Technological Infrastructure and Use of ICT in Education in Africa: an overview

Working Group on Distance Education and Open Learning

Association for the Development of Education in Africa

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Working Group on Distance Education and Open Learning (WGDEOL)

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Foreword.....

The publication of the overview on existing technological infrastructure and the use of ICT in education in sub-Saharan countries as well as other forthcoming studies undertaken by the Working Group on Distance Education & Open Learning on best practices and cost-effectiveness of distance education in sub-Saharan Africa are in line with the Group's plan of activities. I am sure that all stakeholders of education in Africa will welcome this initiative as a valuable contribution to the dearth of information on ICT and education in the region.

In fact, the Report comes at an opportune time when we all realize how crucial it is for decision making regarding educational changes to be informed by relevant research and analytical work. Based on current literature, this desktop study on ICT in sub-Saharan countries will, no doubt, provide decision makers with some useful insights into the major issues and challenges of introducing technology in education. In Africa more than in other developing countries, competing priorities such as the combat against HIV/AIDS, poverty and illiteracy, and local constraints including poor technology penetration, unaffordability of equipment and lack of capacity plead for caution and rigour in planning, implementing and measuring change. In this regard, the Report also underlines the importance of well-costed projects and the selection of pedagogically sound technologies in order to optimize teaching and learning.

Although the choice of ICT should equally take into account the widely used "older" technologies such as print, radio and television, it is becoming more and more evident that "leapfrogging" technologies, wherever possible, remains the primary alternative for quicker response to the daunting challenge of access and equity. The rate of 26 per cent of secondary enrolment and 3.9 per cent of tertiary participation in Africa, for example, compares very unfavorably with that of most developing countries outside Africa where it has reached up to 51 per cent and 10.9 per cent respectively. One can only acknowledge that this disparity is set to widen if no just-in-time and adequate measures are taken.

For both technological and pedagogical reasons, many African countries are ready to envisage adopting state of the art technologies in order to leapfrog into the future. The former view that developing countries should follow every stage in the historical development of distance education from correspondence courses to online learning is no longer predominant. Complementary and convergent use of technologies

for what each can do best should be advocated. However, the major constraint of most African countries is limited access to new technology due to high cost of establishing, using and maintaining the necessary infrastructure, lack of adequate local expertise and low computer literacy rate among user groups.

Given these impeding factors, African initiatives to promote the use of ICT in education will depend, in a large measure, on creative partnerships between public and private as well as local and regional organizations, in particular to lessen costs of operation. It is considered, for example, that Africa can meet the challenge of improving the quality of Mathematics, Science and Technology education at secondary and tertiary levels, on the one hand, and increase access to primary teacher education by subsidizing costs of equipment and reducing communications tariffs for education institutions through such collaborative ventures. Success and sustainability of projects will, however, be subject to in-country policy development and institutions' legislative framework..

Ultimately, the realization must strike home that ICT in education should not be promoted for its own sake, but used judiciously, it can focus on improving educational outcomes in the most cost-effective way.

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1. Introduction

> *If the next century is going to be characterized as a truly African century, for social and economic progress of the African people, the century of durable peace and sustained development in Africa, then the success of this project is dependent on the success of our education systems. For nowhere in the world has development been attained without a well-functioning system of education, without universal and sound primary education, without an effective higher education and research sector, without equality of educational opportunity.*
>
> (Thabo Mbeki, 1999, Opening Speech at the Conference on Education for African Renaissance in the Twenty-first century)

The role of education in society is in flux, as a result of the progression of the forces of globalization, the pace of technological change, the ever-increasing centrality of information and knowledge, and the importance of skills to access and use both new technologies and information more effectively. The result is that the aim of education has shifted:

> *As knowledge in itself becomes a perishable item, the ability of learners to think independently, exercise appropriate judgement and scepticism, and collaborate with others to make sense of their changing environment is the only reasonable aim of education.*
>
> (Haddad & Draxler, 2002, p14)

The central role of education in development is now widely acknowledged. Several authors also argue that distance education, in particular, is fundamental to addressing many of the educational challenges faced in the developing world. It is in the context of focus on distance education and open learning that information and communication technologies (ICTs) in education are especially important. The increasing importance of ICT in the global information society both creates new challenges and provides solutions to old educational problems.

This report seeks to explore various issues relating to education in sub-Saharan Africa. Of particular interest is how distance education and open learning can be supported by ICT, such that the objectives of education, as noted in the quotation above, might become achievable

for the majority of people in Africa (many of whom are now excluded from educational opportunities of any form). The report is based on desk research, including a review of literature and examples of current initiatives using ICTs for education in sub-Saharan Africa, with a specific focus on open and distance learning.

The report begins with a discussion of the socio-economic context of the continent, including the broad educational context within which any efforts to make use of ICTs and/or distance education must function. The role of ICTs in Africa's development generally, including the ICT infrastructure currently available, is elaborated. The importance of ICTs for educational provision is discussed and the issues, achievements, and kinds of projects being implemented in primary and secondary education, tertiary education, adult or basic education, and teacher training are also reviewed. Finally, financial considerations when implementing an ICT-based educational strategy in the African context are discussed.

As a first step, it is important to clarify what is understood by distance education, open learning, and ICTs, as these concepts form the basis of this report and are often used differently by authors in the field, and also by educational providers.

2. Definition of Terms .....

2.1 .....Distance Education: The Need for Conceptual Clarity

The growth of distance education methods of delivery has been a key feature of education in the 20th century. Three primary reasons for this trend can be identified. First, the need has grown to provide access to students who would—either because of work commitments, geographical distance, or poor quality or inadequate prior learning experiences—be denied access to traditional, full-time contact education. Second, it has been necessary to expand access to education to significantly larger numbers of learners. Third, there has been a need to shift patterns of expenditure to achieve economies of scale by amortizing identified costs over time and large student numbers. In African contexts, these drivers are often underpinned by the need to transform education systems that have been ravaged by colonial histories and political instability.

More detailed reasons for embarking on distance education provision vary, depending on the educational sector in which this is occurring. For example, at many higher education institutions, distance education programmes are introduced in an attempt to broaden a declining client base and to generate additional income. Such programmes are also introduced as a way of meeting national priorities or to reach specific groups, such as rural community workers. Many programmes are offered to professionals who are working full-time, and these programmes of necessity use distance education strategies. Some providers and programme coordinators adopt distance education strategies to support their teaching approach, while others are simply fascinated by the new opportunities for innovative teaching that information and communication technologies (ICTs) create.

In another education sector, many countries around the world, when faced with problems of learner access to the conventional schooling systems, have implemented some or other form of Open School as a response to these problems. An Open School is an educational institution operating in the spheres of primary and/or secondary education, providing courses and programmes predominantly through use of distance education methods. Most schools of this nature have been established for some time. The Correspondence School in New Zealand, for example, was established in 1922, while the Open School in India is over 20 years

old. Reasons for establishing such schools have tended to revolve around accessibility to traditional schooling. In the two examples mentioned above, part of the motivation to establish the school was to provide access to students in remote farming communities (New Zealand) and access to large numbers of students whom the mainstream schooling system could not absorb (India).

Very often, establishment of Open Schools has also been motivated by intrinsic weaknesses in the mainstream, 'contact' schooling system, which policy makers have seen as requiring years of structural change before large-scale improvements will become noticeable. Thus, Open Schools provide a handy, reasonably quick institutional solution to problems of educational delivery, which can operate largely outside of the mainstream schooling system and hence not be slowed down by the pace of these structural changes.

These kinds of developments raise questions about what distance education actually is, how it can contribute to solving educational problems in African countries, and its relationship to technology. These points require clarification at the outset of this report, as they have a bearing on considerations about the use of ICT in education.

As has been pointed out, there has been extensive growth of distance education recently, and this looks set to continue for the foreseeable future. However, motivations for shifting to resource-based learning and those for turning to distance education often tend to be conflated during education planning processes. The result is that an unfortunate qualitative value has come to be attached to the term distance education—namely that, de facto, it achieves the goals of resource-based learning—that is neither deserved nor useful. Below are some first-level definitions that help to differentiate between the two concepts.

- **Distance Education**
  Distance education describes a set of teaching and learning strategies (or education methods) that can be used to overcome spatial and temporal separation between educators and learners. These strategies or methods can be integrated into any education programme and—potentially—used in any combination with any other teaching and learning strategies in the provision of education (including those strategies which demand that learners and educators be together at the same time and/or place).

- **Resource-Based Learning**
  Resource-based learning involves communication of curriculum between learners and educators through the use of resources (instructionally designed and otherwise) that harness different media as necessary. Resource-based learning strategies can be integrated into any education programme, using any mix of contact and distance education strategies. Resource-based learning need not imply any temporal and/or spatial separation between educators and learners, although many resource-based learning strategies can be used to overcome such separation.

Although this distinction is somewhat arbitrary, it is helpful for purposes of analysis, as it allows us to establish some underlying problems that have arisen during 'distance education' planning. The intention behind this is not to set up new artificial dichotomies. Rather, it is to illustrate more vividly that moves to resource-based learning do not, de facto, achieve the goals of distance education and vice versa. Thus, while most distance education programmes seek to overcome temporal and spatial separation through use of resources, some seek only to overcome distance using direct communication via telecommunications technologies (such as video-conferencing). Conversely, many efforts to develop educational resources have not systematically focused on achieving the economies of scale that have historically provided such a central motivation for most distance education programmes.

2.1.1 What Does 'Modes of Delivery' Cover?

In historical terms, the concept of 'modes of delivery' has been relatively simple to understand, as people have generally tended to differentiate between 'contact education' and 'distance education' as two readily identifiable modes of delivery. Internationally, this broad distinction began to merge as different institutions moved to establish themselves as 'dual-mode' or 'mixed-mode' institutions, particularly in the area of higher education. This generally began to happen as traditionally contact institutions introduced distance education programmes for students who were not able to attend their central campus on a full-time basis. In simple terms, then, the concept of modes of delivery covers these three broad institutional types:

1. Contact education institutions (where students attend face-to-face sessions of different kinds, and these sessions are the primary mechanism for communicating course curriculum);

2. Distance education institutions (where students and educators are separated by time and/or space, and communication of curriculum takes place primarily through use of educational resources, drawing on different media as necessary); and
3. Mixed- or dual-mode institutions (where the institution establishes parallel administrative systems to enable it to offer both distance and contact education programmes).

In most education systems, there are several examples of educational institutions that fall into these categories. Contact education institutions still tend to be the most common, as most primary and secondary schools fall into this category, as do many colleges and universities. Similarly, there are several examples around the world of dedicated distance education institutions, some of which are very large (such as the Indira Ghandi Open University in India, which has hundreds of thousands of students), some medium-sized (the National Correspondence College in Zambia, for example, enrolled an estimated 21,000 students in 1999), and some much smaller (the Botswana College of Open and Distance Learning had 600 registered students completing their schooling in 1999). Dual-mode institutions are also on the increase in the developing world, particularly in the higher education sector, as the examples of the Universities of Pretoria and Stellenbosch in South Africa illustrate.

2.1.2 Modes of Delivery: An Outdated Form of Categorization

The concept of 'modes of delivery' is based on an historical distinction in education systems between 'distance' and contact' education. This distinction has been very useful for many years, particularly as it allowed for the establishment of innovative responses to education problems—such as Open Universities and Open Schools—that could be set up and run without waiting for changes in mainstream education systems.

This flexibility was important to the success of many distance education institutions around the world, but has also had the unfortunate consequence of establishing two distinct education systems, which have historically operated in parallel and created long-term policy problems. This problem has been compounded recently, as there has been an explosion of education delivery options, around which it has become increasingly difficult to establish meaningful policy and regulatory frameworks.

Neat categorizations, such as those provided above, are increasingly containing too divergent a range of educational practices to remain relevant. This has become particularly problematic in the area of distance education. For example, distributed lecturing systems using video-conferencing equipment and systems using instructionally designed study guides and decentralized tutorial support find themselves located within the same category, although they bear almost no resemblance in terms of pedagogical approach, technologies used, and financial implications. This is not to suggest that one is intrinsically better than the other. It simply points to the inadequacy of planning approaches that assume the planning requirements of both will be adequately met by a single framework called 'distance education'.

Awareness is now growing that elements of distance education have almost always existed in face-to-face programmes, while educators involved in good quality distance education increasingly recognize the importance of different types of face-to-face education as structured elements of their programmes. This trend has rendered rigid distinctions between the two modes of delivery meaningless.

One consequence of this is that many education providers are now struggling with the constraints created by maintaining separate 'modes of delivery'. The Gauteng Youth College in South Africa's Gauteng province, for example, was set up to exploit the benefits of distance education methods of delivery in providing 'second-chance' opportunities to failed matriculants. Amongst the many interesting lessons that this project yielded was a clear understanding that provincial policy and administrative frameworks currently make it very difficult to explore innovative methods of delivery. Key to these policy frameworks is that so many education systems are based on the notion that students will be studying full-time at contact campuses.

An appropriate solution to this problem is the conceptual introduction of a planning continuum of education provision: this one that has, as two imaginary poles, (1) provision only at a distance and (2) provision that is solely face-to-face. The reality is that all education provision exists somewhere on this continuum, but cannot be placed strictly at either pole. Educators often end up equating particular methods of education with good quality education, even when these methods are being poorly implemented. The notion of this continuum is free of such premature and unnecessary judgements about quality.

