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THE USE OF ICT TO SUPPORT BASIC EDUCATION IN DISADVANTAGED SCHOOLS AND COMMUNITIES

A Review of Literature

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TABLE OF CONTENTS

Introduction 2
Information and Communication Technologies 3
ICT and quality in education 6
ICT and the teaching of science and mathematics 11
International Policy Environment 14
Use of ICT in Education in Asia and Africa. 16
South Asia 17
Sub-Saharan Africa. 20
The Rwanda Country Initiatives 27
Mainstreaming of ICT in basic education in Rwanda. 31
Conclusions and Way Forward 38

Introduction

This literature review was undertaken with a view to understanding three basic issues: (a) how information and communication technology (ICT) could buttress basic education in different regional contexts (b) how ICT facilitates the integration of marginalized schools and communities and (c) what research areas and priorities need to be focused on to facilitate the integration of ICT in basic education in low income countries. Attempts have been made to consult a wide array of literature and policy documents that could be accessed in Rwanda. To provide a comprehensive panoramic view of the use of ICT in basic education a comparative approach has been adopted for review and presentation of the findings. In this respect efforts have been made to draw on initiatives at the global, Pan-African and national levels. To provide concrete experiences, some country initiatives in Asia and Africa have been highlighted with a view to creating a context for the Rwandan in-country initiatives. In essence, this review exposes quite vividly the ICT problematic in Africa and particularly in Rwanda.

Questions as to the pursuit of ICT use and literacy at its present level of complexity still prevail. Can we in actual fact pursue ICT in its evolving state without considering the question of adaptability and the ability of the target population in low income countries to appropriate the use of the technology? Is there a fear that the present attempts in ICT use in its present form might flounder just as happened to the various development models and practices that have been adopted from the industrialized world? How can we problematize the issue of ICT use in Africa? Is ICT really a panacea for the teaching and learning challenges that the continent faces or is it a challenge in itself? Are there concerns that ICT might really replace the teacher and how can we empower the teacher to appreciate modern ICT as a tool for professional development and enhancement? These and similar questions arise in almost all discussions on ICT use in schools and communities. They also provide a basis for nascent inquiry into the use of ICT for basic education in low-income countries.

In whichever form ICT is adopted there needs to be a significant rethink as to the viability of the technology in specific cultural contexts. The rethink is aimed at attempting to connect the use of the technology to the community vision especially in consolidating the gains that the technology might provide with regard to adding value to the existing lifestyles. Most low income countries are in essence, and it can be so

emphatically argued, not sophisticated enough to fully absorb the array of gains that new technology can supply. The average lifestyle that is nurtured on less than a dollar per day characterizes more than 70% of the population in most of these countries. In terms of affordability therefore, the population is critically out of reach. The role of the state and the private sector therefore becomes imperative in ensuring accessibility and affordability and diffusion of the technology in a wider proportion of the population. The young population, being the majority population cohort in Africa, as such becomes a fundamental entry point for most technologies and acquisition of skills that are necessary for sustainability. The wide adoption of mobile technologies however puts some of these arguments into question. In Africa for example, East and Central Africa are the fastest growing markets in the sales of mobile telephony. Yet these countries experience some of the widest disparities in access to health and education (The East African, 30th April 2007).

Questions have been raised as to whether the adoption of ICT in low income countries is not a misplaced priority. With the prevailing poverty rates it has been argued that low income countries are better off resolving absolute levels of poverty than directing the "much needed" resources to the knowledge economy. Whichever comes first is a matter of populist discussion. What however is gaining currency in several fora and as a result of research endeavors is that ICT could play a crucial role in alleviating poverty and empowering especially marginalized communities, let alone infusing efficiency in organizational structures and processes. Issues to do with maintenance and sustainability however remain pertinent and as such there must be back up measures to ensure that users of the ICT gain value from the various technologies that are available.

Information and Communication Technologies

The notion of Information Communication Technology (ICT) is as old as mankind and has a long history. For as long as mankind has been in existence there has been a need to relay information and to communicate with a neighbor in the human society. The need to communicate and inform has assured the survival of mankind and hence the reality of the evolution of the tools that humankind needs for self-assertion and survival in society. Societal evolution and the need to communicate provide us with the urge to categorize ICT from two points of view: the old and the modern. This categorization brings to the fore the notions of technological complexity or simplicity, accessibility and use. Old ICT is still with us and is

considered to include those tools that facilitated the transmission of information and communication across the ridges and villages. In the African context we can hence not rule out the importance of the drum and horn, let alone the marathon runners who delivered messages from the chiefs and kings. With the inevitable technological evolution of society and the integration of various countries into the industrial age the tools of information and communication have also evolved and changed. These could include a wide variety of tools such as the pen, pencil, textbook, the post office, train and the car etc.

Today the concept of ICT conjures images of computer equipment and the Internet. Our conception of modern ICT partly concurs with the one held by Richard Gerster and Sonja Zimmermann (2005) who regard modern ICT as those

"technologies that facilitate communication and the processing and transmission of information by electronic means – digitalization therefore being not the criterion".[1]

The authors emphatically argue that ICTs facilitate the creation, storage, management and dissemination of information by electric means. UNESCO and FUTURELAB (2003) however, go a step further and provide a more comprehensive view of ICT. On its part UNESCO portrays ICT as a term used to describe

"the tools and processes to access, retrieve, store, organize, manipulate, produce, present and exchange information by electronic and other automated means. These include hardware, software and telecommunications in the form of personal computers, scanners, digital cameras, handhelds/PDAs, phones, faxes, modems, CD and DVD players and recorders, digitized video, radio and TV and programs like database systems and multimedia applications".[2]

FUTURELAB (2003) on the other hand argues that ICT embraces a range of technologies broadly concerned with information and communication. What constitutes the technology is similar to UNESCO's list but adds that these machines "may or may not be networked or have Internet".[3]

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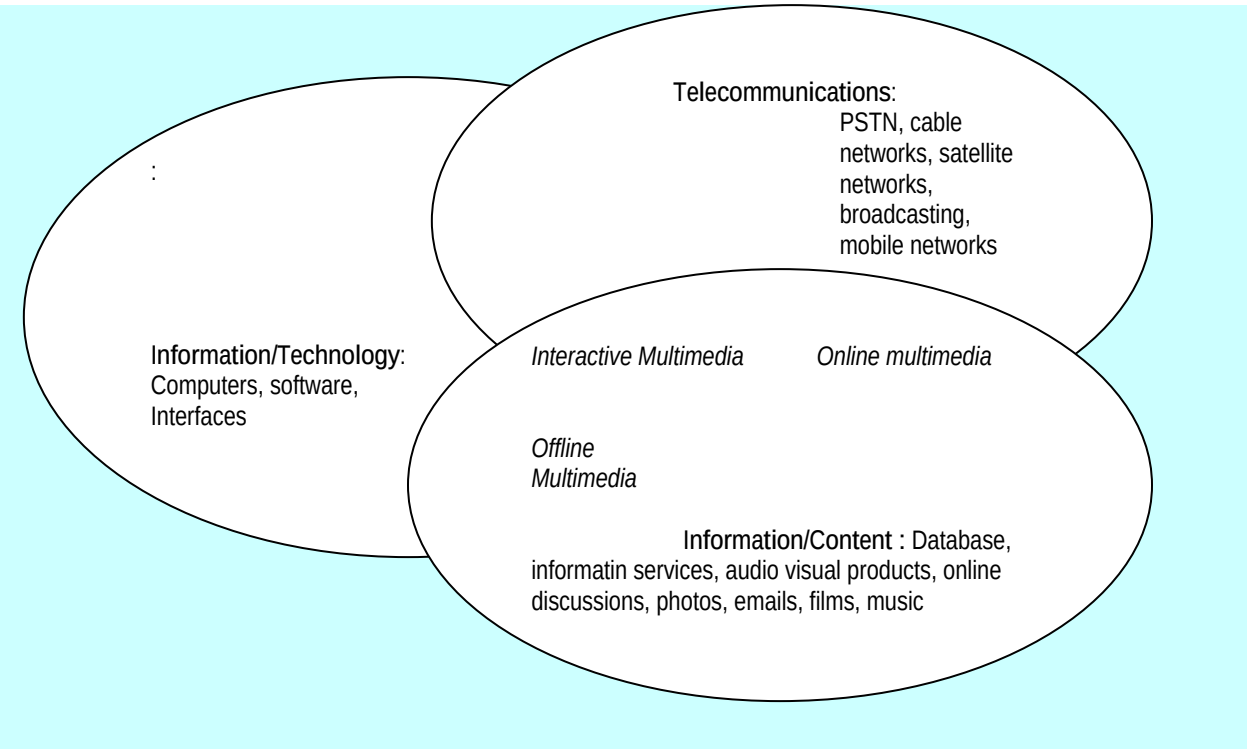
[1] Richard Gerster and Sonja Zimmermann (2005), Up-scaling Pro-poor ICT Policies and Practices – A Review of Experiences with emphasis on Low Income Counties in Asia and Africa. Swiss Agency for Development and Cooperation. URL:http://www.sdc.admin.ch/ict4d , p.7

[2] URL:http://www2.unescobkk.org/education/ict/v2_2/info.asp?id=14283. Piloting Testing Performance Indicators on ICT for Education in Asia Pacific. Accessed on 07.11.2005

[3] FUTURE LAB (2003) Literature review in Primary Science and ICT, Grdauate School of Education, Queens Universitym Belfast

In this regard ICT is a broad term that comprises digital as well as analogous techniques that impact and influence the lives of an increasing number of people and emerge as important tools in the drive towards efficiency and in efforts towards industrialization and establishment of sustainable "knowledge based economies". This recognition has led to the adoption of ICT as a "crosscutting issue" in the development of many sectors in national economies (see Vision 2020 Rwanda, Vision 2030 Kenya).

