difficulties.

**Effectiveness**: is accuracy and completeness with which users achieve specified goals.

**Efficiency**: is the speed in which users accurately complete their task.

**Safety**: this is how safe it is to use the product. Health and safety risks exist for both adults and children from using computers. It is argued that computers should not be seen as toys but as items of electrical equipment to be treated with respect [Rospa, 2009].

## Approaches to user studies

There are different approaches employed in user studies namely: usability testing, field studies and analytic evaluation.

**Usability testing**: Usability testing is argued by Rogers et al. [2007] as a scenario where the test environment is controlled by the evaluator. Here, the usability of the product is of greatest concern and the users of the product do not under go any testing to evaluate their preferences. This approach makes use of controlled experiments. Data collection is mainly through interviews and the speed taken by the user to complete a task is usually of significant importance.

**Field studies:** Field studies are performed in a natural setting, allowing participants to naturally interact with the system. This approach is different from usability testing in that it follows the way people normally interact with the system. Data is collected through observing and interviewing users as depicted by Table 4 below. The advantages of this approach are that researchers get a better sense and more information from the research study [Rogers, Sharp and Preece, 2007]. Questionnaires and interviews are conducted in effective field studies.

**Analytic evaluation:** Analytic evaluation on the other hand includes use of heuristic evaluation and prediction of user performance. These are normally conducted where users are not easily accessible and experts have to do the evaluation of the system. This method can be very costly. Table 4 below shows the various methods used by these approaches.

Table 4: Methods used by different user study approaches [UWA, 2007]

|  |  |  |  |
| --- | --- | --- | --- |
| **Method**  | **Usability testing** | **Field studies** | **Analytical** |
| Observing | x | x |  |
| Asking users | x | x |  |
| Asking experts |  | x | x |
| Testing | x |  |  |
| Modelling |  |  | x |

# Conclusion

This chapter has described past research that has been undertaken in the field of ICTs in education. It has illustrated the importance of the integration of ICTs in education in developing countries. There seems to be a relationship between people’s level of development and their education, and it is hoped that access to facilities like ICTs in education will make significant contributions in the development of poor countries. Various types of netbooks have been developed to address some of the problems faced by the less privileged especially in the field of ICTs in education. These netbooks have varying hardware and software properties but the question is: are these netbooks of value within an educational context. Employing a user study, I will rely on the users to identify the features that they found beneficial in each type of netbook. Finally I hope that I will be able to provide insight regarding their use in the educational context of the previously disadvantage schools.

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