This conceptual shift is vital in changing the structure of education systems around the world. In particular, it allows for greater flexibility and opens possibilities of collaboration, both of which are vital to improvements in educational quality and to the cost-effectiveness of education provision, issues of particular relevance to policy-makers. It allows education providers to plan, implement, and review each education intervention on its own merits, rather than being forced into simplistic, dichotomous categories (such as 'distance education' or 'contact education'), which set arbitrary and unhelpful constraints.

This flexibility should form the cornerstone of all education planning processes. Education systems always serve a diversity of people with a wide range of educational needs. There is no single teaching and learning model that will meet these diverse needs equally well. This point seems obvious, but cannot be stressed strongly enough, particularly given the almost innate human desire to find simple, packaged solutions to complex problems.

This stance fits well with the move towards open learning as an underlying philosophy to guide educational provision. Open learning is based on the principle of flexibility in order to increase access to education and often forms part of broader equity efforts in society. This approach allows learners much more freedom to determine what, how and when they want to learn than traditional approaches to education. The aim is to provide learning opportunities to a diverse range of learners both originating from, and learning in, different contexts, which affects the way in which successful learning occurs. Within open learning approaches, there is commonly reference to learner-centred approaches, as well as resource-based and autonomous learning. This means that the learner is central, 'learning to learn' is in itself a goal, the learner develops critical thinking skills and the ability to learn independently. This philosophy becomes increasingly important in the context of lifelong learning and the need for people to be equipped to function in the knowledge society.

2.1.3 Distance Education and Technology-Enhanced Learning

Linked to the above is an unfortunate trend that has crept into the field of educational technology. This new trend, particularly pervasive in American educational debates but now finding its way into several educational discourses, has been to use 'distance education' and

'educational technology' interchangeably or even as a single, composite term. The most obvious problem with this is that it is simply an illogical inference. Educational technologies are used regularly in contact educational environments, whether they be 'old' technologies like print or whiteboards or 'new' technologies like data projectors or personal computers.

More importantly, though the use of distance education and educational technology as interchangeable or composite phrases introduces a blurring conflation of the terms, which—at least in many developing world educational interventions—has led to poor quality strategic planning. In many ways, it is similar to the conceptual integration of open learning and distance education in the United Kingdom and Australia—open and distance learning—which created a real misperception that distance education was intrinsically 'open'. In the same way, many people harnessing educational technologies think they are harnessing the benefits of good quality distance education, when, in most cases, they are simply finding technologically clever (and often not so clever) ways of replicating traditional, face-to-face educational models. Many of these attempts have blazed a sad trail of failed educational technology projects (most notably in applications of broadcasting technologies to transmit lecture-style programming), wasting huge amounts of time and money. On the positive side, these experiences have provided valuable lessons for education planners in developing countries, so there is no reason to continue repeating many of these costly mistakes.

The key point here again is that each education intervention should be planned, implemented, and reviewed on its own merits, rather than forced into simplistic, dichotomous categories (such as 'distance education' or 'face-to-face education'), which set arbitrary and unhelpful constraints. Leading on from this, attempts by educators to harness the potential of different technologies to support their educational interventions should not automatically be regarded as distance education interventions. Technologies can be applied in a range of ways, to support an almost limitless variety of teaching and learning strategies, and it is essential to keep options as open as possible.

2.2 A Definition of ICT

2.2.1 Information Technology

Understanding the term 'information and communication technologies' (or its acronym ICT) needs to begin with how the term technology itself is used. As Williams notes, this term derives from the 17th-century use of the word to describe 'systematic study…or the terminology of a particular art'. Over time, the word came to be increasingly associated with 'practical arts', finally leading to a 'familiar modern distinction between knowledge (science) and its practical application (technology), within the selected field' (Williams, 1983, p315).

This modern distinction still holds, but has taken on a very specific (some would argue overly narrow) application in most circles when integrated into the composite term 'information technology'. Most definitions of this phrase make specific reference to electronics and computers, and this certainly holds for most people's understanding of the term. We do not wish to debate the merits of this reference, instead choosing to present a definition of information technology that we believe is useful for the purposes of this policy paper:

> *Electronic technologies for collecting, storing, processing, and communicating information. They can be separated into two main categories: (1) those which process information, such as computer systems, and (2) those which disseminate information, such as telecommunications systems.*
>
> (Gunton, 1993, p150)

Thus, this document does not seek to cover all technology in terms of its educational application, although many of the comments made will be applicable to all technology. Instead, we aim to focus explicitly on those technologies described by the above definition.

The definition above would appear to cover both information and communication technologies, raising the question of why the additional composite term has grown in use recently. Although there may be many reasons for this, it is no doubt, in part at least, to make more explicit that the term does actually also cover those technologies covered by category (2) above, a point often missed by people using the term 'information technology'. In addition, though, we believe that this new

term has emerged to reflect the growth in technological convergence of information, communication, and broadcasting technologies. This trend is, therefore, worth exploring briefly.

2.3.....Technological Convergence

In terms of a dictionary definition, convergence is described as 'movement towards or terminating in the same point' (Onions, 1987, p418). In itself, this provides an obvious enough definition, but it requires further explanation in terms of its relevance to technological trends. One simple description of convergence provides a useful starting point for understanding the concept from a technological perspective. In brief, convergence may be described as:

> *The coming together of two or more disparate disciplines or technologies. For example, the so-called fax revolution was produced by a convergence of telecommunications technology, optical scanning technology, and printing technology.*
>
> (ZDNet Webopedia, 1999)

This description is helpful because it provides an illustration of a completed process of technological convergence, which in turn helps us to separate the general concept from its application to a specific process of technological convergence currently taking place.

From the perspective of this report, however, the term 'convergence' will be used to describe one particular process of technological convergence. This can be summarized as follows:

> *In information technology, convergence is a term for the combining of personal computers, telecommunication, and television into a user experience that is accessible to everyone.*
>
> (Whatis.com, 1999)

Convergence is an on-going process which entails the coming together of the following:

- content from the audiovisual and publishing industries;
- potentially separate physical infrastructures (such as those supporting broadcast television or telecommunications services) able to carry similar sorts of information at increasingly lower costs;
- the interactive information storage and processing capabilities of the computer world;

- the ubiquity, improving functionality and ease of use of consumer electronics.

(ISPO, 1999)

Convergence is, however, by no means a commonly agreed concept. The European Commission Information Society Project Office has, for example, recently completed a Green Paper process on convergence, in which the following was reported:

> *Some comments suggested that it was unclear exactly what the term convergence represents. For others, convergence defied definition. Yet others predicted a degree of divergence in terms of the range of content and services offered…views on the pace of developments were…cautious. There was wide recognition of the reality of convergence at the level of technology and network infrastructures. But most agreed that this did not mean that convergence of either markets (in terms of the players involved) or services would automatically follow. Convergence was seen as an evolutionary rather than a revolutionary process.*
>
> *There were clear differences between sectors as to their perception of the extent and speed of these developments, but there was broad acknowledgement that convergence, however defined, was at an early stage and characterized by uncertainty, in particular about the level of demand there might be for such services. These differences were also reflected in many of the examples offered as to how converging technologies are influencing both the business world and our everyday lives, many of them based on the growing popularity of the Internet. One important feature in this context was the degree to which new services offered users the possibility to customise and control the information and services received.*
>
> *An important distinction between developments in the work environment and the home was recognized. Many considered that developments at work would be driven by the Internet, electronic commerce and PC-based activities, and would have an impact on home-use.*

> *On the other hand, and despite the increasing take up of computers in the home, digital television, offering entertainment and information, was seen by some as the predominant platform in the home for the foreseeable future.*
>
> (ISPO, 1998)

It is not the purpose of this document to debate the merits of convergence, but it is necessary to be aware of the above discussions. Most importantly, we believe that the lengthy excerpt provided above is a reasonably accurate summary of the current situation in Africa. In particular, we believe the following points are worth noting:

- Convergence is an evolutionary not revolutionary process;
- At the technology and network levels, convergence is already a reality; and
- There is lack of clarity about how much demand there might be for services in a converged technological environment.

This document will draw on these three points as appropriate. Just as importantly, though, our use of the composite term 'information and communication technologies' is intended to incorporate those technologies evolving from the process of technological convergence. For us, therefore, it incorporates the full range of broadcasting technologies, particularly as these technologies are creating global opportunities for exponentially increased transfer of digital data.

The adaptive nature of ICTs means that technology can be used to support traditional teaching patterns as much as it can be used to support moves to resourced-based and open learning. Haddad and Draxler (2002, p4) note that one of the myths of ICT and education is that 'merely providing ICTs to schools transforms the learning process, and merely connecting to the Internet changes the learner's world'. The introduction of ICT into education at all levels cannot be seen as independent of educational reform more generally, nor of the context within which this takes place. It is thus important to note that:

> *No miracles derive from the mere presence of ICT in a school; it does not, except in unusual circumstances, act as a catalyst for wider scale improvements. Instead, ICT can be a powerful lever for change when new directions are carefully planned, staff and support*

> *systems prepared, and resources for implementation and maintenance provided.*
>
> (Venezky & Davis, 2002, p20)

A final introductory point with respect to ICTs should be made. In discussions of ICTs and education, a common tension emerges—that of ICT for quality versus ICTs for access. Schools (both primary and secondary) tend to make use of ICTs to enhance educational quality, while tertiary institutions and teacher training programmes use ICTs for both quality and access, often privileging one or the other. It is important to move beyond this 'either-or' conceptualization of the problem facing education provision. Rather the focus should be on identifying how ICT might be used to facilitate and support education in such a way that access to good quality education might eventually become available for all.

3. Understanding Media and Technologies .....

In order to make choices about the educational use of technologies, it is worth differentiating between media and technologies, two concepts that are often used interchangeably. Such use masks important conceptual differences in the way the terms are used throughout this document. Tony Bates developed a useful grid to highlight the differences, and relationships, between media and technologies (Bates, 1984, p248). This table was amended by the TELI Research Team, and has been further amended for inclusion below. It is by no means a comprehensive map of the full range of media and technologies, but helps to illustrate the relationship between the two.

This grid is complicated by rapid convergence in both form and functionality of many information, communication, and broadcasting technologies, as has been discussed above. This convergence, however, reinforces the importance of distinguishing between technology and medium, particularly when trying to understand potential educational roles for different technologies. Communication technologies are the means of delivering media messages. Using a simplistic analogy, the technology might be considered to be the type of pipe used, while the medium (or media) is the form of the substance (or combination of substances) flowing down the pipe. Thus, a key criterion in assessing the potential educational value of a particular technology is to understand which medium – or combination of media – can travel down the 'pipe' under evaluation and in which directions it can travel. This understanding can then be related back to predetermined educational goals and objectives in order to determine whether or not a specific technology can be used to support or enhance an identified teaching and learning environment. Naturally, this process will need to take into account financial constraints and cost-effectiveness.

3.1 .....Using Technologies to Support Education

All education and training involves processes of communication between an educational provider and learners, and it is essential to develop an understanding of the modes of communication most appropriate to a particular teaching and learning process. Those deciding to use

Medium	Technologies for Delivery	Educational Applications
Face-to-face contact	• Overhead projectors (manual or electronic) • Specialist technologies • All of the below	• Seminars, tutorials, classes, workshops, and lectures • Learner study groups or self-help groups • Conferences • One-to-one interaction, either between educator and learner, learner and learner, or learner and mentor (especially in work-place) • Drama-in-education or theatre-in-education sessions • Practical demonstration and activities
Text (including graphics)	Print	• Books, booklets, and pamphlets (either already published or written specifically for a course) • Study guides, written either as stand-alone material or as 'wrap-around' guides to already published material • Workbooks intended for use in conjunction with other media materials (for example, audio or video cassettes or computer-based learning) • Newspapers, journals, periodicals, newsletters, and magazines • Printed learner support materials (for example, self-tests, project guides, notes on accreditation requirements or other aspects of courses, bibliographies, and handwritten/typed materials or comments passing between learners and educators) • Maps, charts, photographs, and posters • Written/printed correspondence

Medium	Technologies for Delivery	Educational Applications
		• Learner support material (for example self tests, project guides, notes on accreditation requirements, or other aspects of courses, bibliographies, and materials or comments passed between leaner and educator)
	Facsimile	• Written/printed correspondence • One-multi point distribution
	Computers (including a range of applications such as e-mail, electronic databases, Worldwide Web hypertext documents, FTP or ASCII documents, CD-ROM)	• Electronic publishing • Study guides, written either as stand-alone material or as wrap-around guides to already published materials • Instructional material intended for use in conjunction with other technologies (for example, audio or video cassettes or printed materials) Newspapers, journals, periodicals, newsletters, and magazines • Learner support material (for example, self-tests, project guides, notes on accreditation requirements, or other aspects of courses, bibliographies, and materials or comments passed between learner and educator)
Audio	Audio cassettes	• Audio programmes (music, talk radio, documentary, literature review, lecture, panel discussion, news, current affairs, debate, drama etc.)
	Audio Compact Disc	• Audio programmes as for above
	Radio broadcasts	• Radio programmes as above. Radio phone-ins, talk-back radio)
	Telephone	• Telephone tutoring • Information or enquiry service • Telephone conferences
	Computers with related applications (including CD-ROMs)	• Multimedia sound (audio files) • Voice communication

Medium	Technologies for Delivery	Educational Applications
Video	Television broadcasting (terrestrial, satellite or cable, digital or analogue transmission, including narrowcast educational television)	• Video programmes (music, talk shows, documentary, literature review, lecture, panel discussion, news, current affairs, debates, game shows, drama, films etc). • Lectures • Simulations of procedures and processes
	Video cassettes	• Video programmes as above • Lectures
	Video discs	• Video programmes as above • Instructional material (for example, art pictures or biological photographs)
	Video conferencing	• Video conferences (with two-way audio and video or one-way video and two-way audio) • Point-to-multi-point classes with interactive video and audio
	Computers/ Internet	• Video graphics • See-You-See-Me conferences
Integrated multimedia	*Stand-alone* Computer-based workstation, CD-ROM/DVD, CDI, etc.	• Presentation of information/ knowledge • Simulations • Interactive exercises and assessment
	Networked Linking Computer-based workstation, CD-ROM/DVD, or Set-Top Boxes to public (Internet) or private (Intranet, LAN, WAN) networks	• Presentation of material and/or resources integrating all above media (text, audio and video) and possible applications • Simulations • Assignment submission, assessment and feedback • Conferencing data, audio, video

technologies to support education need to understand the nature of the communication between educators and learners in order to seek ways to support and enhance these processes. Any teaching and learning process consists of combinations of different modes of communication, which in turn support the teaching and learning strategies and activities of a particular course. This communication can either be one-way or two-way, depending on need. Communication can take place in various ways:

- Face-to-face, for example, in classes, tutorials, or practical sessions;
- Via correspondence, whether it involves post, courier, fax, or electronic mail;
- Using printed media of various kinds, which can be distributed either via correspondence or in face-to-face sessions;
- Using audio such as radio, audio cassettes, telephone calls, or audio conferencing;
- Using video, for example, one-way broadcasting, video, or video-conferencing;
- Using computers and computer-based multimedia, whether they be stand-alone or part of a network.