A more comprehensive view of ICT is one advanced by Jeny Leach, Shumi Makalima, Kim Porteus, Rhodri Thomas and Nomakholwa Tshumi (2006) in the article which carries the question *Is There a Role for Information and Communications Technologies In Rural Schools and Their Communities*? They argue for an integrated view of ICT in which one 'emphasizes the intersection of information technology, information/ content and telecommunications enabling new forms of knowledge production and interactivity". This view is captured in the figure below and argues that ICT should be underpinned by the ability to facilitate interactivity. .



Source: Leach et, 2006, p.7 at http://www.open.ac.uk

According to the authors this is a common way of understanding ICT but which may be far removed from the common understanding among rural folk. The efficacy of this model in the rural and marginalized

contexts is thus debatable when one considers the question of infrastructure, accessibility and spread of the ICT language. It is this context of definition that brings to the fore the arguments against ICT especially in developing countries. The viability of ICT has as a result been critiqued by the authors on three fronts.

- That the dominant discourse about ICT is influenced and reflects 'business' interests
- This discourse has pervaded the imagination of even extremely marginalized communities who have come to believe that ICT is the bridge to good and therefore quality education
- ICT in education has been understood to mean computers and computer labs in schools and this has contributed to the "computer tragedy" that we observe in most schools today (see also FUTURELAB 2002, Report 2, page 21-36 on using computers to teach thinking skills).

The adoption of ICT in the developing country contexts therefore has to put into consideration the social structure that emerges as a result of introduction of ICT, the development of a consciousness amongst educators and earners that ICT facilitates active thinking and participation in local and global contexts, bridges physical spaces by facilitating relationship and enables the development f human capital. These contribute widely to the widening of 'horizon of knowledge' and to the acceptance of ICT as a means of creativity and expression. The lack of this consideration will further widen the digital divide that has been identified between rural and urban areas and the industrialized and low income countries.

ICT and quality in education

The use of ICT in education has been recognized the world over (see Leach 2005, the DEEP IMPACT report). Its alleged potential for transforming the thinking and practice in education in developing countries is even greater considering the high level of inequalities that exist therein and the need to bridge the existing divides. In this context, it has been recognized as a tool for improving accessibility and improving the relevance and quality of education. In the DEEP IMPACT Report (2005) the use of ICT in teaching and learning and reaching out to marginalized communities is addressed. Dhanarajan (2001) on the one hand is quoted as having stated that "if applied with thought, extreme sensitivity and knowledge … ICT offers a means to extend access to education and training to the knowledge poor, the unreached, the isolated and those who have been ignored for too long". On the other hand Pontefract is also quoted as cautioning the broad based acknowledgement of the role of ICT in education and training. He states that effective use of

ICT must be linked to the specific needs of developing countries and desist from the 'one size fits all' approach (LEACH 2005:112).

The use of ICT is not entirely new in Africa or Asia. For quite some time since the early 1960s radio and, in a couple of countries, television has been used to reach out to large number learners and had as such initiated a revolutionizing effect in our understanding of teaching and learning and the classroom that early. For example, the school broadcasts were very popular with teachers and learners in the rural areas of Kenya until the late 1980s. The onslaught of modern technology and its adoption in the education setting has accelerated further our perception about education and how it can effectively be delivered in the 21st century. In turn it has introduced a challenge with regard to sealing the emerging divide between information rich and information poor communities. Within developing countries it has in particular introduced new challenges related to internal digital divides. The World Bank (1998), nevertheless, is of the view that

"ICTs greatly facilitate the acquisition and absorption of knowledge offering developing countries unprecedented opportunities to enhance education systems … One of the greatest hardship endured by the poor and by many others who live in poor countries is their sense of isolation .The new communication technologies promise to reduce that sense of isolation and to open access to knowledge in ways unimaginable not long ago".[4]

The use of ICT in education is hence premised on the fact that it makes it possible to transcend space and time in the teaching and learning process. This enables education providers to access learners in remote places. It also allows learners to access learning resources at a distance and at their own time. The geographical and socio-cultural peculiarities in most developing countries dictate that more innovative ways of teaching and learning ought to be established to reach out to a greater number of people. This is more crucial considering the cost implications of putting up physical buildings to serve an educational and information hungry population. In addition, quite a number of children and adults live through their lives without satisfying their urge for knowledge. ICT as a tool for information delivery has to be exploited to achieve universal knowledge let alone meeting the MDG of universal basic education.

[4] The World Development Report, 1998/99. Quoted in Tonio, V. ICT in Education, p.6.

In this context, ICT has a crucial role in preparing individuals in school and the work place. According to the North Central Region Education Laboratory the workplace on its own will tend to play a leading role in influencing the education systems to facilitate the acquisition of relevant skills that buttress the development process in the prevailing economic and information order.[5] The skills to be attained have an ICT bias and will have to be facilitated by embracing ICT in the modern world. These skills include:

- Digital age literacy - that comprises functional literacy, scientific literacy, technological literacy, information literacy, cultural literacy, and global awareness.
- Inventive literacy – that includes adaptability, curiosity, creativity and risk taking.
- High order thinking – that includes creative problem solving and logical thinking that results in sound judgment.
- Effective communication - that comprises teaming, collaboration, and interpersonal skills personal and social responsibilities, interactive communication high productivity.

The improvement of the quality of education is further discerned in the use of ICT particularly as a learner–centered tool, instead of the traditional pedagogy that has been mundane in the industrial age and which tends to be disempowering in most instances. Thijs, *et al* in their article *Learning through the Web*[6], state that ICT tends to

- Motivate learners by combining text, sound, color and moving images that enhance content for easier learning
- Facilitating acquisition of basic skills through drill and practice. This is better accomplished by education television broadcasts that teach literacy and numeracy at basic education level
- Enhancing teacher training by improving access to and the quality of teacher training.

They argue that ICT creates a learner-centered environment especially by facilitating what Haddard and Draxler categorize into five levels of technology use[7]. These levels are presentation, demonstration, drill and practice, interaction and collaboration. These levels enable the learning process within the context of

[5] Quoted in Tonio, ICT in Education, p. 7. URL: http://www.ncrel.org/engauge/skills/21skill.htm Accessed on 14 November 2005
[6] Quoted in V. Tonio, ICT in education, p. 9. URL:http://www.dedidenet.nl/publications/webbasedlearning.pdf Accessed November 14 2005
[7] Refer to Tonio, V, ICT in Education , p. 11

new pedagogy for the emerging information society. The learning process is characterized basically by the following aspects:

- Different activities whose pace is determined by learners learning in small groups
- Collaborative and heterogeneous groups learning as a team and supporting each other
- Emphasis on creative and productive learning based on finding new solutions.
- Integrating theory and practice and establishing relationship between different subjects. The subjects converge on thematic areas that call for collaboration within a team of teachers.
- Evaluation is student directed and is diagnostic.

These aspects are learner-centered and diametrically diverge from the traditional pedagogy that is individualistic, teacher and discipline centered, and summative. For developing countries these aspects pose a real challenge in the sense that in most geographical areas there is a conspicuous lack of infrastructure that can support a deliberately planned ICT policy. More resources are required to supply not only power but also the human capacity that would be able to productively use the few ICT resources that may be availed to various schools. The other challenge is whether developing countries have the culture that can easily adapt to the fast moving technological world. Most authors tend to focus on the need for appropriate technology as a solution to the problem of inadequate access to modern ICT.[8] However, there is a real danger that even this type of thinking might generate a digital divide that most ICT planners are wont to seal. Gerster and Zimmermann (2005) are also of the view that appropriate technology is the solution to most problems associated with cost and access. They, however, prefer a combination of complementary technologies such as radio and Internet in areas where reliance on the Internet alone would exclude a disproportionate number of people.[9]

Haddad and Draxler (2000) point out that the current ICT innovations have to be integrated within the school system in which a "new school paradigm" is being considered. This paradigm captures and divorces the conceptualization of a school system from the traditional perception. They argue that there has to be a paradigm shift in the way we perceive a school, a classroom, a teacher and teaching aids. A school will, therefore, not just be regarded as a building but as a knowledge infrastructure consisting of laboratories,

8 Willem J. PELGRUMAND Nancy Law, in their book edited ICT in Education around the world: trends problem and prospects, 2003. Paris UNESCO, p. 105-122. See also Neil Butcher, Technology Infrastructure and use of ICT in Education in Africa: An Overview,2003,Paris, Association for the development of Education in Africa,p61.