Making decisions about technologies always requires a clear understanding of the varied teaching and learning environments that one aims to support, as well as their potential functions. There are three broad applications for technologies:

3.1.1. Technologies to Support the Educational Provider

Technologies have a crucial role to play in supporting the educational provider itself, particularly in its day-to-day management and administration. Regretfully, however, this important use is often neglected, both in policy statements and in the deliberations of people planning the use of technologies to support education and training.

While some technologies, such as telephones and filing cabinets, have long been used for these purposes, there is a growing understanding that the rapid development of information and communication technologies provide significant opportunities for generating savings in this area of education and training and also for leading to more effective management and administration systems. For example, the growing use

of databases and information warehouses, together with the explosion in the use of e-mail to facilitate quick, cheap communication are two relatively simple applications of such technologies that can prove very cost-effective.

3.1.2. Technologies to Support Delivery of Resources

A crucial role that technologies can play in supporting education and training is to support the delivery of educational resources, particularly course materials. These technologies are made up predominantly of the wide range of information and communication technologies, from the printed book and other printed materials through television and radio to multimedia computers and the Internet.

A defining characteristic of such applications of technologies is the implicit requirement that this will demand some investment in course materials design and development processes. Thus, the technologies covered by this group would not only support delivery of resources by making these available to students, but also support course materials design and development processes. For example, the technologies required for printing books—as well as the technology of the book itself—are necessary to make these resources available to students. Behind this, however, lies increasing use of computers—word processors, graphics programs, desktop publishing—that support the development of the printed resource. Both the development and distribution of resources should, therefore, be considered when making investments in this area.

3.1.3. Technologies to Support Teaching and Learning

Provision of course materials is an important part of the teaching and learning processes in all education and training, whether face-to-face or at a distance. In addition, however, there are many technologies that might support other teaching and learning processes. Some of these can be used generally in any education and training programme, such as whiteboards or overhead projectors, while others might be referred to as specialist technologies, such as woodwork equipment or language laboratories. Again, the technologies covered by this group ranges from the very simple, such as pen and paper, to the very sophisticated, such as computerized simulators.

Convergence in the functionality of technologies is blurring the roles of technologies that directly support teaching and learning processes and those that support provision of course materials. For example, educators may use video conferencing both to deliver pre-designed resources and to support live discussion between geographically separate groups (or to deliver live lectures). Likewise, e-mail can be used to support communication amongst educators and learners, as well as to deliver pre-designed resources.

4. Characteristics of Different Media.....

In this section, we explore some of the characteristics of specific media. Each medium has different strengths and can complement other media to exploit these strengths and overcome potential weaknesses. Below is an introductory explanation of the nature, characteristics, and potential educational applications of each medium. Following this, where appropriate we have described and contrasted the technology options for delivery, focusing specifically on radio, television, and, to some extent, computers.

4.1 .....Face-to-Face Contact

Face-to-face contact has long been the cornerstone of educational practices and mediated learning experiences (to the point that many people now unjustifiably use it as a yardstick for measuring educational quality). This type of contact allows for immediate interaction between educator and learner and between learner and learner. The educational purpose of a face-to-face contact session, the way in which it is designed, and the number of learners and educators involved, influence the nature of this interaction, as do the personalities of the individuals involved. Compare a lecture delivered by a single educator to a large audience with a facilitated group activity in which learners engage with each other in small groups. Each has very different purposes, and hence allows for very different educational experiences.

Face-to-face contact enables individual interaction between educators and groups of learners and, in some instances, between individual learner and educator. It also allows learners to be taken to different locations where the learning experience is designed around the immediate environment of the group. Field trips and excursions are examples of such educational applications. Its strength, when employed effectively, lies in the nature of human interaction. Social interaction, which is frequently beyond the scope of course material, is possible during contact sessions. Both social interactions and related learning experiences can be monitored while sessions are in progress, and instructional design adapted immediately where necessary. Potentially, both learners and educators can read how a situation is progressing, and choose to intervene during the session. Face-to-face contact allows educators to monitor moods, participation, attendance, and levels of engagement with relative ease.

Increasingly, however, extensive face-to-face contact is coming to be viewed as an unnecessary luxury due to its expense. This has been further influenced by the tendency of many educators to use face-to-face contact to communicate the curriculum to learners, a use for which it is ill suited both educationally and financially. Consequently, as has been noted in the previous section, many traditional face-to-face institutions now seek to use distance education and resource-based learning methods to overcome some of the more inefficient uses of face-to-face contact. Many distance education methods seek to emulate or replicate this medium by using combinations of other media and a selection of technologies to replace some of the traditional functions of face-to-face contact.

4.2.....Text

The term 'text' is commonly used to refer to scripted words and other related signs like numbers (Bates, 1995, p116). For the purpose of this discussion, however, text also includes graphics such as pictures, charts, diagrams, and maps. It is often debated whether text or face-to-face contact has been or is the dominant teaching medium, which has the greater influence, and which is the most effective. Such debate erroneously protects one medium at the expense of the other, thereby ignoring the individual strengths and complementary nature of different media.

Various technologies can be used to facilitate textual media communication between learners and educators. For example, an educator may write a note on a chalkboard, course design teams may develop printed study guides for learners to read, learners may type or write assignments, and both educators and learners might participate in e-mail discussion lists. Text has many applications. To name but a few examples, it can serve as a record of activity, as a source for detailed explanation, as a reference for a summary of key concepts, or to support correspondence (including post, facsimile, courier, and electronic mail).

Text can precisely represent facts, abstract ideas, rules, principles, and detailed, lengthy or complex arguments. It is good for narrative or story-telling, and, in the hands of a skilled writer, can lend itself to interpretation and imagination (Bates, 1995, p119).

4.2.1 Technologies for Delivering Text

Text can be delivered by using print, facsimile or computer technologies (including e-mail, databases, web sites, or on CD-ROM).

4.2.1.1 Print[1]

Print could be said to be the foundation of all education. More than 85 percent of distance education programmes use print either as the main delivery technology for courseware or in conjunction with other media and technologies. The importance and quality of print have increased as ready access to relatively low-cost desktop publishing and on-demand printing technology has eased the tasks of preparing, updating, and revising textual and graphic materials. As with computer technologies, printed materials can take a number of forms—newspaper supplements, one-page letters or circulars, posters, booklets, workbooks and textbooks—the full range of which has been presented in the table above. We describe some educational applications of newspapers, textbooks, and workbooks below. Many of the points made for print technologies describe educational concepts, rather than ideas specific to print only. For example, it is quite conceivable to have Matriculation revision guides that are available on the Worldwide Web (and not just in newspapers or booklets), or to have a wrap-around workbook that is contained on a CD-ROM rather than developed as a printed booklet. It is nevertheless useful to spell out these educational applications, as they serve to illustrate how a range of technologies can be used to do similar and complementary educational functions.

Special supplements or regular items in national newspapers—sometimes in conjunction with radio and other mass media—have often been used in large-scale education systems (and distance education programmes in particular) in such subjects as health care and rural development or in national in-service teacher training programmes. Using newspaper distribution networks is often the most cost-effective way of getting educational material to large numbers of readers. Newspapers are also used as a vehicle for communication and contact between and among students, course developers, tutors, and instructors, while

1. *This description of the educational applications of print has drawn extensively from the Southern African Global Distance Education Network web site. http://www.saide.org.za/worldbank/Technology/print_recorded /tech_print.html*

in-house student newspapers are sometimes used to provide general information on an institution's courses. In South Africa, educational newspaper supplements are common, with most large national and regional newspapers carrying an educational supplement on a regular basis.[2]

Most schools and tertiary education institutions make use of textbooks. These are written for classroom use, as well as for independent study and reference purposes. Some textbooks are written in a personal style, including self-assessment questions and review tests or questions at the end of each main section or chapter. Where textbooks are to be used for independent study, they often need to be complemented by a study guide or course guide with commentary and notes. Some online courses based on a 'wrap-around' model use standard textbooks or course readers (edited compilations of articles) as a basic resource, giving online guidance on which sections, chapters, or articles to read for later discussion through the conferencing system.

Modular units or workbooks are written for independent study by the course designers or instructors, and tailored to the course and students. They are generally written in a personal style, as if the writer was speaking directly to a student (a 'tutorial in print'), and are structured so that the student's reading corresponds to the agreed study schedule for the course (each unit might correspond to eight hours' work or a week's work, for example). A well-designed unit contains explicit study objectives, a clear table of contents, a glossary of any new or technical terms introduced, completed examples, and many in-text activities, such as exercises and self-assessment and review questions. Students may be encouraged to annotate units with their comments and answers to exercises and quizzes, and then compare their responses with model answers or instructor's comments at the end of the unit.

2. *Soul City and Yizo Yizo – recent South African educational broadcasting interventions – have used newspapers to distribute accompanying print materials. The Weekly Mail and Guardian includes a regular supplement called The Teacher for South African teachers. The Learning Channel Campus distributes Matriculation support and revision materials for school students via newspapers like the Star and the Sowetan, and makes duplicate consolidated newsprint packages for distribution through other networks. The Media in Education Trust has used similar methods, particularly for materials directed at teachers on Curriculum 2005.*

4.2.1.2 Computer Applications[3]

Most computer applications make extensive use of text. The written word is used for instructions, entering data and presenting most information. Two computer applications that are frequently used in tandem and are primarily text-based are online services and databases. Online services play an important part in education, including subject-related databases and library services, online access to information about courses, and links to administrative services such as registration and fee payment. Increasingly, however, personal computers with web browsers have become the most common mode for accessing online services.

Another is the hypertext protocols used for web-sites. Hypertext is a protocol for linking parts of documents to other documents or to parts of other documents. Clicking on a 'hot spot' in a hypertext document activates a hypertext link in the underlying software, taking the reader to the linked item. These items may be text, audio, graphics, or video documents—separate files coded in hypertext mark-up language (HTML). HTML files are read by a web browser, a mouse-driven software interface. Writing text-based course materials in HTML is no more complex than using a word processor. The hyperlinking function allows a course developer to build interactivity into courseware, presenting students with options and paths to follow depending, for example, on their interests or on the answers they give to self-test questions.

Electronic mail also makes extensive use of text. It is a form of store-and-forward computer-based messaging that enables a user to send text messages from a personal computer over a data network (such as the Internet) to one or more recipients. Recipients collect messages from their 'mailbox' on a central server, using their own personal computer or workstation. Access to e-mail is becoming widespread in many countries, through institutional and corporate networks or Internet service providers. As network bandwidth and personal computer processing power increase, so does the ability to attach files to e-mail messages, ranging from formatted documents to sound and graphics or even video files. E-mail can be used both for one-to-one and one-to-many communication (through e-mail distribution lists) and thus can support group interaction.

3. *This description of the educational applications of computer based technologies has drawn extensively from the Southern African Global Distance Education Network web site. http://www.saide.org.za/worldbank/ Technology/*

For example, a tutor can use e-mail to easily send the same message to every student in a group, and a group of students can use e-mail to work together on an assignment.

4.2.1.3 Communication Technologies

Much of the discussion above has related to choices about how text-based material is distributed. Often this choice is based on the levels of interaction required between the recipient and the sender. The communications technologies used to support interaction are frequently divided into two broad categories:

- Asynchronous (or deferred-time) technologies, which do not require participants to be present simultaneously. Examples include postal correspondence, electronic mail, and computer conferencing.

- Synchronous (or real-time) technologies, which require participants to interact at the same time, generally prearranged. These technologies include telephony, audio-conferencing, audio-graphic conferencing, video-conferencing, and multi-user object-oriented environments (MOOs).