9 Gerster and Zimmermann, Ibid. 2005, p.7

radio, television, Internet, computer, museums, etc. A classroom can in a sense facilitate individual learning, which can be fused into collaborative learning with others at a distance. A teacher will no longer be the sole provider of knowledge but will be expected to play the important role of tutoring and facilitating the acquisition of knowledge by learners .The reliance on textbooks will have to be rationalized by integrating multimedia materials including print, audio, video, and digital aids in the teaching and learning process.[10]

The real challenge for educationist is, therefore, how to harness the potential of ICT to complement the role of a teacher in the teaching and learning process. Learners will also be challenged to incorporate ICT into the learning process so that the experience of learning becomes interesting and motivating. In this vein ICT has a special place in making education relevant, responsive and effective for anyone, anywhere anytime.

Fear is normally expressed as to the role of a teacher in an ICT equipped classroom (Futurelab 2003). Of course the fear is not misplaced. Teachers that do not have a chance to develop professionally in the use of modern ICT are more under threat than those that have an opportunity to acquire modern computer literacy and skills. The relevance of a teacher in the 21st Century will be determined by the will to develop professionally. In this case teacher development, according to MacDougall and Squires (1997), should focus on the following aspects in pre-service and in-service training programs[11]:

- ICT skills with particular applications
- Integration of ICT into existing curricula
- Curricular changes related to the use of ICT including changes in instructional design
- Changes in teacher role in the face of ICT
- Underpinning educational theories

These foci will prepare the teacher to handle the learner centered processes of education in which s/he will be expected to play the role of facilitator, mentor and coach. The teacher will have to become less authoritative in class and guide the learners on how to

- Ask questions and pose problems
- Formulate hypotheses

[10] Haddad W.D and Draxler, A (2002). Technologies for Education. Paris. UNESCO and the Academy for Educational Development

[11] See Blurton, C., New Directions f ICT Use in Education, 1997, p. 29

- Locate information and then critically assess the information in relation to the problems posed.

This experience is also a learning experience for the teacher, as it will involve discovering new things along with the learners[12]. We do not rule out the capacity of the teacher to traditionally teach all the above competencies and skills. However, it is our considered view that the teacher will be more effective when s/he is given an opportunity to integrate ICT in the teaching and learning process.

ICT and the teaching of science and mathematics

The teaching of science should, among other things, develop in the learners those skills that focus on team working, creativity, innovation and learning how to learn. In particular, primary science should employ methodologies that not only provide knowledge but emphasize the effect of the scientific methods on the individual child. In this respect the methodologies should be *child active* (developing both manipulative and mental active) and *child focused* (concentrating on an aspect of the world the child experiences and in which the child can display an interest). The debate however has also focused on how these two could be achieved especially on the choice between "*hands on* or *minds on* methods or using both (FUTURELAB 2003 Report 5, p.2)[13].

How can ICT be used to improve the teaching of science at the basic education level? FUTURELAB (2003) argues that

> "ICT can support both the investigative (skills and attitudes) and more knowledge aspects (concepts) of primary science. The more recent approaches to science learning particularly the social constructivist methodologies highlight the importance of verbal as well as written communication as being vital for children to construct meaning. ICT use can greatly enhance the opportunities for children to engage in effective communication" (p.6).

The constructivist methodologies, adopted from psychology and philosophy, assume that learners must be engaged in the construction of knowledge based on what they already know. How to engage several

[12] World Links for Development: Telecollaborative Learning Projects. Training Manual, June 2001.
[13] [13] FUTURE LAB (2003) Literature review in Primary Science and ICT, Grdauate School of Education, Queens Universitym Belfast

learners to actively participate is however challenging for the teacher. The use of ICT nevertheless will support investigation, referencing for the teacher and the learner, communication among learners and between them and the teacher, and exploration of issues in the discipline being taught and learnt.

In two of the literature review reports from NESTA FUTURELAB (2003, Report 6 and Report 5) it is expressed that the linkage between ICT and the teaching and learning of science education is inextricable. ICT provides the tools that make teaching and learning of science motivating and interesting. Such tools include tools for capture, processing and interpretation (data logging systems, databases and spreadsheets, graphing tools, modeling environments, multimedia software for simulation of processes and carrying out virtual experiments, information systems, publishing and presentation tools, digital recording tools, computer projection technology and computer controlled microscope (see Report 5, page 23-32). The author argues that such tools "enhance both practical and theoretical aspects of science teaching and learning. They in part

- expedite and enhance work production from manual process and hence allow the teachers and learners more time for thinking, discussion, and interpretation
- increase currency and scope of relevant phenomena by linking school science to contemporary science and providing access to experiences not otherwise feasible
- support exploration and experimentation by providing immediate visual feedback
- focuses attention on overarching issues, increasing salience of underlying concepts
- fosters self-regulated and collaborative learning
- improves motivation and engagement

The author, however, laments that the processes are constrained by

> "lack of time (on the side of teachers) to gain confidence and experience with technology, limited access to reliable resources, a science curriculum overloaded with content, assessment that requires no use of the technology and a lack of subject specific guidance for using ICT to support learning" (FUTURELAB 2003:5).

Central to all these processes, therefore, is the role of the teachers who operationalize the curriculum and the techniques to implement it. The report argues that under all circumstances teachers must be brought on board. "We need to acknowledge the critical role played by the teacher, in creating the conditions for ICT

supported learning through selecting and evaluating appropriate technological resources and designing, structuring, and sequencing a set of learning activities" (Report 6, 2003, p. 1-6).

Ros Sutherland in *Teaching for Learning Mathematics* (Open University) ponders over the purpose of learning mathematics by the youth and whether ICT could facilitate the learning process[14].

> "Young people learn mathematics at school to educate them in some way for life outside school. This education has many possible purposes. It could be about learning to become informed citizen. It could be about learning to appreciate the ways in which mathematics plays an increasingly important hidden role in the life of the twenty-first century, for example in the growing computer games industry. It could be about education for the world of work. It could be about education for higher education after school. Or it could be about education for everyday life. These possible purposes relate to different mathematical practices, different ways of knowing mathematics, different mathematical objects, technologies and symbols and different ways of being empowered by mathematics".

Sutherland advances a case for ICT in mathematics and gives vivid scenarios in which learning improved among learners who previously were considered "slow learners". In *Digital Tools for Leaning Mathematics* she emphatically states that "mathematics was one of the earliest subjects to make use of the computer in the classroom" especially the first digital computers which were developed to solve differential equations. For a long time she has been "convinced that computer programming could provide a valuable way into learning mathematics". She illustrates the experiences of two students who enjoyed mathematics in lower primary because of the access they had to Logo and Basic. She is further convinced that computers enable young learners to experience mathematics and use them in peculiar ways. This interest in using computers as tools for learning should hence be carried forward to further levels of the secondary school sub-system so that learners do not despair and later lose the motivation to discover and experiment with mathematical ideas. What arises also from the literature is that young learners tend to experiment with computer programmes at home and expect these to be developed further at school. These include the use of spreadsheets, BASIC, *et al*. However, the author argues that this is not always the case. "Teachers need support in order to take the risk of beginning to use ICT in the classroom, especially when they are working with high stakes assessment systems" (page 67).

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[14] FUTURELAB (2004) Literature review in Informal Learning with Techno logy Outside School, WAC Performing Arts and Media College. Report 7.

International Policy Environment

To what extent has ICT been recognized and appreciated as a tool for improving the quality of education? At the international level there are quite a number of initiatives, which, as much as possible, highlight the importance of ICT in education and development. The magnitude of success the international initiatives have had at the local level is debatable. What one can postulate, however, is that they provide the framework through which other initiatives can be formulated and implemented. These initiatives can be differentiated from those international initiatives that are fronted by the private sector or other non-governmental organizations. The initiatives that have been fronted by the international community especially at the United Nations level are two. The Jomtien and Dakar Framework address the issue of Educational For All (EFA). EFA was especially emphasized in its 1990 and 2000 conferences in which it was stated that

> "Basic education should be provided to all children, youth and adults. To this end basic education services of quality should be expanded and consistent measures must be undertaken to reduce inequalities".[15]

To facilitate the teaching and learning process in all schools the Jomtien and Dakar declarations were more emphatic as far as ICT is concerned. In Article V of the World Declaration on Education For All it is emphasized that

"all available instruments and channels of information, communications, social action could be used to help convey essential knowledge and inform and educate people on social issues. In addition to the traditional means, libraries, televisions, radio and other media can be mobilized to realize the potential towards meeting the basic educational needs for all"[16]

The Millennium Development Goals (MDG) of the United Nations Organization also provide a basic reference in terms of mainstreaming ICT in education and development[17]. The MDGs do not expressly indicate the role of ICT in meeting each of them. In particular MDG 2 provides the target of ensuring that by 2015 all children (boys and girls) will be able to complete primary education. The *will* to do is left to the

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[15] URL:http://www.unesco.org/education/efa/ed_for_all/ Accessed on 20.11.2005
[16] URL:http://www.unesco.org/education/efa/ed_ed_for_all. Ibid
[17] See the United Nations and Republic of Rwanda Status Report 2003, Millennium Development Goals, p. 5

discretion of the individual states. For example, Rwanda's progress towards reaching MDG 2 is highlighted in the context that there are currently 2000 primary schools serving a total of 1,5 million children. Gross enrollment has overshot 103% and it is envisaged that full enrolment will be achieved by 2010. However, it recognizes major challenges, which include among others "accelerating measures aimed at systematically seeking out and enrolling children who are not in school (in effect the poorest and most vulnerable members of the society)[18].