This is an important conceptual distinction for making decisions about which technologies to use to support educational processes—it will be returned to when considering technologies for delivery of audio and video media.

4.3 ....Audio

One of the primary ways in which humans communicate is by using sound or audio. As communication plays a fundamental role in education, it is not surprising that audio is a key component of many educational initiatives. To illustrate, conversation, debate, counselling, and lectures all use this medium frequently.

Bates attests that a great deal of the educational use of audio centres around the human voice. A great advantage of listening to a voice is that it can be modulated, in other words, the voice can vary in pitch, intonation, pace, volume, and emphasis. Of course, audio resources can make extensive use of music and sound effects as well as human voices. Thus, 'audio is possibly the most undervalued of all media. Audio technologies are cheap, easy to use, accessible and generally educationally effective' (Bates, 1995, p138). Audio resources are effective

for supporting communication skills and for explanation of concepts. They can be used in combination with other media (such as text, graphics, or video) to provide multi-sensory input, and are important for teaching appreciation of music or identification of sounds. Audio can also be used to create a specific mood or atmosphere. Pronunciation and language skills can be supported. In all these instances, though, audio resources, especially when transmitted via radio broadcasts, are transitory.

Several underlying assumptions exist about audio resources. One of the most important—and abused—is that audio resources assume homogeneity among listeners. On this basis, many developing countries have developed audio resources (distributed via radio broadcasts) as part of a strategy to democratize distribution of educational materials or correct a bias towards urban areas and middle class schools (Olsson, 1994). This democratization argument is very powerful, but essentially erroneous. While it may be possible for distribution to be democratized through broadcast, distribution is a quantitative entity. It does not follow logically that educational impact, a qualitative and far more complex phenomenon, will necessarily be similarly democratized or distributed. Audio resources have differing abilities to support interactive learning. Unless interactivity is intentionally part of the instructional design of a resource, it is not likely to be implicit to it.

Audio resources have real potential to assist children with developing communication and language skills through practice. There is, however, some concern about whether or not these resources can do anything more than simulate a conversation between 'tape teacher' and 'tape student', and whether or not synchronous use of radio broadcasts promotes active learning by the student.

Audio resources have also been used successfully with early childhood development learners and foundation phase students. In some examples, resources used auditory stimulation to encourage exploration and development of other sensory experiences and awareness. This form of stimulation can potentially create any environment in a listener's mind, because it relies on the power of imagination and creativity of scriptwriters, listeners, and caregivers. Like most effective use of educational media, audio is best used in combination with other media.

4.3.1 Technologies for Delivering Audio

Audio can be delivered using radio, audiocassette, music/audio compact discs, or computer applications. We focus on the former two options as the latter are discussed under integrated multimedia.

4.3.1.1 Radio

Dubbed 'the most accessible technology in terms of cost and comprehension', radio has been used in education ever since it became available. It has been used for school broadcasts, in-service teacher support and training, and adult literacy and basic education campaigns. In combination with tutorials, print materials, local listening groups, and face-to-face meetings, radio has been used in many countries to teach a wide range of subjects at the school and college level. Several large distance teaching universities around the world use radio in many of their distance education courses. Now that audio cassette recorders are more widely available, educators can more easily compensate for the ephemeral nature of radio broadcasts and its fixed transmission times. Where students have access to telephones, phone-in discussion programmes can help to overcome the one-way nature of radio broadcasting.

4.3.1.2 Audiocassettes

When audio materials are recorded, they provide significant educational advantages over radio. Audiocassettes are less glamorous than technologies such as the Internet or television but, as an educational technology, potentially have a more positive impact on learning processes than radio. As a technology, audiocassette recorders give educators and learners the power to record audio resources for asynchronous use. Teachers and students can also purchase complete sets of programmes, which would have the added advantages of being well organized and clearly labelled. Use of recorded audio resources allows learners greater control over the duration of the listening-learning process, as well as its frequency or quantity.

Recording radio broadcasts is not a simple process. The type of equipment available in the home or learning and teaching site such as a school (separate radio and tape recorders are less effective for recording than combined radio-tape players), the skills and coordination required to record radio broadcasts, and storage and cataloguing of recordings impact on this process. Provision of cheap, efficient, and coordinated

distribution of audio resources by a broadcaster is one way of simplifying the process and encouraging asynchronous use of audio resources.

Audiocassette recordings of radio resources do, however, differ in style and educational effectiveness from audio resources intended for individual use as part of a course. Students have, for example, reported that course-based supplementary audio materials were more helpful than radio-based learning materials intended for broadcast use (Bates, 1984, p205). Audiocassette resources and associated technologies provide students with stop-start and review facilities, while teachers can exploit opportunities provided by *'the hidden nature of the next part of the tape to be played'* (Bates, 1984, p205). Replay and pause facilities have been found to be effective for analysis or revision-type learning activities.

In combination with print materials, audiocassettes allow for simultaneous audio and visual stimulation, while students can move between media at their own pace. This flexibility is important in resource-based learning and learner-centred education. Use of audiocassettes also allows students and teachers the opportunity to leave their hands and eyes free. Bates lists the following advantages of using audiocassettes as learning materials:

- To analyse or process detailed visual material…The purpose of the cassette is to 'talk' students through the visual material;
- To enable students through repetition to obtain mastery in learning certain skills or techniques (e.g. analysis of language, language pronunciation, analysis of musical structure and technique, mathematical computation); and
- To analyse or critically review complex arguments, or carefully structured logical arguments.

(Bates, 1984, p248)

A variety of formats and styles is available to producers of audiocassette resources. The traditional format of audiocassette resources is the 'Reith Lecture', where an eminent person presents a series of lectures on cassette. Other possibilities include: 'talking' students through a learning process; music; synthesized sound special effects; naturally occurring events; the cacophony of sounds on streets; extracts from political speeches; recordings of sports and dramatic events; or the voices of ordinary people participating in a panel discussion, radio talk show, or phone-in. Educational audio programmes can use music, talk radio, documentary, literature review, lecture, panel discussion, news, current affairs, debate, drama and other common formats.

The educational value of audiocassette resources is dependent on the extent to which they encourage interactivity. For example, a 'tape teacher' or sound special effect can encourage (cue) students to practise pronunciation, translation, grammar, or to turn the page of a printed text. This supports communication and language skill development. If instructionally designed to do so, audiocassette resources can encourage students to summarize in written form what they have heard, thereby reinforcing mastery of oral and written literacy skills.

Audiocassette resources have also been used with secondary school students, to present different points of view of a range of people. They can be used to familiarize students with an argument or even a story or play. They provide a useful way of showing students how course materials are linked to events occurring in the wider society. If audiocassettes include a commentary about an event or experience, they can be useful in motivating students and allowing them some opportunity to experience an unfamiliar event emotionally.

Audio resources are effective for supporting communication skills and for explanation of concepts, stimulation to encourage exploration, and development of other sensory experiences and awareness. This form of stimulation can potentially create any environment in a listener's mind, because it relies on the power of imagination and the creativity of scriptwriters, listeners, and caregivers.

After print, the humble audiocassette is the most widely used technology in distance education, in both single- and dual-mode institutions. Audiocassettes are cheap to produce and distribute, can be listened to almost anywhere, and can be easily re-used. In arts, science, and technology courses, they can be used in conjunction with print materials (diagrams, illustrations, photographs) to provide 'audiovision,' with an instructor or expert providing commentary and guidance as the student views the material. The educational potential of audio in such subjects as drama, poetry, and music is self-evident. Audiocassettes can provide instructions for hands-on manipulations or procedures ranging from carrying out a home experiment to learning to use computer software. They can also personalize a print-based education course, enabling the student to hear the instructor's voice as he or she explains concepts developed in the print materials.

4.4 ....Video

Video has a wide range of potential educational applications. It is a good medium for providing students with an opportunity to view that which they would not usually experience (for example, the inside of an aeroplane cockpit). Video can be used to show text and graphics. It can also be used to show a lecture or presentation, often referred to educationally as a 'talking head'. A person can be shown talking about a subject, and this presentation could either be broadcast live, pre-recorded, or combine live and pre-recorded material. The latter might mean that a presenter could show lecture aids, such as notes, diagrams, charts, or photographs while talking through explanations or complementary commentary. Video clippings of processes or events might also be included in such presentations. Video can also show what is being explained, as it happens in the 'real world'. Video can be particularly useful educationally for showing movement or procedures. It is a good medium for actualization, visualization, and story telling. While video is often criticized for being ephemeral and fleeting, this can also be viewed as its strength. A good story can be presented without interruption, gripping viewers and enabling them to see processes played out over time. When used on videocassette or computer, video can be interrupted and reviewed at will. Nevertheless, it can be viewed continuously, presenting a set sequence of events in an appealing and entertaining manner.

Video can be used to capture and reflect on student performance. For example, teachers can learn by seeing themselves in the classroom, actors or sports players can reflect on their performance, while students might improve their presentation skills by seeing how they come across on camera. With a video camera, students can produce videos, using this to present an assignment or to share an experience with other students. Although the above uses of video may be regarded as the domain of small and expensive educational courses or programmes, this need not necessarily be so. Snippets of material developed in the above ways might quite conceivably be integrated into video resources that are broadcast via television or distributed on videocassette.

One way in which the educational impact of video resources can be measured is to examine the impact on student and teacher interactions. Educators and broadcasters agree that video makes innovative styles of teaching and learning possible, and shared student/teacher viewing potentially can change the power dynamic between teacher and student

(Moses & Croll, 1991). Of course, it can just as easily reinforce authoritarian teacher-centred patterns.

Multi-cultural classrooms are often sites of invisible, but very real, hegemonic struggle for cultural dominance (Walkerdine, 1991). Thus, for example, the content of a geography lesson on 'farming technology' can benefit from video information on traditional and non-traditional methods of farming with which a teacher may be unfamiliar. Video resources can provide support to teachers within a multi-cultural classroom, and have the potential to challenge often-invisible resistance to alternative viewpoints in a classroom (Moses & Croll, 1991).

Video-based learning resources can introduce interesting factors into debates about the merits of literacy versus oral-based learning and cultures. The use of video resources such as archival footage might add to an understanding of the history of a country. Because video resources most often are accompanied by audio tracks, they tend to rely on multiple media to present information that is neither purely oral nor purely literal. In this way, video can show behaviour, nuance, and relationships in a variety of contexts that simultaneously demand oral and literary skills (Moses & Croll, 1991).

The educational impact of video resources depends, at least in part, on the extent to which instructional designers include interactive learning activities for students. Viewers, whether adults or children, do not come to the screen with 'empty minds', but have prior learning experiences that are relevant to how they access and use visual information. In an age where we are expected to receive, process, and discriminate between messages at very high levels, video resources need to challenge what students know and potentially can know. Integrating recognition of prior learning into the instructional design process (especially of television broadcasts) is, however, complicated by the fact that audiences tend to be assumed to be 'homogeneous', while distribution of the message is 'democratic'.

A correlation exists between video comprehension and reading comprehension, as does a cognitive interdependence between viewing and reading skills (Kelley & Gunter, 1996). Educationally, video's strength is the attractiveness of its content, not its complexity. This is important for developing and using video resources in the classroom. Several international studies have examined this issue, and it is clear that learning from video is only possible if teachers and parents support

a young student's learning process. Conceptualization of viewing has changed significantly, to the extent that it is now commonly regarded as a skill that can be taught. Learning from video therefore demands the development of particular skills. One study tested this hypothesis, finding that, if viewing skills are taught to children, it significantly improves their ability to learn from video resources.

Increased demand for visual literacy skills is often used by romantic, 'pro-technology' groups to justify their argument that each classroom must have a television. Certainly, visual displays of information are widespread and growing in sophistication, and clearly children's cognitive development must, by necessity, include development of these skills. Findings from cognitive research support these claims. Today's children draw on visual memories several hundred times more often than their parents, who rely mostly on literal associations. The importance of enhancing visual literacy skills is forcing reconsideration of the traditional schism between logical/verbal/numeric and spatial understanding/manipulation/imagery skills. Visual literacy research suggests a stronger interdependence between these skills, encouraging that both be developed together and not to the other's detriment. As with all other skills, however, the development of visual literacy skills in video resources must be an overt objective of the instructional design process. Simply watching video does not 'automatically' develop visual literacy skills.

4.4.1 Technologies for Delivering Video

Video material can be recorded on electromagnetic tape, and replayed using videocassette machines. Videocassettes store video in an analogue format. A range of other technologies can also be used for recording and replaying video materials. Video can be delivered via terrestrial or satellite television broadcast, using videocassettes or videodiscs, as part of video conferences, or across the Internet.

4.4.2 Television

Television programmes are far more costly to produce and to transmit than radio programmes, especially if they are broadcast over public networks and expected to meet production standards similar to those of news, documentary, and entertainment programmes. Narrowcast programmes can be produced on smaller budgets, but simply placing a lecturer in front of a television camera and transmitting the results is

generally considered an ineffective use of the medium for education (although this approach is widely used in the vast Central Chinese Television University). Television comes into its own in a mixed-media distance education course, used to demonstrate scientific or laboratory experiments, to broadcast field trips, case studies, or performances, and to help visualize dynamic processes and sequences of events. In cultures where television viewing is passive and recreational, however, it can be difficult for students to change their viewing habits and see television as an educational medium. In addition, unless students have access to recording equipment, at home or at local study centres, the ephemeral nature of the broadcast must be taken into account in determining its educational objectives and its place in a structured educational course.