In MDG 8 the United Nations envisages a situation whereby all countries of the globe would develop close partnerships for development. In the Rwandan context it is spelt out that the country would ensure that the advantages of Information and Communication Technologies are available to all. How these noble intentions can be achieved is a basic challenge for all countries especially in the developing world, considering that in most of these countries the problem of basic educational infrastructure still lingers on amidst pressing challenges of meeting more pressing survival needs.

There are over 16 global initiatives whose focus is to address the emerging digital divide on the continent and within individual countries. Of interest we refer to only three[19].

- *Catalyzing Access to ICT in Africa (CATIA)*

  This is an initiative that enables poor people to gain from ICT and acts as a catalyst for reform through radio and Internet especially. In its practical interventions it supports the purchase of low cost computers and open source software in Africa. It also supports a stronger network of community radio, FM and public service radio stations across Africa, offering good pro-poor programs, among others[20].
- *Global E-school and Community Initiative*

  This is an initiative that tries to use ICT as a tool for improving quality in education. It envisages the connection of schools on the continent as well as addressing the problem of human capacity in ICT. It tries to empower local communities through capacity building and access to information. It is currently represented in Ghana and Namibia and programs its activities according to the following criteria[21]:
    - The initiative must be based on the needs and interest of the local communities
    - A concrete plan of action with measurable goals and milestones is needed

[18] UNO and Republic of Rwanda, Status Report 2003, p.5-*+
[19] Refer to Mkusanyiko on School Networking. A Product of the SchoolNet Africa's African Education Knowledge Warehouse, May 2004.
[20] Website: http://www.catia.ws

- Innovative funding options based on private-public partnerships are needed
- Building on, linking to and supporting – rather than duplicating – existing efforts is essential
- Efficient and transparent governance process are essential

- *Leland Initiative- Africa Global Initiative*

  This is an initiative that tries to facilitate Internet access through 20 countries on the African continent. It builds on the existing capacity with the ultimate aim of facilitating Internet access throughout each country. It specifically aims at achieving the following objectives

  - Improving access by Africans to people and information for sustainable development
  - Improving connectivity within Africa
  - Enhance African ability to find solutions to African problems
  - Making African-produced information available in the world.

  In its school to school program it tries to facilitate cross cultural dialogue and joint projects between primary and secondary schools in countries where the initiative is active. The initiative is represented in almost all corners of the continent[22].

The impact of these and many other initiatives on the continent begs to be seen. Their impact on the local level is still unfelt. There is also the problem of coordination in that most of these initiatives are proposed singly and could have very little local impact in terms of empowering the youth for participation in the current knowledge and information society.

Use of ICT in Education in Asia and Africa.

Africa and Asia have a lot in common but significant gaps exist in the magnitude of adoption of technologies especially in education. In this section we highlight a few initiatives that have been put in place to integrate ICT in the teaching and learning process.

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[21] Refer to its global website: http://www-wbweb4.worldbank.org/disted/

South Asia

A general view on the use of ICT in education is provided by Victoria Tonio in her work *ICT in Education*[23] In the paper the author reiterates the role ICT can play as a tool for qualitative transformation in education. She traces the use of ICT in the promotion of quality of education in Asia and argues that quite a number of countries in Asia have increasingly relied on radio and TV broadcasts since the 1980s. These media have essentially been employed in:

- Direct class teaching, where broadcast programming substitutes for teachers on a temporary basis.
- School broadcasting, where broadcast programming provides complimentary teaching and learning e.
- General educational programming over the community, national and international stations which provides general and informal education opportunities.

In Asia direct teaching and learning using radio and television was started in Thailand in 1980. Indonesia, Pakistan, Bangladesh and Nepal started theirs in 1990. Through Interactive Radio instructions (IRI) lessons are conducted for 20-30 minutes daily. According to Tonio
"the radio lessons, develop around specific learning objectives at particular levels of mathematics, science, health and languages in national curricula, are intended to improve the quality of classroom teaching and to act as a regular and structured aid to poorly trained classroom teachers in under-resourced schools"[24].

The replacement of these media cannot be discerned in the foreseeable future. They form a base for reaching the under-serviced communities and schools in the poor countries of Asia. The emerging technologies will, therefore, have to be integrated in the traditional technologies so that a wider population is easily reached and at their pace of technological adaptation.

Ian Pringle and M.J.R David provide an analysis of the benefits derived from using integrated ICTs in promoting basic education and reaching out to marginalized communities in Asia. In their paper *Rural*

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[22] See the Leland Initiative: Africa Global Information Infrastructure Project. Accessed at URL:http://www.usaid.gov/regions/afr/lelnad/

[23] This is an internet publication, being a set of primer on the application of information and communication technologies to development. The primers are produced by the UNDP'S regional projects in Asia and Pacific and cover a wide range of key topic of special interest to ICT and development. See http://www.eprimers.org.and http://www.apdip.net.

[24] Victoria Tonio, ICT in Education, a primer presented by the UNDP for the benefit of participants to the World Summit on the Information Society in Tunis.

community ICT Application: The Kothmale model[25] they provide a glimpse into the role ICT can play in creating general awareness, inculcating skills in various domains and improving access by the marginalized rural communities to new technology in Sri Lanka and elsewhere in South Asia. They discuss an ICT initiative that was borne out of the realization that rural people have been left out of the benefits of new technologies and hence the consequent widening of the "digital divide" within countries. In fact according to the authors rural people "have no foothold in the revolution that ICTs are ushering in", p.7.

With the support of UNESCO, a radio-internet project was started in the region of Kothmale in Sri Lanka. The project was a pure ICT application in marginalized rural communities of 200,000 people of 50 villages and 17 schools. The project incorporated simultaneous radio and Internet use, a process that has been described as *radio webbrowsing*. They state that radio webbrowsing by the villagers was
"an innovative tool that has been successful not only in addressing information needs but particularly in terms of raising awareness, a factor that the project has correctly identified as a prerequisite to addressing information needs through access or content development" p.5.

In the Kothmale project the authors state that the (radio) programmers
"browse the Internet live on the radio using a computer in the studio. The content of each program focuses on specific information within a different topic: health, legal issues, and ICTs themselves. Staff, volunteers and guest experts provide interpretation and translation of the web-based information for the local audience", p.5.

They argue further that the Kothmale experience in ICT application for marginalized and rural communities in Sri Lanka has proved the inherent ability of local residents with no prior computer or Internet experience to master basic and even more advanced skills while using new technologies.[26] The fact that marginalized communities are usually denied access to modern technologies does not rule out the fact that they have the capacity to use new knowledge in a participatory form to change their rural lives. In this case, a

[25] This paper can be accessed at URL:htt.www
[26] Victoria Tonio states that ICTs do not necessarily have to be used in isolation. They could be used in combination as evidenced by the Kothmale Project. She states that the Kothmale Community Radio uses both broadcast and computer and internet technology to facilitate the sharing of information and provide education opportunities in a rural community in Sri Lanka. Log on URL:http://www.eprimers.org and http://www.apdip.net for more information and a variety of others sources on application of ICT in development.

combination of various forms of ICT can empower marginalized communities to participate in the national and global economic, social and local networks that have local impact.

The Chinese initiatives in the use and accessibility to modern ICT by schools and communities is typical of many Asian countries. According to the Education Week, an American Online Newspaper of May 6th 2004, the metropolitan areas in the East and South-East of China are generally decades ahead in school technology access and integration, compared with underdeveloped areas. It points out, for example, that in the southern coastal province of Guangdong,

"many middle and high school students surf the Internet on the latest wireless laptop computers, send text massages to their friends on personal cellphones and download class lessons from their school websites"[27].