From an educational perspective, broadcast for immediate viewing is subject to several limitations. The most notable of these are:

- Learners are required to gather at a certain place (where a television is) at a certain time;
- Learners have no control over the pacing of the broadcast;
- Broadcasts tend to encourage passivity amongst learners (and strategies employed to overcome this problem inevitably start generating significant additional cost, usually leading to serious financial inefficiency);
- Integrating other media with video broadcast live is very difficult to achieve, and, when applied, very often leads to inefficient use of both broadcast technology (an example of this might be leaving 'dead' spaces to allow students to consult a printed resource) and the medium (this type of integration most often leads to quite boring television); and
- Broadcasts tend to be organized in time packages that are much longer than the time an average student is able to concentrate fully on the television screen.

In summary, it is much easier to develop poor quality than good quality educational television broadcasting. There is a very narrow band of educational applications for video that is accessed by learners via a broadcast signal.

Of course, broadcasts can be recorded using a videocassette recorder, thus turning the broadcast infrastructure into nothing more than an alternative distribution mechanism. Obviously, videocassettes can also

be distributed separate to a broadcast. The major advantage of either recording a broadcast or using a videocassette is that videocassettes can be used when and how people desire. Learners or educators can choose when to screen a video and which sections of it to use. It can be paused, or rewound and reviewed, if desired. This can be educationally useful if, for example, sections of the video (particularly those depicting movement or procedures) need to be shown repeatedly. The ability to watch and re-watch video can also be exploited by learners using video as part of a self-paced, resource-based learning environment, in which they watch the material in their own time. All of these features facilitate the integration of use of other media into the video-watching experience. In a structured learning site, videos can also be stored for re-use every time a course is run, allowing for effective amortization of costs of many student cohorts.

4.5.....Integrated Multimedia

Most computer and broadcast technologies allow for the integrated use of a number of different media. The integration of media has, however, also long been a common strategy used in the traditional classroom environment. To illustrate, a teacher might explain a concept (face-to-face contact), while writing notes onto a chalkboard (text). Learners might then watch a television programme (video), before completing a worksheet (text), and discussing their responses in a group (face-to-face contact). Convergence of information, communication, and broadcasting technologies is rapidly increasing the ease with which media can be integrated, as well as allowing for delivery of multimedia resources via common technological platforms. In the above examples, separate technologies of a chalkboard and chalk, a television, and printed material were necessary. Computer technology allows text, audio, and video material to be accessed via a single platform. Furthermore, because all three media can be stored as digital files, they can increasingly be accessed in a number of ways. They may, for example, be stored and extracted directly from electronic databases, accessed via the Worldwide Web, distributed on CD-ROM, or broadcast and accessed using televisions and set-top boxes.

In education, multimedia has come to mean the integrated use, in a computer-based system, of digitized text, audio, graphics, animation, and video to present elements of course content. These elements can be presented in many different ways, allowing learners to choose their

own path through the courseware using keyboard or mouse interactions. Developing good multimedia courseware is a highly skilled task requiring knowledge of subject matter, instructional design skills, and familiarity with authoring software. Multimedia courseware may be presented on a CD-ROM for use on a stand-alone personal computer or over the Worldwide Web through networked computer terminals.

The readily available and robust Web browser software and tools for Web software development have made it relatively easy to design customized web environments for education and training. These environments may combine courseware resources (hypertext pages, multimedia) and scheduling aids with tools allowing tutors, trainers, and other participants to interact both asynchronously (email, computer conferencing) and synchronously (audio and video links). The environments can be configured in different ways to support different types of learning activity (individual, small group, plenary). They can also contain aids for instructors for course design, class management, knowledge structuring, testing, and evaluation.

5. Socio-Economic Context of Sub-Saharan Africa .....

Having provided a detailed overview of the range of educational technologies available and how ICTs fit into this range, it is now possible to begin reviewing the context in which educational technology is used for educational purposes in Africa. This section aims to provide a brief overview of the socio-economic context of sub-Saharan Africa. Care will be taken to highlight the diversity, as well as the similarities, between countries, since a common problem of continental reviews and projects is that Africa is treated as a homogeneous continent. This means that initiatives relevant in one context are often assumed to be relevant in another. This is not to say that there are no similarities or possibilities for sharing and learning from other country or regional experiences, but rather that such learning should always be evaluated in terms of the specific conditions in each country or region.

5.1.....General Socio-Economic Indicators

For ease of reading, ten African countries representing each of the regions of the continent (Southern, East, West and Central, and North) have been selected and socio-economic indicators presented. Not only do these countries represent regional differences, but they also serve to highlight the wide disparities in socio-economic conditions across the continent. These countries have also been selected because they were those for which the widest range of data was consistently available. For comparison purposes, data are also provided for sub-Saharan Africa, developing countries and for OECD countries. These statistics highlight the importance of adapting models of best practice from developed countries to the specifics of the African context.

According to the 2002 Human Development Report the population of sub-Saharan Africa was 606 million in 2000, with 45 million people under the age of 15 years. Table 1 (on page 49) provides general demographic information for the ten selected countries.

This table reveals diverse socio-economic conditions across these ten countries. Total population ranges from 113.9 million in Nigeria (the most highly populated country in Africa) to as low as 0.4 million in Cape Verde. The population of Africa is still predominantly rural, although in some countries (such as Morocco) the urban population is over 50%. This,

Table 1: Socio-economic indicators of selected African countries

Country	Population in 2000 (millions)	Urban population in 2002 (% of total)	Annual % population growth		GDP per capita 2000 (PPP US$)	% below poverty line (1983-2000)	
			1975-2000	2000-2015		1$ per day	2$ per day
Botswana	1.6	49.0	1.8	1.0	7 184	33.3	61.4
Cape Verde	0.4	62.2	1.7	1.9	4 863	...	...
Cameroon	14.9	48.9	2.7	2.0	1 703	33.4	64.4
Congo, DR	50.9	30.3	3.2	3.3	765	...	...
Egypt	67.9	42.7	2.2	1.5	3 635	3.1	52.7
Kenya	30.7	33.4	3.3	1.8	1 022	26.5	62.3
Morocco	29.9	55.5	2.2	1.5	3 546	<2	7.5
Mozambique	18.3	32.1	2.3	1.7	854	37.8	78.4
Nigeria	113.9	44.1	2.9	2.5	896	70.2	90.8
South Africa	43.3	56.9	2.1	0.2	9 401	11.5	35.8
Region							
Sub-Saharan Africa	606T	33.9	2.8	2.4	1 690	N/A	N/A
Developing Countries	4 695T	40.0	1.9	1.4	3 783	N/A	N/A
OECD	1 129T	76.9	0.8	0.5	23 569	N/A	N/A

Source: *Human Development Indicators* (2002)

however, is also a function of the geography and climatic conditions of this region. Of these ten countries, the Democratic Republic of Congo and Mozambique have the lowest percentage urban population. This rural-urban split is important because there are generally higher poverty levels in rural areas, which have less access to all forms of services and infrastructure, including education. While the population of all ten countries is predicted to continue growing from 2000-2015, evidence of lower rates of growth is apparent for most of the countries listed above.[4]

Per capita income also varies widely, with people in Congo DR living on an average of US$765 per year compared to US$23,569 for OECD countries. The percentage of people living below the poverty (PPP) line ($1 and $2 per day) is telling. In Nigeria, the vast majority of the population lives below the poverty line, with 90.8% of Nigerians earning less than $2 a day. South Africa, the country with the highest GDP per capita in Africa, still has 35.8% of the population living on less then $2 a day. These statistics are especially important when educational issues are considered, since many studies have shown that children are forced to work (either for wages or for subsistence) in conditions of poverty.

According to statistics presented in the Human Development Report 2002, several African countries have shown a negative GDP per capita growth rate between 1995 and 2000. These countries include Algeria (-0.1), Sao Tome & Principe (-0.8), Kenya (-0.5), Cameroon (-0.8), Congo (-3.4), Togo (-0.4), Madagascar (-0.9), Nigeria (-0.4), Djibouti (-3.9), Congo DR (-8.2), Gambia (-0.3), Angola (-1.8), Rwanda (-2.1), Central African Republic (-0.5), Chad (-0.8), Guinea-Bissau (-1.1), Burundi (-4.7), Niger (-1.0) and Sierra Leone (-6.5).

Table 2 (on page 51) provides information about the health and well-being status of people living in Africa. It is evident that life expectancy varies widely across countries. Out of the ten countries listed here, all for which information was available have problems with nutritional provision. This is especially the case for Congo DR, Mozambique and Kenya, where more than 50% of the population are undernourished. Once again, this has important implications for education since cognitive development can be impaired when nutrition is poor. Furthermore, there are high levels of children under the age of five years who are under weight for their age. Nutritional problems early in life can have

4. *Population growth statistics are likely to change dramatically in the next decade as the effects of the* HIV/AIDS *pandemic become increasingly evident.*

Table 2: Health and well-being indicators for selected African countries

Country	Life expectancy at birth (years)	Under-nourished people (% total population)	Children under weight for age (% under age 5)	HIV/AIDS		
				Adults (% age 15-49 years)	Women (no. age 15-49)	Children (no. age 0-14 years
Botswana	40.3	23	13	38.80	170 000	28 000
Cape Verde	69.7	...	14	...	...	...
Cameroon	50.0	25	21	11.83	500 000	69 000
Congo, DR	51.3	64	34	4.90	670 000	170 000
Egypt	67.3	4	12	<0.10	780	...
Kenya	50.8	46	23	15.01	1 400 000	220 000
Morocco	67.6	6	9	0.08	2 000	...
Mozambique	39.3	54	26	13.00	630 000	80 000
Nigeria	51.7	7	27	5.80	1 700 000	270 000
South Africa	52.1	...	...	20.10	2 700 000	250 000
Region						
Sub-Saharan Africa	48.7	17	...	1.32	18 000 000T	2 900 000T
Developing Countries	64.7	34	...	9.00	15 000 000T	2 600 000T
OECD	76.8	...	...	0.28	360 000T	19 000T

Source: Human Development Indicators (2002)

permanently damaging developmental effects. In addition, this situation also places pressures on governments to make difficult decisions about sectoral spending.

The table also provides some information about HIV/AIDS. For all countries depicted here, except for Egypt and Morocco, there is a high number of people infected. Particularly worrying is the number of children infected. The HIV/AIDS pandemic has implications for education in several ways, as will be addressed below. Most countries in Africa now have both preventive and treatment programmes, although some countries have been very slow to recognize the severity of the problem.

These basic socio-economic statistics paint an alarming picture about the state of the African continent. There is reason for concern and this should be translated into action to address the many challenges that lie ahead. However, these statistics do not show the wealth of initiatives in many African countries and across the continent as a whole that seek to tackle these issues and encourage development of the continent (examples of these are provided in later sections of this report).

5.2.....Educational Context

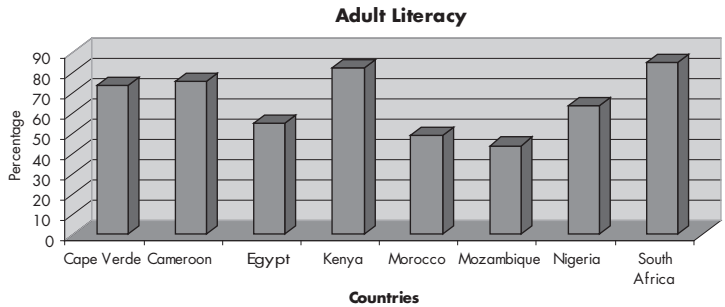
The importance of education for a country and region's well-being, development, and prosperity is now commonly acknowledged. This section aims to provide further contextual detail about the current educational landscape in African countries.

Compared to global trends, African education lags behind. In Africa, natural and human-made disasters and conflicts have placed extreme pressure on educational systems, many of which are built on weak physical and institutional bases. In addition, many countries in Africa have been victims of austere structural adjustment programmes, which, among other consequences, have led to cuts in educational expenditure. This, together with increasing debt burdens, governance problems, an unsupportive global economic context, and the impact of HIV/AIDS, means that the basic human right of access to education has been denied to many (Sub-Saharan African Education for All Framework for Action, 1999). The statistics below describing the African educational context bear witness to these observations. However, education has been recognized as a fundamental pillar of African development. This means that, although the journey towards an integrated and fully functioning educational environment that equips African people for the

global knowledge society/economy is a long one, it is a journey that has begun.

Literacy levels are a common starting point for assessing the state of basic education. As Chart 1 below illustrates, many African countries still have some way to go in achieving basic literacy for all, although many gains have been made during the past decade.

Chart 1: Adult literacy in selected African countries



Source: *Human Development Indicators* (2002)

Few countries in Africa have achieved universal primary education (only 10 countries in 1999), although enrolments have increased. From the chart below showing primary school enrolments[5] for several African countries, it can be seen that none of the selected countries have achieved an enrolment ratio of 50% or greater. Only 26% of primary school-going age children from Niger are enrolled in schools, leaving 74% not in school. On average, only 37.7% of primary school children are in school in the seven selected countries, and the figures are worse when enrolment ratios for girls only are reviewed. For many countries, these data are still not readily available.

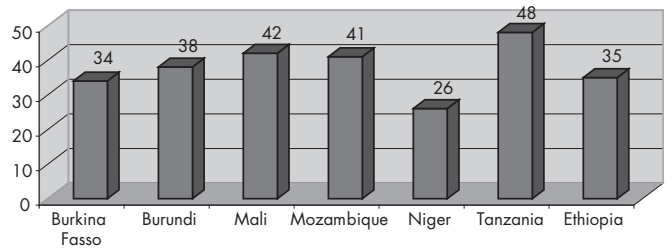
UNESCO (2002) notes that to achieve universal primary education in sub-Saharan African an additional 88.1 million primary school places will need to be created. In addition to Niger, the problem is particularly acute for Angola, the Central African Republic, DR Congo, Lesotho, Liberia, and Somalia, which each need to increase their places in primary schools by more than ten times current levels. Further, the EFA (Education for All)

5. *It should also be noted that several authors are questioning the relevance of enrolment ratios as a measure of educational success in favour of graduation rates, which provide a better indication of the quality of schooling, and of the learning that takes place.*

Global Monitoring Report for 2002 rates sub-Saharan and North Africa, together with East Asia, as high-risk with respect to achieving these targets. These figures should be compared to primary school enrolments for many developed countries, which average 95-100%.

These disturbing trends notwithstanding, some African countries have fared very well. For example, Cape Verde had a primary enrolment ratio of 99%, South Africa 100%, Egypt 92%, and Morocco 79% in 1998 (Human Development Indicators, 2002). Thus, again, the diversity of educational provision across the continent is evident.

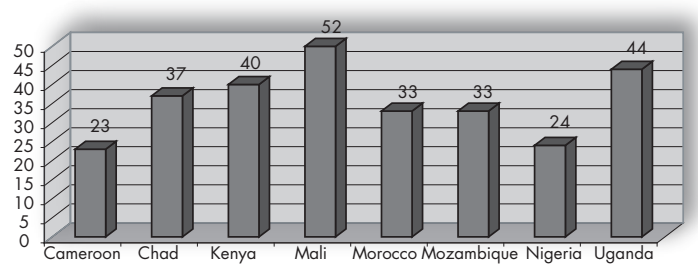
Chart 2: Net primary enrolment ratio 1998 – Selected African countries



Source: *World Development Indicators database* (2001)

There are several factors, usually always related to living in poverty, which keep children out of school. Child labour is still a common survival strategy for families in many developing countries, as shown in Chart 3 below. UNESCO estimates that there were 113 million children out of school in 1998, 97% of which are in developing countries and 60% of whom are girls. Sub-Saharan Africa has the largest proportion of children out of school, constituting up to 40% of the world total.

Chart 3: % of children aged 10-14 years in labour force in selected African countries

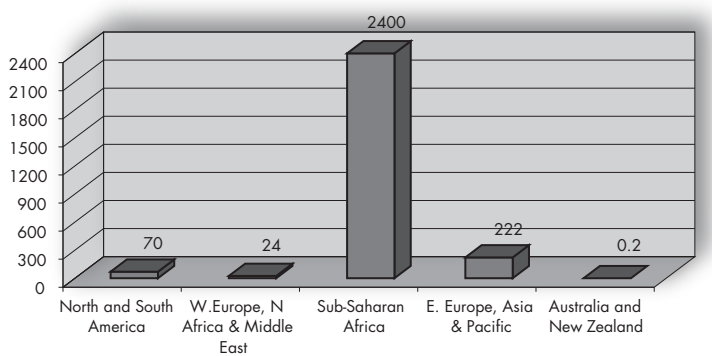


Source: *World Development Indicators* (2001)

In Mali, for example, 52% of children aged between 10 and 14 years are part of the labour force instead of being at school. 44% and 40% of children in Uganda and Kenya respectively are involved in labour activities. One of the reasons for this situation is the need for children to assist with agricultural activities at particular times of the year. Girls are often the first to be burdened with additional household duties that make attending school difficult.

The HIV/AIDS pandemic must also be taken into account when considering school attendance. Youth, particularly children, bear the brunt of the effect of HIV/AIDS, some as sufferers of the disease, and many as orphans and heads of households where parents have died. Ainsworth, Beegle, & Koda (2002) showed that orphan status, particularly maternal orphans, had a negative effect on primary level enrolment. On the positive side, the study found that children already in school did not tend to drop out on the death of a parent. Due to high rates of mother-to-child transmission of HIV (which are particularly severe when health care facilities are lacking), sub-Saharan Africa also shows disturbingly high levels of children who are HIV positive.

Chart 4: Children under 15 years estimated to be living with HIV/AIDS (x1000) Dec 2001



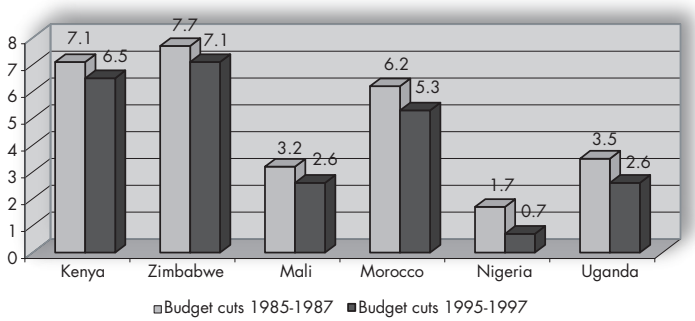
Source: UNAIDS *http://www.unaids.org/worldaidsday/2001/EPIgraphics2001/EPIgraphic7_en.gif*

Many HIV positive people are in the 16-35 year age group, and it is predicted that Africa will lose many of its teachers in the decade to come. This will further complicate the current situation wherein there is a vast shortage of teachers. Education systems are dependent on the supply of well-trained teachers, academic managers, and support staff. Of the 59

million teachers in the formal education sector globally, only 2 million are in sub-Saharan Africa (UNESCO, 2002). It has been noted that, in order to achieve EFA in sub-Saharan Africa, 700,000 more teachers will be needed by 2005, and 1.2 million by 2015 (UNESCO, 2002). These estimates do not take into account the effects of teacher loss due to HIV/AIDS.

Despite current crises facing children, particularly in the context of education, national education budgets continue to be cut. The impact of budget cuts is felt mostly with teacher training, where there is an urgent need for replacement of teachers who have died of AIDS-related diseases, as well as a need to provide quality training for many teachers who, although teaching, do not have the required training to provide quality education. With the introduction of ICT into education, teacher training becomes even more important. Further, there is a need for investment in educational infrastructure, as classrooms remain over-crowded and learning resources for many schools are minimal. Budget cuts for a ten-year period (1987-1997), in selected African countries, are provided in Chart 5.

Chart 5: Education budget cuts in African countries 1987-1997



Source: *Human Development Report* (2001)

The above chart shows that although budget cuts are still a problem in the African context, for all of the countries shown here the cuts have decreased from the 1985-1987 period to that of 1995-1997. This possibly indicates that there has been increasing recognition of the importance of education. Table 3 (on page 57) provides some data on public expenditure on education. It should be noted that these data are often

not available, but as far as possible, countries have been selected to represent different regions.

Table 3: Public education expenditure for selected African countries: 1995-1997

Country	Public education expenditure		Public education expenditure by level, % of all levels		
	As % of GNP	% total government expenditure	Pre-primary and Primary	Secondary	Tertiary
Burundi	4.0	18.3	42.7	36.7	17.1
Cameroon	…	16.9	…	86.8*	13.2
Egypt	4.8	14.9	…	66.7*	33.3
Gambia	4.9	21.2	48.9	31.6	12.9
Malawi	5.4	18.3	58.8	8.9	20.5
Morocco	5.3	24.9	34.6	48.8	16.5
Namibia	9.1	25.6	58.0	28.9	13.1
Senegal	3.7	33.1	34.2	42.5	23.2
South Africa	7.6	22.0	43.5	29.5	14.3
Zambia	2.2	7.1	41.5	18.4	23.2

Source: *Human Development Indicators* (2002)

**Combined primary and secondary*

Table 3 illustrates that different countries spend varying amounts on education. In this sample, Zambian expenditure at 2.2% of GNP is particularly worrying. On the other hand, many African countries (for example, Namibia, Senegal, and South Africa in Table 3) do spend a significant proportion of their GNP on education. A World Bank report (2002) notes that, based on OECD experience, investment in education should be between 4 and 6% of GDP, a range within which most of the countries included above fall. However, when one considers the difference in GNP between most African and developed countries, the absolute value shortage of funding made available to build the education system is striking. A recent World Bank study, cited by the EFA Global Monitoring Report 2002, reported that achieving EFA goals by 2015 would require external funding of about US$2.5 billion over the 15-year period. Sub-Saharan Africa will require 85% of this funding. DR Congo, Ethiopia, Nigeria, and Sudan are predicted to have financing gaps of US$100 million per annum. Cameroon, Côte d'Ivoire, Mali, Niger,

Senegal, Uganda, and Tanzania are predicted to need US$50-100 million per annum to achieve EFA targets.

The second part of the table indicates that most African countries are focused on primary education, as this is where the majority of expenditure is channelled. This will make an important contribution to achieving universal primary education. However, it is becoming increasingly important for countries to develop both secondary, and particularly, tertiary level education provision in order for African people to be able to compete in the global knowledge environment. In addition, tertiary education plays a fundamental support role in the development of primary and secondary education (Nwuke, 2001; Mansell & Wehn, 1999; Levey, 2002; Saint, 1999; World Bank, 2002). Therefore expenditure of the education budget should be between 15-20% for tertiary education, although, where basic education for all has not been achieved, spending greater than this will favour an elitist education system (World Bank, 2002).

The tertiary education[6] environment in sub-Saharan Africa is as troubled as the schooling one. Saint (1999) notes that the gross tertiary enrolment ratio for sub-Saharan Africa is 3.6% compared to 14% in the Arab states, 10.4% in Asia, and 18.4% in Latin America. Given the importance of tertiary education in supporting teacher, primary, and secondary education, this situation is a matter for concern. Saint (1999) notes further that, for many countries in sub-Saharan Africa, even maintaining their enrolment ratios at the current 2 to 5% will be difficult in the long term. In addition, a minimum of 16 countries in the region will need to double their current tertiary enrolments over the coming decade, which translates to an annual growth rate of 7%. Given the effects of HIV/AIDS on student numbers and graduation rates, in order to meet human resource needs, Saint (1999) argues that several countries (Angola, Benin, Burkina Faso, Burundi, Central African Republic, Congo, Côte d'Ivoire, Democratic Republic of Congo, Ethiopia, Gambia, Madagascar, Tanzania, Uganda, Zambia, and Zimbabwe) will need to triple their current tertiary enrolments by the year 2010.

According to 1999 statistics (cited by Gauci, 2001), only 16 African countries (seven Francophone) provide tertiary education that is free for the student.

6. *Following several authors, e.g., Saint (1999) and Murphy et al. (2002) the term tertiary education is used rather than higher education which is often assumed to mean universities. Rather, tertiary education refers to all post-school educational provision.*

Most countries employ a cost-sharing mechanism, where part of the cost is met by the student and part through public expenditure. While this is a common approach globally, affording tertiary education is difficult for many students in African countries, especially if they are not able to work whilst studying. Saint (1999) notes that public expenditure per student decreased during the 1980s from $6300 to $1500, and during the 1990s there has been a further decrease of about 30%. This means that for many African countries, expenditure per student is now below the level of $1000, which is estimated to be the minimum level required to provide an acceptable quality tertiary education.

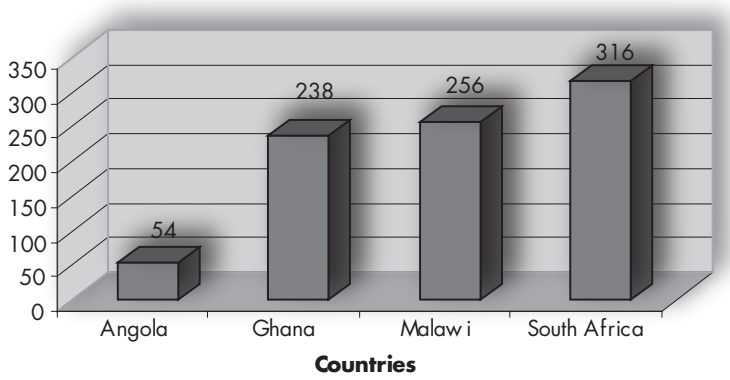
Given the above, it is clear that policy makers have to contend with the dilemma of deciding how to make scarce funds go far enough to address the wide range of educational needs, from basic to tertiary education. It is also evident that, together with a predicted increase in demand for tertiary education as primary and secondary level education improves, current modes of tertiary provision will not be adequate to meet the needs of most sub-Saharan African countries. The role of distance education in this context becomes increasingly important. Africa has significant experience in use of distance education and technology to increase access to educational opportunities. In some instances, this has been achieved through extending existing systems, while at other times new systems have been developed. Almost all African countries have at least one distance education programme at the tertiary level (Murphy, et al., 2002), while Saint (1999) notes that more than 140 pubic and private institutions currently provide some form of tertiary distance education service. These programmes use mostly print media, written assignments, and some face-to-face tutoring. A survey conducted in 1998 by Roberts & Associates found that, of 143 tertiary institutions surveyed, 52% of Anglophone and 67% of Francophone distance education programmes were aimed at teachers and school administrators (cited by Saint, 1999). 12% of all programmes were targeted at university students.