However, the situation in the rural west is worse due to scarcity of learning technology and supplies. It points out that

"Schools often lack enough teachers, supplies, and up-to-date textbooks – never mind computers and the Internet's information highway. And because of their nomadic status, hundreds of thousands of migrant children in the rural west are shut out of school altogether".[28]

The scenario is repeated all over Asia. However, South Korea, Indian Singapore and Taiwan have succeeded in integrating ICT in school programs while countries like Vietnam, Laos and Mongolia are still decades behind. According to the Education Week, the better off countries have formulated comprehensive national master plans to install high speed computers in schools, train teachers to support their lessons using technology and encourage students to conduct online research, build websites and develop online projects. South Korea, for example, integrated computer technology in all its schools in 1996 and founded EDUNET, an online education service that by 2003 had over 5 million registered users in the country. In 2002 all South Korean primary and secondary schools had been connected to the Internet and the student to computer ratio stood at 9:1, one of the lowest in the world.

[27] 12 URL: http://counts.edweek.org/report/tc04/article.cfm?slug=35asia.h23
[28] Ibid. p.1

In 1998 India, through its master plan, introduced what it called hightech "smart schools". In 2001 it also introduced "computer literary programs in 10,000 schools, computer aided learning in 1,000 schools and more integrated use of computers in academic work in 100 smart schools".[29]

Japan's example is even more elaborate in terms of manipulation of ICT in the learning process, although it is presumed to fall behind South Korea and Singapore. According to the Education Week,

"In Japan students in some primary schools head outside for their science lessons. Armed with personal digital assistants or mobile computing devices they take digital photos of plants and insects, record their measurements and location, then upload the research and images onto a website that other schools can use"[30]

The integration of ICT in schools was further developed when the country started a one hundred School Networking Project in which more "43,000 schools started using computers for collaborative student learning as well as for basic research and online interaction with other schools and education organizations"[31].

These initiatives prove that ICT is indispensable in education and especially in reaching out to the marginalized communities and schools. Irrespective of the dearth in resources in most developing countries the reality of jumpstarting technology in schools and far-flung areas has to be felt.

Sub-Saharan Africa.

There are seven concrete Pan African initiatives that can be considered to be in the forefront of mainstreaming ICT in African schools and communities[32]. These initiatives include the following

- *African Learning Network*

[29] Ibid, p.2
[30] Ibid, p.5
[31] Ibid, p.5
[32] See Mkusanyiko on School Networking. URL:http://www.schoolnetafrica.com

The African Learning Network (ALN) aims at bringing about a shift from traditional teaching and learning methods to modern ones[33]. It attempts to facilitate young learners to share information across the geographical divides on the continent by using radio, video, computers and the Internet. It has three major pillars, two of which are:

- ICTs in schools and the creation of a regional SchoolNet Africa structure that supports national and regional school networking activities and
- OOSYNET, a youth networking initiative that addresses the needs of out-of-school youth at both national and regional levels.

The ALN engages in three layered activities within the above pillars:

- Curriculum development and access to information for learning
- New learning approaches and outcomes
- Knowledge sharing and building intellectual capital
- Program sustainability and revenue collection

- *Africa Youth Initiative*

This initiative aims at bridging the digital divide by using ICT to address the continent's problems. It is represented in ten African countries. It has piloted CatchITYoung in Ghana[34].

- *NEPAD e-school Initiative*

The NEPAD e-school Initiative is a continent-wide initiative that aims expanding access and raising the quality of education in African schools. It is a brain child of the African Union e-Commision which aims at developing computer literacy in African pupils through equipping African schools with appropriate information and communication technologies, equipment and apparatus which enable them to participate in the information society. At the base of this NEPAD initiative is the goal of ensuring that African youth graduate from primary and secondary schools with skills that will enable them to function effectively in the information society and knowledge economy.[35]

- *SchoolNEt Africa*

[33] Website: http://www.uneca.org/aisi/aln.htm
[34] Website: http://www.ayinitiative.net

SchoolNet Africa has a presence in 30 Africa countries and aims to promote computer literacy through ICT use in all African schools.

The mandate of these initiatives point to one realization that the majority of school-going children in sub-Saharan Africa are disadvantaged in terms of accessing ICT-led quality education. Since the majority of the children live in rural areas the likelihood that they may get a decent and quality education is very thin.[36] This is further depicted by scanty statistics on the use of ICTs in education. However, the little that is available provides quite an array of efforts so far made on the extent of ICT use and the need to intensify the integration of ICTs in education. Neil Butcher (2001) in his book entitled *Technological Infrastructure and Use of ICT in education in Africa: An Overview* provides statistics on the general penetration of ICT in Africa. Of the 818 million people in Africa

- 1 in 4 have a radio
- 1 in 13 have a television
- 1 in 35 have a mobile
- 1 in 40 have a fixed line telephone
- 1 in 130 have a personal computer
- I in 160 use internet
- 1 in 400 have a pay TV

These statistics portray a picture of a generally low level of ICT use and penetration in Africa. Of course there are differences in individual countries whereby we encounter regions within countries that have their own local digital divides. It is hopeful, however, that ICT infrastructure continues to be built and the level of modern ICT appreciation continues to rise. According to African Connection (2002) there is a very strong demand for "basic voice communication" in rural Africa. This saw the growth in mobile growth telephony to 24 million subscribers by 2001. This is of course an underestimate since mobile telephony is one of the high growth industries in sub-Saharan Africa. The number of fixed lines is also increasing irrespective of the costs of installing the infrastructure and the accompanying maintenance. African Connection estimates that there were almost 13 million lines in Africa but by 2001 they had risen to 21 million.

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[35] URL:http://www.nepad.gov.rw/index Accessed on 20.11.2005

[36] Dan Wagner, Bob Day and Joseph provide a case for ICT in promoting literacy amongst the poor. See their report: Information Technologies and Education for the poor in Africa, 2004 : A Report of the Imfundo: Partnership for IT in Education . DFID. Accessed at http//www.schoolnetafrica.net/fileadmin/resources/ITEPA01.pdf

South Africa, African Connection states, has the highest penetration of radios on the continent with 316 radios per 1000 people and over 17% of its schools have access to a computer. In fact in Western Cape Province alone almost 100% of its schools have computers and Internet connectivity. Egypt has the highest percentage of computers in schools standing at slightly over 31%. In Mozambique only 20 schools have access to a computer. In Ghana slightly over 1% of its population has access to a computer and 24% have access to a radio. In Ethiopia 9 out of 12000 primary schools and 10 out of 424 secondary school had access to Internet by 2001.

Basing on this picture of ICT infrastructure and use Neil Butcher prefers that national policy focuses on providing appropriate ICTs for a given environment rather than making the focus of ICT and education efforts on computers *per se*.[37] He also points out that Africa suffers from typical infrastructure cases that include

- Insufficient funds
- Insufficient numbers of computers
- Lack of computer literacy among teachers
- Lack of subject teachers trained to integrate computers into learning areas
- Absence of properly developed curricula for teaching computer skills

The above problematic is atypical to South Africa, following research done by Lundall and Howel (2000).[38] The authors argue, however, that the problem can also be applied generally to the whole of the continent. Furthermore, Isaacs (2002) argues that Internet access infrastructure is still underdeveloped in most African countries[39]. He identifies the key problems to comprise

- Lack of infrastructure generally and network infrastructure in particular
- High telephone and internet costs
- Limited expertise and ICT skills

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[37] Butcher ibid p.61

[38] Lundall, P. Howell, C (2000). Computers in Schools. A National Survey of information and communication Technology in South African schools. Cape Town , Educational Policy Unity, University of Cape Town

[39] Isaacs, S(2002) . ICT in African schools: A Multimedia Approach to enhancing learning and teaching TechKnowlogia, January-March, 4(1) p.3-34 Referred to in Butcher , Ibid 2003

- Lack of an enabling environment

In this context, therefore, he postulates that
"It is necessary that other technologies and resources such as radio, television and print media should not come to be seen as less important than computers and the Internet. These media will continue to play a fundamental role in provision of educational resources to learners"[40]

There are specific initiatives that have been tried in the use of ICT in education, a number of which can be described to have been relatively successful. Like Asia, radio and Interactive Radio Instruction (IRI) have been widely used in primary and secondary schools in Africa. According to Murphy *et al* (2002) IRI is the most preferred since it

- Provides instruction to learners particularly in subjects that are ineffectively taught.
- Covers the whole curriculum which is well structured to allow students to respond and participate in the teaching and learning process
- Uses entertainment to engage and motivate students

IRI has been effectively used in Ethiopia, Kenya, Lesotho, South Africa, Cape Verde Guinea, Zambia and Tanzania. Let us look at a few of the initiatives from a number of African Countries.