5.3.....ICT in Education

Given that the focus of this study is on ICT in education, it is useful also to provide an indication of the technology status of education in Africa. There is a scarcity of data on this topic, but the statistics presented below do provide some indication of the technological context within which efforts to use ICT in education take place. Chart 6 and Table 4 provide

an indication of the penetration of radios and computers in selected African countries.

Chart 6: Number of radios per 1000 people



Source: Murphy, *et al.* (2002), *taken from* World Bank (2000).

Table 4: Computer penetration ratios at schools in selected African countries

Country	Number of schools	Schools with computers	Percentage schools with computers
Egypt	32 000	10 000	31.25
Ghana	35 000	500	1.43
Mozambique	7 000	20	0.29
Namibia	1 519	60	3.94
South Africa	28 798	5 000	17.36

Source: Isaacs (2002)

Of the countries depicted, South Africa has the highest penetration of radios per 1000 individuals at 316. Egypt has the highest percentage of computers in schools, at 31.25%. In Mozambique, only 20 schools currently have access to computers. Across the continent, radio is the most widely available technology. Looking at Ghana and South Africa, the countries for which both radio and computers in schools data are available, it is clear that in Ghana, for instance, only 1.43% of schools have access to a computer, 238 in 1000 (23.8%) people have access to a radio. Similarly, for South Africa, 17.36% schools have access to a computer while

31.6% of people have access to a radio (and this does not take shared use into account). These comparisons highlight the importance of using the most appropriate ICT for a given environment rather than making the focus of ICT and education efforts on computers, specifically.

As will be further highlighted below, when discussing access to ICTs, the physical infrastructure is but one aspect to be considered. The same applies in the context of education. Physical access to computers is a fundamental starting point, but alone will not lead to computer use or enhanced learning outcomes. Teacher training is one essential requirement for successful use of ICT in education (Haddad & Draxler, 2002; Lundell & Howell, 2000; Khanya Evaluation Report, 2002; SchoolNet South Africa, 2002).

Lundell & Howell (2000) note the following factors in the South African context (but relevant more generally too) that prevent schools from using computers for teaching and learning:

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

In addition, many of those schools that do have computers still do not have access to the Internet, which is an important requirement for supporting networking for learners and teachers, as well as for collaborative learning. The Internet can provide a wealth of learning resources, access to which is, at present, very limited for many African education institutions. In Ethiopia, for example, only nine of the 12,000 primary schools had Internet access at the end of 2001, and ten of the 424 secondary schools (Jensen & Sarroco, 2002). Further, the costs of Internet access can be prohibitively high for many schools, both in Africa and elsewhere. In a study conducted in the US, it was shown that subsidies to schools for Internet access (which ranged from 20-90% of costs depending on school characteristics) led to 66% more classrooms with Internet (Goolsbee & Guryan, 2002).

According to Isaacs (2002), the main obstacles faced by African schools (and tertiary institutions too) with respect to Internet access specifically are:

- Lack of infrastructure generally, and network infrastructure in particular;
- High telephone and Internet costs;
- Limited expertise and ICT skills levels; and
- Lack of an enabling policy environment.

Given the constraints on widespread computer and Internet access, it is essential 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.

Although the situation may appear bleak, senior leaders across the continent have recognized many of the education issues highlighted above, and have committed themselves to tackling them. The Sub-Saharan Africa Education for All Framework for Action (1999) explicitly states that the participants (Education Ministers, representatives of civil society, and international development agencies) 'recognize the necessity of educational systems to provide all African people with the opportunity to acquire the skills and knowledge essential for access and use of information and communication technology'. However, questions are raised by some about the value of focusing on ICT for education, given the many other and often-times competing needs in African educational systems and societies more generally (for example see Lelliott, Pendlebury, & Enslin, 2001). The importance of ICT for education in Africa therefore justifies further consideration. This will begin with some reflection on the link between use of ICT for education and the role of ICT in Africa's development more broadly.

6. Africa, ICT and Development .....

This section looks at the concept of ICT as a significant contributor to social and economic development in Africa. This includes an understanding of the potential advantages of ICT, as well as appreciation for general disparities in access to ICT between the developed and developing world. It also touches on some of the initiatives being undertaken to address this disparity by assisting developing countries in ICT advancement. In the context of ICT for development, the issue of ICT in education is also introduced.

The past few decades have shown an increasing recognition globally of the role of ICT in development efforts (Hewitt de Alcantara, 2001; Marker, McNamara & Wallace, 2002; ILO, 2001). The 1998 World Development Report was dedicated to this issue and the 2001 Human Development Report was entitled 'Making Use of Technology for Human Development'. New information and communication technologies offer vast and varied opportunities for economic growth, better service delivery, improved health services, and prompt, efficient, globally accessible education. Some have referred to this trend as the 'information revolution'. Others refer to what is called a 'knowledge economy', an economy in which knowledge and ideas, promptly provided, lead to development of products, economic growth, and hence progress (Castells, 1999, 2001).

The potential advantages of the information revolution have prompted efforts by governments, the private sector, corporate entities, and non-governmental organizations across the globe to support changes in the nature and reach of information delivery infrastructure. While the process is being speedily conducted in the developed world, developing countries' progress in this regard has been slow for many reasons, including an unsupportive global economic environment, poverty, and lack of resources in poor countries. In some instances, there is also resistance to the transparency of information that ICTs make possible. Therefore, while it is increasingly apparent that the information revolution has changed the way in which the world learns, conducts business, or governs, a compelling divide is emerging between the digital 'haves' and 'have-nots' (Castells, 1999, 2001). This divide is represented by unevenly diffused infrastructure and technology between developed and developing economies and is compounded by the cost of provision of basic tools, as well as rapid changes in the nature of information technology.

Because of the divide, there have been many efforts by international

development organizations to promote universal access to telecommunications as an integral part of development approaches. If used wisely, ICT can provide a solution to inequalities, as it can be a source of digital diversity and opportunity, rather than of division. However, many of these initiatives have based their activities on narrow and problematic assumptions about what 'access' to ICT means. Most approaches have seen access as the availability of telephony, and in some cases, physical access to computers within a certain distance from the home.

In terms of telephony, the situation is complicated because many African countries have yet to fully operationalize and implement a universal access programme, particularly for under-served rural areas (Benjamin, 2001; African Connection 2002). The African Connection found that, of ten countries surveyed, only South Africa had implemented a universal access plan and not with great success. Algeria, Kenya, Morocco, Nigeria, and Tanzania were in the planning and strategic development phases. Uganda (not in the sample for the African Connection study) is one of the few African countries, together with South Africa, that has a Universal Service Fund. At the policy level, nationally and internationally, debates have centred on the most appropriate regulatory system for ensuring access targets are met. However, in South Africa for example, significant numbers of people have been connected to the national telecommunications grid as part of the universal service requirements of the national telecommunications operator, only to be cut off a few months later as tariffs increased and usage fees for telephone lines became unaffordable.

The situation becomes even more complex when considering computing technology, effective use of which also requires that people have a basic level of ICT skills. Many early development projects in the area of ICT set out to ensure that as many people as possible had a computer within walking distance, often using telecentres or other means of shared community access for delivery. However, it is only more recently that studies into the complexity of access—where access includes use and value of the technology—have been done. A recent example is a study done by Bridges.org on real access. This study showed that real access criteria should include the following categories: physical access, appropriate technology, affordability, capacity, relevant content, integration into daily routines, socio-cultural factors, trust, legal and regulatory framework, local economic environment, macro-economic environment, and political will (Bridges.org, 2002).

Integration of ICT into education, together with the enhancement of educational opportunities, is essential for achieving real access to ICT for the African continent. Without appropriately educated and skilled people, the areas of capacity, relevant content, integration, and trust in technology are going to be difficult to achieve. Jensen (2002, p13) states that 'perhaps [the greatest] problem is that the brain drain and generally low levels of education and literacy amongst the population has created a scarcity of skills and expertise at all levels, from policy making down to the end-user'. Further, there is also a need for careful economic and policy direction to incorporate beneficial use of ICTs. This requires well-educated people ready for the information society who will then be able to mobilize an African response (for African benefit) to the global knowledge economy (Opoku-Mensah, 1999; Maclean, et al., 2002).

Therefore, one of the greatest challenges for developing countries lies in education and human resource development to service the knowledge economy. This is no easy task given the resource requirements needed, not only to ensure physical access to ICTs, but also to enable the people of Africa to afford to use the technology, to see its value, and to use it. Furthermore, long-standing gender disparities with respect to science and technology training and use, as well as more recent gender disparities in ICT access (in the widest sense), will need to be explicitly tackled when considering human resource challenges (Hafkin & Taggart, 2001; Rathgerber & Ofwona Adera, 2000).

Several continental leaders are seriously considering the importance of ICT for development, and there has been increasing recognition among African policy makers of the role of ICT in this regard. Since the historic Information Society and Development (ISAD) conference in 1996, there has been a growing number of initiatives to bridge the digital divide, with many of them focusing on the education sector. The African Information Society Initiative (AISI), spearheaded by the United Nations Economic Commission for Africa (UNECA) in 1996, provided a framework for Africa's digital inclusion which involved governments from all over the continent, followed by: the historic African Development Forum in 1999; the Digitial Opportunities Taskforce of the Group of Eight Nations in 2000; the World Economic Forum's focus on Bridging the Digital Divide; and the United Nations ICT Task Team in 2000. These all highlight the importance of bridging the educational divide through integration of ICTs in education. The formation of SchoolNet Africa was strongly influenced

by these processes and more specifically, was a direct outcome of the first African Development Forum in 1999. The UNECA-driven processes after ADF 99 led to a strategy to consolidate the AISI framework which includes the call for an African Learning Network comprising three components: VarsityNet, Out of School Youth Network (OOSYNet), and SchoolNet Africa.

Over the past three years however, parallel regional networks and programmes to promote ICTs in school education in Africa have also been formed. Here the World Links for Development Program (WORLD), the Department for International Development (DFID)'s Imfundo Project and to a lesser extent, Schools Online have consolidated their programmes in Africa over the past two years and have country projects in several African countries. To date, conscious attempts at collaboration between the various regional programs remain limited. More recently, the New Partnership for African Development (NEPAD) has also been introduced, spearheaded by a number of heads of state in a renewed attempt at African revival.

NEPAD[7] provides an African-owned and African-led effort to promote accelerated economic growth and sustainable development for Africa, based on partnerships between African countries themselves, but also between Africa and the developed world. NEPAD explicitly recognizes ICT as a key priority in development efforts for the continent (NEPAD, 2001). In the NEPAD document, several comparative advantages for the African continent from intensive ICT use are identified. These include: support of democratization and good governance, integration into the information society, provision of training, use in research, enhancement of trade opportunities, support of regional distance learning and health programmes, input to conflict management and the control of pandemic diseases through early warning systems. Five specific objectives with respect to ICT are noted. These are:

- To double teledensity to two lines per 100 people by 2005, with an adequate level of access for households
- To lower the costs and improve reliability of service

7. NEPAD *is a comprehensive plan for the development of Africa, the details of which cannot be covered here. It is however important to note that this initiative has been criticized from several fronts. Notwithstanding, this document is currently a defining approach for development and change in Africa.*

- To achieve e-readiness for all countries in Africa
- To develop and produce a pool of ICT-proficient youth and students from which Africa can draw trainee ICT engineers, programmers, and software developers
- To develop local-content software, based specifically on Africa's cultural legacy

(NEPAD, 2001: 28)

While these objectives represent an important starting point for ICT and development for Africa, some are rather ambitious targets and over-simplification of the complexity of widespread ICT use in Africa needs to be avoided.

To achieve the above objectives, it is noted that action is required with respect to

- Policy and legislative development
- Regulatory capacity enhancement
- The establishment of a network of training and research institutions to build high level manpower
- The promotion and acceleration of existing projects to connect schools and youth centres
- The establishment of financial mechanisms for mitigating and reducing sector risks

(NEPAD, 2001 – emphasis added).

The two activities emphasized in the above list highlight the role that education can play, and situate education initiatives as an integral component of NEPAD. In addition, the NEPAD document recognizes the importance of ICT in the context of bridging the educational gap specifically. This includes improving access to ICTs across the education sector, as well as the need for a task team to accelerate introduction of ICT in primary schools. Finally, to highlight further the importance being accorded to ICT for the continent, it should be noted that ICT is included as one of four programmes proposed for fast-tracked implementation (the other three being communicable diseases, debt reduction, and market access).

7. ICT Infrastructure in Africa.....

The importance of ensuring access to ICT has been noted above. Even though it was argued that real access to ICT means much more than just a consideration of the infrastructure available, having the infrastructure available is still a necessary (although not sufficient) condition for access (Mansell & Wehn, 1998). This section considers the state of ICT infrastructure available in sub-Saharan Africa.[8] It should be noted that aggregated statistics for the African continent can be very misleading given wide disparities in conditions across the continent. This is also true within specific countries. For example, in South Africa, the Internet industry was rated 18th globally in 1998, but this included a small group of mostly white men in the urban centre of Johannesburg. Further, it is difficult to measure Internet access because patterns of use in developing countries are different from those in developed countries. For example, in developing countries there are many shared Internet accounts and public access is most common; thus statistics used in developed countries such as dialup subscriber accounts are misleading (Jensen, 2000, 2002).