In Guinea, the IRI was started as an interactive student and teacher radio program to serve all classes in basic education. The show dubbed *Under the Kapok Tree*, teaches language, mathematics, science, community health and childhood development to all learners in basic education. To complement the radio programs wind-up radios, teacher's guides, activity books, posters and science kits are supplied to all schools. Neil Butcher points out that
"while the show is being broadcast teachers usually follow the instructions of the radio teachers directing children to sing songs, answer questions and manipulate objects, draw pictures, move physically and work in small groups to solve problems"[41]

[40] Butcher, Ibid p62
[41] Butcher, op.cit

In Zambia IRI has been used to reach out-of-school children especially orphans and vulnerable children. It provides access to education for children who do not have schools and teachers and who are increasingly exposed to the impacts of HIV/AIDS and poverty. This was a program initiated through the collaboration of the state and NGOs. In this program 30-minute lessons for lower primary are provided everyday and emphasis is on learning mathematics, English and life skills

Cote d'Ivoire experimented with Educational Television to solve the inequalities that existed between urban and rural education and to contribute to quality teaching and learning in the classroom across the country. The initiative, however, collapsed due to lack of consultation between the major stakeholders and heavy reliance on expatriate resources. The project lacked goodwill and sustainability safeguards. In its short life, however, it had impacted on education quality in that more primary students who followed the program reached Grade 6 as opposed to those who relied solely on traditional teaching and learning approaches. It also reduced repetition rates from 30% to 10% and improved spoken French at primary school levels.

Swaziland started an initiative to supply computers to schools under a program called Computer Education Trust. Although quite a number of schools received the computers and teachers were trained in their use, the initiative suffered from lack of a steady reservoir of capacity to run and maintain the computers. In essence schools had computers, which actually could not wok after some time. In this case the question arises as to whether the presence of computers in schools alone suffices to ensure quality education.

The World Links for Development started an initiative in several African countries including South Africa, Botswana and Uganda. The aim of the program was to promote the use of technology to improve education and prepare the youth to participate in the global information society. It aimed at establishing school-based tele-centres to facilitate access to ICT by pupils and rural communities. In Uganda it has been applied in a number of schools and has been hailed as a model for involving the community in education. With the support of the government the head-teachers have taken the responsibility for meeting running costs. In addition all ICT coordinators at the schools, teachers and student have been trained. Butcher argues that "in some of the communities where there was no other communication system before the project is seen as fundamental to the community's development"[42].

[42] See Butcher, Ibid. p. 87. Robert Hawkins also provides an in-depth analysis of ICT and Education in the Developing World. He analyses eight lessons that have been experienced in the process of implementing the World Links Program in developing countries. Through the program underprivileged schools in twenty one countries have been networked. In the process thousands

The World Links in Rwanda[43] has three components. In secondary schools it has trained at least two teachers in every school. It has targeted twenty secondary schools where it will also equip a computer lab. The labs would further be opened to the community to improve access to the modern ICT. At primary school level it aimed at developing computer literacy by providing hardware and training to more than half of all primary schools in Rwanda. According to the program it was envisaged that each primary school would be equipped with a computer with a Birchfield Interactive educational software and Microsoft Office. In addition each school would have two trained teachers in basic ICT concepts and the use of the educational software.

Mozambique is a typical case of the pitfalls of ICT initiatives that were not thoroughly thought out. Butcher proposes that countries should

"start where the skills are and then progress from there. It is often tempting to get excited by the prospects offered by ICT, yet those prospects may not be appropriate to the specific context"[44]

*Internet para as Escoles, a*n ICT initiative for schools in Mozambique was began in 1988 for a four year period with the support of IDRC. The initiative was aimed at

- Facilitating the sharing of ICT among students, teacher and educational departments using emails and internet
- Introduce computer literacy as well as integrate computers into the teaching of different subjects.

The initiative was to benefit 350 teachers and 4680 learners in 24 schools. In each school it was planned to install 11 computers and a computer lab. The evaluation of ICT use in schools, thereafter, revealed that the project did not achieve its intended aims. There were teething problems with infrastructure availability, skills level, work conditions and low culture of technology use.

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of students and teachers around the world have been linked for collaborative learning. It has also helped ministries of education to pilot and learn from the implementation of Networked Learning in schools. He argues that World Links has managed to bridge the gap in skills, knowledge and educational opportunities between students in the industrialized and developing countries. In particular he argues that In countries where learning resources are limited and teachers never dream of having a fully stocked library, let alone the Internet, teachers and students have been introduced to a new world of learning. As a result those participating in the pilot have been greatly empowered and now believe they can compete in a global knowledge based economy because they know that their knowledge, ideas, culture and passions are as valuable as any in the world Chapter 4, p.38-43.

[43] URL:http://www.World-links.org/rwanda Accessed on 20.10.2005

[44] Butcher,Ibid. p. 88

The most ambitious initiative is the one dubbed SchoolNetAfrica. The initiative focuses not only on availing computers but ensuring the use of the technology as a means of working together and improving school opportunities on the African continent. It tries to popularize the use of computers in the classroom and for school administrative and management purposes.[45]

Most of these initiatives have been tried with the support of some donor organization. The fear is generally about the sustainability of the initiatives. Hawkins has acknowledged that the initiatives are expensive but they work. As such the problem of accessibility is the major barrier to computer literacy and networking. He notes that

"establishing a working computer lab and a reliable connection to the Internet remains a dream for most schools around the world. In a recent survey in … Africa and Latin America … it was found out that lack of adequate hardware and software as well as unreliable Internet access were significant barriers to using computers in instruction." [46]

In developing countries where disposable incomes are generally low, the future of modern technology will need to be supported by a deliberate enabling environment for sometime. One of the foreseeable initiatives is one being developed at the Massachusetts Institute of Technology. Through its MIT Media Lab a 100 Dollar Laptop has been invented and it is envisaged that the laptop will not be for sale. It will instead be availed to schools via large government initiatives through an established non-government organization called One Laptop per Child (OLPC). This initiative was announced at the January World Economic Forum in Davos, Switzerland. This is an initiative that will definitely benefit African countries that have deliberately planned ICT in education policies.[47]

The Rwanda Country Initiatives

Rwandan initiatives can be seen at two levels, both of which attempt to mainstream ICT in education and in basic education in particular. We shall see the policy context and the implementation endeavors that the state has put in place. It is pertinent to note as this juncture that there is hardly adequate referential

[45] URL:http//www.schoolnetafrica.net
[46] Robert Hawkins, Ten Lessons for ICT and Education in the Developing World, Chapter 4, p. 1
[47] Refer to 100 Dollar Laptop at URL: http://laptop.media.ict.edu/

literature published on ICT development and use in Rwanda. This makes a contextual understanding of the magnitude of ICT use in the country a very challenging exercise. However, Rwanda is more at an advantage than most African countries in that it is more proactive in terms of embracing ICT in all sectors of the economy[48]. It has a long-term vision with regard to the benefits that ICT can bestow to the country. A glance at the policies in different sectors indicates that the country has set for itself targets and strategies for the successful implementation of the ICT programs. It has consequently integrated ICT in almost all its development programs, including of course the education sector. This vision is reiterated in its Vision 2020, the poverty Reduction Strategy Paper and in the Educator Sector Policy, among others. In this case there is an array of policy documents that reiterate the national vision of integrating ICT in daily life. In this section we look at two policy contexts of ICT development in Rwanda. This is a preamble to the plans of implementation of ICT at the basic education level.

The Education For All Action Plan for Rwanda draws from the Dakar Framework for Action in which it is stated that

- By 2015 all children of primary school age should participate in free schooling of acceptable quality and that gender disparities in schooling would be eliminated
- Levels of adult illiteracy would be halved and learning opportunities for youth and adults would be greatly increased.
- All aspects of education quality would be improved

In trying to achieve these broad objectives the Rwandan government has identified eight priorities, among which, is the increase "in expenditure on laboratory and scientific equipment and the promotion of ICT and science and technology in teaching".[49] To realize this priority it has stated that science and mathematics teaching and ICT shall be at the heart of all levels of Education.[50] In this connection it has strategized to:

- Train a critical mass of science and ICT teachers

[48] APC Africa ICT Monitor gave an interview to one Rwanda government official in March 2005, who indicated that Rwanda has in place a broadband infrastructure. It is possible to wireless Internet access. We have the fiber optic infrastructure in the city and most of the towns and the provinces. We are working to expand it to other areas of the country. We are expanding Internet connectivity to schools. All secondary schools should be connected within the next twelve years. We have a digital backbone provided by different providers in the country. Refer to URL: http://africa.rights.apc.org/ Accessed on 20.10.2005

[49] Republic of Rwanda, education For All plan of Action, June 2003, P. 39

[50] Republic of Rwanda, Ibid, P.46

- Ensure practical skills and provide science equipment and computers to identified schools and progressively to all schools, as means allow
- Establish model centers of excellence in mathematics, science and ICT at secondary level.
- Develop ICT curriculum for all levels of education.

At the national level, therefore, it can be argued that the state has tried as much as possible and declaratively to mainstream ICT in the educational policy. As we shall see below there are deliberate attempts to realize these intentions. The levels of success will of course differ due to financial and infrastructure encumbrances

In this section we provide a panoramic view of the vision that shapes Rwanda's development and education policies in relation to planning and provision for ICT. This vision is contained in a number of policy documents whose mission helps in planning for education provision using ICT, type of initiatives that have been implemented and their degree of success; and also identifying priority areas that need strengthening[51]

Vision 2020

Vision 2020 is a document that was published in 2002 as a framework for Rwanda's development. It presents the key priorities and serves as the country's guide for the future. This document puts a lot of trust in the potential of the Rwanda's human capital for accelerated national development. It emphasizes the need for expanded, improved and relevant education and training particularly for youth and women. It is noted with concern that Rwanda lags behind in professional training, "with most acute deficiency being apparent in the fields of applied and natural science and ICT."[52]

Science, technology and ICT is one of the cross-cutting issues identified in the Vision 2020. It is projected here that by the year 2020 Rwanda will have adequate, highly skilled scientists and technicians to satisfy the needs of the knowledge-based economy. It is also stated that in order for Rwanda to achieve this objective, it will have to emphasize the teaching of science and technology at secondary and University

[51] Republic of Rwanda, Ibid, P.46
[52] Republic of Rwanda, Vision 2020, pg. 16

levels. It will facilitate the creation of high and intermediate technology enterprises and develop access to ICT to the administrative sector level in accordance with the ICT plan. The eventual streaming of science and technology into secondary and tertiary levels will however, have to rely on the preparedness of pupils at the primary level. This requires hence a deliberate increase in infrastructure investment at the primary school level.

It is within the framework that ICT use in supporting basic education should be comprehended. This vision has influenced the formulation of the education sector policy and the subsequent initiatives in developing ICT curriculum and the introduction of ICT in primary schools in Rwanda.

Poverty Reduction Strategy Paper

In this document technology is seen as one of the crosscutting issues for poverty reduction. The Government of Rwanda recognizes the role that information communication technology can play in accelerating the socioeconomic development of Rwanda towards information and knowledge based economy.

In this regard the government established the Rwanda Information Technology Agency (RITA) and developed a twenty-year ICT-led socioeconomic development framework and an integrated plan for 2001-2005. The framework contains the following broad strategies:

- To promote and encourage the development and utilization of ICT within the economy and society.
- To transform Rwanda into an IT literate nation
- T o improve the efficiency of civil and public service
- To improve the information and communications infrastructure of Rwanda
- To transform the education system using ICT
- To improve the human resource development capacity of Rwanda
- To develop a legal, institutional and regulatory framework to support ICT
- To improve socials; and cultural interaction within society

Education Sector Policy 2002

It is recognized that science and technology are important fields in the Rwandan education system. And effort is being made to promote science and technology with special focus on ICT. However, it is also observed in this document that ICT is at its embryonic phase in the education system, even though some initiatives have been started for teaching and learning using ICT facilities, especially in selected primary schools and at the tertiary level. Strategies proposed here are to:

- Train a critical mass of science and ICT teachers
- Ensure practical skills and provide science equipment and computers to identified schools and progressively to all schools, as means allow.
- Establish model centers of excellence in science, mathematics and I ct at secondary level

Education Sector Strategic Plan (ESSP2005-2010)

The ESSP 2005-2010 is an update on the road towards developing Rwanda's education sector. It provides a forward looking plan with strategies, key activities and related indicators that have been costed based upon the policy goals identified in education sector policy. To promote science and technology with special attention to ICT as one of the goals of education sector is, therefore, addressed in the ESSP. At both primary and secondary school levels, policy objectives emphasize promoting interest and enhancing ICT, science and technology. The strategies to achieve this include availing schools with ICT and training teachers to improve quality of science and technology teaching

Mainstreaming of ICT in basic education in Rwanda.

In the context of ICT the concept of marginalization captures the notion of 'underserved constituencies'[53]. These constituencies embrace the

"scattered and rural populations, groups traditionally excluded from education due to cultural or social reasons such as ethnic minorities, girls and women, persons with disabilities and the elderly as well as all others who for reasons of cost or because of time constraints are unable to enroll"[54]

[53] Tonio, Ibid., p.6

[54] Tonio, Ibid. p.6

In Rwanda this context may be taken a little bit further within the realm of education. It might mean certain schools or sections of the population being left out, ignored or not captured within the mainstream education process. In this case we have to delineate schools in terms of public and private. In most instances public schools are resource advantaged as opposed to the many emerging private schools. However, there are quite a few private schools, which are elitist and hence have resources to invest in information and communication technologies.

The 1994 Genocide introduced a population group, which is vulnerable and without assistance it will not be able to effectively fit into the mainstream development process. There are orphans, child-headed households, widows and widowers all of whom are susceptible to marginalization within the education sector. To tap them will require concerted efforts including using modern ICT to ensure that they acquire knowledge and skills that will make them useful members of the society.

Schools can also be categorized as being urban and rural. Urban schools in Rwanda tend to be resource rich as opposed to rural schools. Urban schools benefit from economies scale and externalities, which exist as a result of comprehensive urban planning and development. They, therefore, have an opportunity to benefit from good road networks, electricity networks, and fixed and mobile telephone networks etc. Rural schools tend to suffer as a result of orthodox marginalization that characterizes them. Rural areas tend to lack most of the amenities that urban areas have. Yet the number of children in rural schools is more than that in urban schools. Yet these schools generally do not have access to the basic amenities that would facilitate accessibility to information and communication technologies.

In the Rwandan context as in many developing country contexts, marginalization and being disadvantaged can also be applied to gender disparities. There is possibility that women are more disadvantaged than men in terms of access to information and communication technology. This fact is in conformity with the World Bank's view that

"females have less access to skills training and development that would enable them to gain employment in the ICT sector. When females are employed they generally work at lower levels with less pay. These initial disadvantages prevent girls and women from benefiting equally from the opportunities offered by the new technologies. Paradoxically, these same technologies offer opportunities for them to overcome these

disadvantages by obtaining the education and technical skills that will enable them to participate equally in the knowledge economy".[55]

Considering that women form the majority population in many countries their participation in realms that empower cannot be gainsaid. In the teaching profession women tend to form the largest proportion. The World Bank is of the view that gender disparities would be addressed when the proportion of women would increase especially by their participation in distance education to bolster their professional skills. The most productive form of distance education is in this case characterized by use of ICT tools that rely on mass access to unlimited knowledge sources.

To circumvent the problem of inaccessibility based on the foregoing analysis there must be a deliberate policy to close the ICT divide. In this instance the use of modern ICT in Rwanda is now official policy. Already the ICT unit in the Ministry of Education has a project in which it is envisioned to develop computer literacy in Rwandan primary schools. The Ministry has begun this project with the training of teachers and then later engaging learners at different levels depending on accessibility to the computer resources and infrastructure. The project implementation process is two-phased. Phase 1 is the distribution of computers and training of teachers in schools that have electricity. This was done between February 2004 and June 2004. It saw the training of two teachers per school in 98 primary schools that had electricity[56]. The training sessions comprised of seven sessions of five days each. On the ground there are 180 teachers who were trained on the use of computers for teaching and learning. To-date each of the schools with electricity has received two desktops computers and one AlphaSmart.

Phase two of the project covered 1020 primary schools without electricity. It involved 2040 teachers and was expected to end by December 2005. 58 schools per province were to be equipped with a laptop computer and solar kit. 99 schools were to receive one laptop computer each from those given by the Ministry of Education. A total of 170 teachers were trained.

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[55] URL:http://www.worldbank.org/ "What development practitioners need to know about Gender, ICT and education"., p. 1

[56] Through the Rwandan Development Global Alliance Rwanda is expected to implement an extensive capacity building program to ensure that at least two teachers per school are trained in the use if the newly acquired equipment to improve teaching and learning. Members of the Alliance include the government of Rwandan, USAID, World Links, Microsoft, ComputerAid, AlphaSmart, Birchfield Interactive (U.K), digital links (U.K), coca coal and DHL. An analysis of feasibility study data was done to ascertain the actual situation of infrastructure in the provinces. With the collaboration of the ministry of education GIS department. It was confirmed that the number of schools that have electricity is significantly lower than was indicated in the conclusions of feasibility study. That is from 2170 to only 74 primary schools.

Rwanda has also been a beneficiary of the *NEPAD E-school initiative* in which six schools have been earmarked to spearhead the initiative. These schools include Groupe Scolaire de Muhura in Northern province, College Saint Andre in Kigali City, Groupe Scolaire de Shyangi in Western province, Lycee de Zaza in Eastern Province ESSA in Western province and College Christ Roi in Southern province. Through this initiative the schools benefited from supply and installation of apparatus, which would be administered, by Cisco and Microsoft consortium for one year. After which the program will be handed over to the Rwandan government for eventual rolling out to other schools by 2013. The program essentially will perform three basic roles

- The installation of ICT equipment in the schools along with the soft ware
- The training of pre-service and in-service teachers to use this technology to impart ICT skills to the students as well as facilitate preparation and delivery of course materials in all other subjects
- The use of ICT to develop appropriate course materials and make them available to schools and teachers.

The problem of lack of appropriate infrastructure was noted and it was factored within the program that "where electricity might not be readily accessible in the identified rural schools, solar energy dishes and power generators will be set up to tap energy".[57]

A major initiative apart from the government led initiative is one led by *Computer Aid International*. By 2005 the organization had planned to put 3000 personal computers into Rwandan schools and community projects. This was triple the number that had been supplied in 2004. The charity organization's vision is to make Rwanda a "knowledge economy, bypassing the industrial stage of development".[58] The organization is of the view that "Rwanda has changed and wants to change more. It is the only African country with an ICT policy. … Over the last twelve months Computer Aid has put 1000 computers into Rwanda, around 60% of them to schools and the rest to community and health projects".[59]

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[57] Computer Aid to treble PC delivery to Rwanda, URL:http.nepad.gov.rw/index/
[58] URL: http://management.silicon.com/itdircetor/
[59] Ibid, p. 1

Since 1997 Rwanda has had a program of science and technology for primary school.[60] The aim of the program was basically to orient school learners in primary schools to the environment of science and technology and to appreciate the role scientific and technological innovation and invention have in the facilitation of human life. In the realm of technology quite an array of topics are learnt. However, computer literacy within the comprehensive discipline of science and technology scantly features. The general nature of the pedagogic approach, however, sets the stage for embracing information, communication and technology as part of daily life. The Ministry of Education has a vision of integrating ICT in the curriculum of primary education and financial resources have been budgeted for the development of such a curriculum. Arising from an interview held with a CNDP official the teaching and learning of all primary school in Rwanda was envisioned to start in 2006. The curriculum would be taught as a key subject that would also cut across mainstream subjects. That is, it could be used in different subjects such as mathematics, science, history, among many others. This means that specific computer accessories will have to be availed in form of CDs, which can be used to teach and learn topics in the mainstream subjects.

The teaching and learning of ICT in basic schools is also aimed at inculcating basic computing literacy in the pupils. It is planned that the pupils would be able to manipulate computers in terms of accessing various programs and surfing on the Internet. This is in addition to learning basic word processing and numerical computation. The computer is intended to be regarded as a user-friendly tool especially for pupils and teachers.

The curriculum development and the consequent teaching and learning process will , however, be alive to the following three questions:

- Will students be learning about ICT?
- Will students be learning with ICT?
- Will students be learning through ICT?

What do these questions infer? Considering the general dearth in supply of computer equipment and accessories in Rwanda and indeed in many developing countries there is a tendency of schools limiting themselves to teaching about ICT. This limit will essentially beat the objective of the program since the

[60] Centre National de Development des Programmes (CNDP) (1997), Programmes de Sciences et Technologies Elementaire au 2e du Primaire. Kigali CNDP.

learners will not have the necessary hands-on experience in the manipulation of the ICT to learn particular disciplines. There is hence danger that learners might only have the theory of computers and lack the functional literacy that goes with the existence of computers in schools.

Learning with computers infers that teachers and learners use the ICT to deliver and receive content and acquire skills in the normal classroom situation. The teachers use the traditional teaching and learning methods and may not be able to involve learners generally in the teaching process. There is less change of professional values and traditions, which the use ICT requires. In this instance the transformation of the teacher into a skilled tutor and facilitator of the learning process is not experienced. The fear of the displacement of the teacher's traditional role is hence selfishly guarded. In this case therefore, the teacher has an option of not integrating computers into the teaching process. Without the ICT he or she cannot be out of job.

Learning through computers requires that there is a deliberate and well intended integration and use of ICT for teaching and learning. Without them therefore very little teaching and learning will take place. This situation requires an enabled environment in which teachers are available and possess the required professional skills with regard to ICT. It also means that a reliable and sustainable ICT infrastructure exists that supports the teaching and learning process on a continuous basis. This sounds like a long shot for most developing countries.

The process of curriculum development should therefore be cognizant of the level of ICT awareness and application in different countries. To enable the recognition UNESCO has accordingly categorized countries especially in Asia and the Pacific. This classification could also assist in knowing the extent to which a country could position itself to benefit from ICT development and the influence it could have on ICT policy development and formulation. In the table below we provide a summary of the categorization as perceived from Asia and Pacific.

Category, Characterization and Indicators of ICT development

Category	Country Characteristics	Indicators
EMERGING	There is general awareness of the benefits of ICT in education. A national policy has just been set, budget has been allocated and guidelines for implementation have been prepared. The country is undertaking infrastructure development in preparation for nationwide access. Schools are in hardware build-up in terms purchasing computers and other ICT facilities.	• Infrastructure build-up and ICT availability • Penetration and connectivity • Master plan and budget allocation • ICT policy in education linked to national ICT policy
APPLYING	Ministry of Education testing out and piloting use of ICT in selected schools and subjects have not integrated ICT as part of curriculum. Schools in particular have started benefiting from the conveniences of using or applying ICT in the management and administration of education. Schools are not adequately equipped and teacher-student ratio is still low. Internet connectivity is just beginning to appear on selected basis and for limited use. Schools may be offering computer course as a subject and most computers are stand-alone units. Teachers are being trained in computer literacy rather than the use of ICT in teaching and learning. ICT materials for teaching subjects are being developed and teachers are using ICT in classroom for preparing presentations, entering grades and assignments, making handouts, text processing and classroom management, as	• Availability, penetration and accessibility of ICT • Teacher-student-computer ratio • Internet connection • Teacher training outcomes • Use of ICT by teachers and students or how ICT is used in schools
INTEGRATING	Ministries of Education have integrated ICT use in the standard curriculum and developed standards and competencies for teachers and students in ICT use. Schools have computer labs with computers set up in a network, have a working LAN and access to Internet by students, teachers and administrators. Most students have email addresses. ICT use is more of a tool for teaching and learning rather than a curriculum subject. Teachers are naturally and routinely using ICT and other educational software in teaching subjects and students employ them in classroom activities and in completing their assignments. Telecollaboration and communication between teachers and students and other schools can occur at this stage.	• Assessment of teaching and learning process/outcomes as well as efficiency of ICT in communication • Networking and providing easy access to online educational resources
TRANSFORMING	ICT use is routine, widespread and systematic in ministries and in their programs across the country. ICT is integral part and important facility in management and administration in education and has become an efficient and effective way of teaching and learning, solving problems, communication and collaboration. Traditional learning has been replaced by e-learning and online learning. Students and staff have personalized websites and students have full grasp of ICT facilities in their schooling.	• Availability of larger bandwidth • Countrywide penetration of ICT including the marginalized areas • Easy access to online resources as far as infrastructure is concerned • The use of ICT for e-learning, telecollaboration or collaborative work, use of online professional development, extent of teacher training coverage and training of teachers in advanced use of ICT and how it is used to develop learners creativity, critical thinking and problem solving capacity • How new graduates are integrated into the knowledge society and workplace

Adapted from UNESCO, URL:http://www2.unescobbk.org/education . Accessed on 07.11.2005, p. 1-5

The above categorization, characterization and indicators of ICT use provide a glimpse into the potential and ability of different countries to adopt and use ICT for educational purposes. They provide food for thought for almost all African countries and the level of commitment that the countries can invest in availing and using ICT for basic education and reaching out to the marginalized and vulnerable communities. The table indicates at a glance that most African countries are either at the emerging stage or lie between emerging and application of ICT in education. It is, however, evident that a number of them could lie at the beginning of ICT application, if only in a handful of schools.

Conclusions and Way Forward

What does the foregoing analysis portend for Rwanda? Is Rwanda on the right path? Could Rwanda benefit from the specific country initiatives from Asia and Africa in terms of adopting and adapting appropriate technology that is commensurate with its level of development? Or would there be a need for an integrated ICT initiative that would address divergent development needs within the country. The way forward for Rwanda lies in the responses to the above questions. The analysis has presented a comparative review of literature on the need and use of ICT for basic education especially in developing countries. The emerging scenario is that modern ICT has a definite place in the education system and especially in attempts to improve quality education as well as to reach out to a vast majority of population groups that are vulnerable and marginalized. International, pan-African and country initiatives have been formulated and some have succeeded in integrating ICT in basic education. In some countries such as Egypt and South Africa concrete steps have been taken to avail and use ICTs in teaching and learning and not just in management and administration of education. However, challenges still remain especially in the efforts to build a viable ICT infrastructure that would enable mass access to information and communication resources.

Rwanda is one of a few countries in Africa that have an ICT policy especially in education. The country has gone against the odds of the Genocide and invested time and financial resources in a working ICT infrastructure that is envisaged to support a demanding basic and secondary education system. Already computer hardware and software have been availed to quite an increasing number of schools. The efforts are continuing especially now in launching an ICT curriculum for basic education.

The lingering question in all these initiatives is the issue of sustainability of the initiatives. And hence the worry about the dangers of the technology going obsolete without having achieved the intended purposes of developing an IT literate society that can compete effectively in a knowledge based global economy. These and similar issues arise to provide a research agenda that will facilitate the identification of priorities for countries to consider for the development of ICT in basic education. Rwandan ICT needs are legion and problems will surely emerge along the way. The commitment to create an ICT literate nation, therefore, provides opportunity for research to inquire into the logistics and dynamics of achieving the country's ICT vision.