In general, the level of technology penetration in Africa is very low compared to developed countries (US Internet Council, 2000). Of the 818 million people in Africa, statistics from 2001 estimate that only:

- 1 in 4 have a radio
- 1 in 13 have a television
- 1 in 35 have a mobile phone
- 1 in 40 have a fixed line telephone
- 1 in 130 have a personal computer (PC)
- 1 in 160 use the Internet
- 1 in 400 have pay-TV

(Jensen, 2002)

There are several reasons for this,[9] including:

- The general low level of economic activity often makes technology unaffordable
- Many African countries still have irregular or non-existent electricity supplies, which makes ICT use problematic

8. *For a detailed discussion please see* African Internet Status, *available at www3.sn.apc.org/Africa/afstat.htm. Much of the information presented in this section is taken from this website and from* Jensen (2002).
9. *See* Jensen 2002 *for details.*

- Rail, road, and air transport is limited and this infrastructure is needed to implement and support ICT infrastructure, as well as the increased social and economic activity that this technology should stimulate
- Many tax regimes define computers and cellular phones as luxury items, which adds to the price of these goods especially as the vast majority must be imported
- Lack of skills together with the problem of brain drain (as noted above) also makes widespread adoption of new technology difficult.

All of the above issues are further complicated by a business climate that encourages investment in Africa through large multinational companies rather than in ways that might be more beneficial to the continent.

Further details of the status of ICT infrastructure in Africa are provided below. It should be noted at the outset, however, that, although the challenges facing Africa in the drive to develop an African response to the information society/economy are many and great, much has already been achieved. Further, as was discussed above, combating the digital divide and using ICTs for continental development are fundamental focuses of current development initiatives.

Tables 5 and 6 below provide a summary of the economic and technology/infrastructure status of selected African countries, as well as various OECD countries, and low, middle and high-income countries.

Table 5: Technology in Africa

Country	Technology and Infrastructure			
	Telephone /1000	Cost/local call $/3min.	Personal computers/ 1000	Internet host/ 1000
Benin	-	-	1.5	00
Botswana	77.0	00	31.0	6.0
Burundi	2.8	00	-	00
C.A.R	2.7	0.5	1.4	00
Egypt	75.0	00	12	0.3
Ethiopia	3.1	00	0.7	00
Ghana	8.0	0.1	2.5	0.1
Kenya	10.3	0.1	4.2	0.2
Nigeria	-	-	6.4	00
Mozambique	4.0	0.1	2.6	0.1
South Africa	125	0.1	54.7	33.4
Tunisia	89.8	0.0	15.3	0.1
Uganda	2.6	0.2	2.5	0.1

Source: *World Development Indicators* (2001) *and World Bank Group database* (2002)

Table 6: Technology in OECD countries and economic groups

Country	Technology and infrastructure			
	Telephone/ 1000	Cost/local call $/3 min.	Personal computers/ 1000	Internet host/ 1000
OECD Countries				
Switzer-land	699	0.1	461.9	370.6
Norway	709	0.1	446.6	753.1
United States	664.0	-	510.5	1479.7
Economic groups				
Sub-Saharan Africa	18	0.1	8.4	2.3
Low income	26.3	0.1	4.4	0.3
Middle income	121.3	0.1	27.1	7.6
High income	582.8	0.1	345.7	603.1

Source: World Development Indicators (2001) *and World Bank Group database* (2002)

Tables 5 and 6 show the low levels of technology penetration in African countries compared to OECD countries. In addition, the differences between different African countries are highlighted in Table 5.

In terms of computers, Jensen (2002) notes that current estimates indicate a total of about 7.5 million computers in Africa in 2001, or 1 per 100 people. However, there are studies that have come up with figures of only 1 computer per 500 people. In addition, because of poor maintenance and insufficient skills to diagnose and repair computers where needed, many available computers are out of use. Current estimates of African Internet users are between 1.5 and 2.5 million (excluding North and South Africa). This translates to approximately 1 user in every 250-400 people compared to the global average of 1 in 15, and a North American and European average of 1 in 2 people. In Africa, 39 countries now have 1,000 or more dialup subscribers, 20 have more than 5,000, and 16 have more than 10,000. In an effort to deal with high costs of telecommunication and Internet use, many countries have

instituted low call charges for all Internet calls. This is a major benefit for those living in remote areas. Thus far, 19 countries have adopted this approach, namely Benin, Burkina Faso, Cape Verde, Chad, Ethiopia, Gabon, Malawi, Mali, Mauritius, Mauritania, Morocco, Namibia, Niger, Senegal, South Africa, Togo, Tunisia, Uganda, and Zimbabwe. The Seychelles has reduced Internet call costs to 50% of normal local calls to encourage Internet use. These efforts notwithstanding, the cost of Internet access is still too high for the majority of the African population. For example, the cost for a local dialup account is approximately $60/month, which is much higher than the average African income. This cost is compared to $22/month in the US. This is equivalent to just less than 20% of GDP per capita for African people, compared to the global average of 9% and only 1% in high-income countries (Jensen, 2002).

The cost of international bandwidth is high due to international tariffs and lack of circuit capacity, but there has been substantial growth of international bandwidth (although from a low base), which has been driven by growth of shared/public access and use of corporate networks. However, the cost has made it difficult for most countries to obtain sufficient international bandwidth, and congestion at peak times is common. Chart 7 below shows bandwidth, bits per capita, and destination of outgoing connections, for all of Africa.

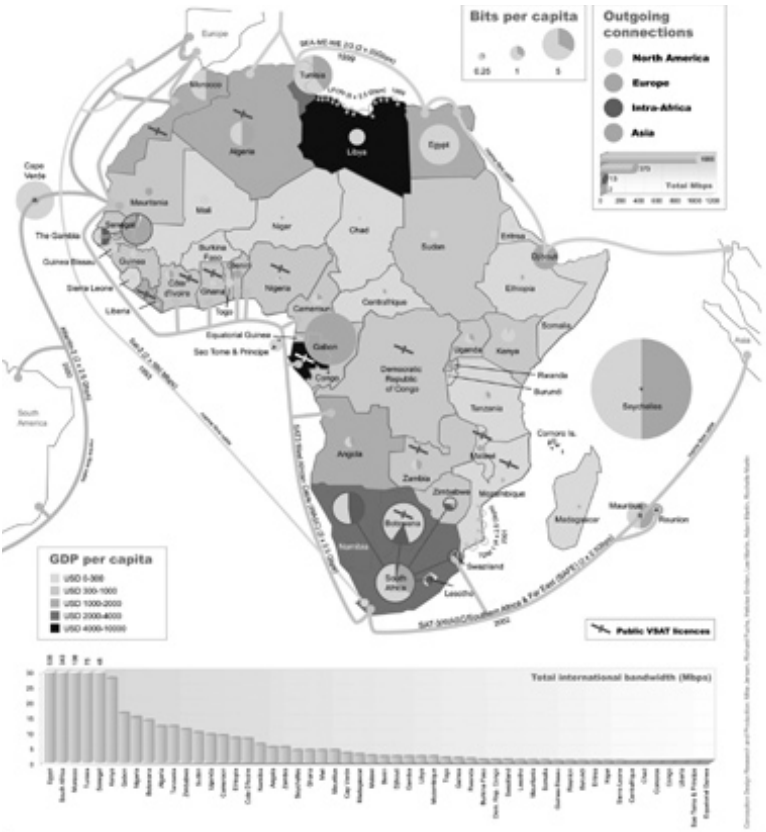
In the area of telecommunications, there is a high rate of growth of both fixed lines and mobile coverage (also from a low base). Research in ten African countries by African Connection has shown that the strongest demand in rural Africa is still for basic voice communication (African Connection, 2002). For Africa as a whole, the number of fixed lines grew from 12.5 million in 1995 to 21 million in 2001. However, North Africa has 11.4 million of these lines and South Africa 5 million, meaning that the rest of the continent has only 4.6 million lines. Thus, the situation varies greatly across regions and countries.

Some examples of teledensity (number of lines per capita) include:

- Sahel and Central Africa – 1 line per 200-500 people
- North Africa and South Africa – 1 line per 13 people
- West and East African coastal regions – ranges from 1 in 50 to 1 in 100.

Except for North Africa and South Africa, only a few smaller countries have been able to reach a teledensity above 1 in 50. These are, Botswana, Cape Verde, Gabon, Mauritius, Mayotte, Namibia, Sao Tome, Senegal,

Chart 7: African bandwidth, bits per capita and destination of outgoing connections



Source: *www.idrc.ca/acacia/divide*

The size of the Internet in a country indicates an element of its progress towards an information-based economy. International Internet bandwidth provides a measure of Internet activity because many people share accounts, or use corporate and academic networks along with cyber cafes and business centers. Outgoing bandwidth also takes better account of the wide range of possible use, from those who write a few emails each week, to users who spend many hours a day on the net browsing, transacting, streaming, and downloading. Because of this, the often used 'Number of Internet Users' indicator may have less relevance in the developing world than in other places. The coloured circle in each country on the map shows, to exact scale, the international bandwidth in bits per capita (BPC) available in Mid 2002 from publicly accessible IP networks.

and Swaziland. These low levels of teledensity are being overcome, to some extent, by rapid growth in mobile cellular telephony, especially the pre-paid service that accommodates irregular sources of income. In 1990, there was a cellular presence in only six countries, while today there are over 100 networks in 48 African countries, serving more than 24 million people (10 million of whom are in South Africa) (Jensen, 2000, 2002).

The role of mobile telephony is thus very important in the African context. Table 7 below shows the number of fixed lines and mobile subscribers in 2001 for the ten countries that were part of the African Connection study.

Table 7: Fixed and mobile lines in 2001

Country	Fixed lines per 100 people in 2001	Mobile subscriptions per 100 people in 2001
Algeria	6	0.3
Cameroon	0.67	2.73
DR Congo	0.04	0.26
Kenya	1.0	3.0
Morocco	3.9	15.7
Nigeria	0.43	0.28
Senegal	2.45	4.0
South Africa	11.35	21
Tanzania	0.41	1.19
Zambia	0.8	0.92

Source: *African Connection* (2002)

In all cases, except for Algeria and Nigeria where mobile companies have only recently entered, mobile telephony is reaching many more people than are fixed lines.

Other new technologies such as Voice over IP (VOIP) and wireless connections are also increasingly being seen as alternatives to fixed line telephony, especially because of the high costs associated with fixed lines and hence also Internet usage.

8. Importance of ICT for Education.....

Over the past few decades there have been major transformations occurring in the formal education sector, as well as in other areas that are important for enabling people to develop new capabilities necessary for the knowledge/information society (Mansell & Wehn, 1999; Butcher, 2001). These changes are partly due to the development of ICTs, as well as the forms of networking, knowledge sharing, and interactive learning that ICTs facilitate (Heppell, 2000). Haddad & Draxler (2002) note that change is required of schools (and education systems more broadly) which were originally developed in the context of the industrial age and which now must meet the educational needs of the current global knowledge environment. In effect, the Information Age has brought with it a new context in which schools must function. As such, Haddad & Draxler (2002, p8) call for a new paradigm of schooling, as is shown in the table below.

Table 8: The new schooling paradigm

From	To
A school building	A knowledge infrastructure (schools, labs, radio, television, Internet, museums…)
Classrooms	Individual learners
A teacher (as provider of knowledge)	A teacher (as a tutor and facilitator)
A set of textbooks and some audiovisual aids	Multimedia materials (print, audio, video, digital…)

Source: Haddad & Draxler (2002, p8)

Given this changing paradigm, the role of distance education is becoming increasingly important. Not only does distance education have great potential for expanding access to educational opportunities (particularly tertiary education and teacher training), but also, the teaching and learning methods are especially suited to the new paradigm described above. In explaining this new paradigm in more detail, Haddad & Draxler (2002, p8) note that 'education will not be a location anymore, but an activity: a teaching/learning activity'. This is what distance education has always been. Thus, focusing on how ICT can enhance distance educational delivery should be seen as an integral aspect of improving education for sub-Saharan Africa along with global trends. The benefits

of introducing ICTs to schools and tertiary education institutions are many and are gaining increasing recognition in the education literature (for some examples see Haddad & Draxler, 2002; World Bank, 2002; Byron & Gagliardi, 1998; Alverez, et al., 1998).

Some of the benefits of ICT for education are:

• Delivery of educational resources

ICTs can be used to provide immediate, up-to-date resources, using one or more media, to large numbers of educators and learners, easily and relatively cheaply. Changes made to resources are immediately available to educators and students without incurring major additional distribution costs. Resource distribution should, however, not be mistaken for education. An additional benefit that ICTs can bring to designers of online learning resources is the huge resource base that resides on the Worldwide Web.

• Facilitating communication

ICTs can be used to support a range of communication strategies, especially easy asynchronous communication between educator and learner, and amongst learners. Where appropriate, this communication can be extended to include groups of people rather than just individuals. A major component of this strength is the capacity to support many requirements for communication to ensure effective management and administration of the system.

• Facilitating interaction in resources

Combining the above, ICTs can provide educators with a range of very interesting opportunities for creating resources that allow learners different levels of interactivity. This can lead to the creation of interesting and exciting interaction of learners with educational resources.

• Building and exploiting information bases

There are growing possibilities for building and exploiting information bases. Possibly most importantly, it becomes essential to develop effective strategies for storing information in ways that allow it to be very easily manipulated for future purposes. Increasingly, value lies not in possessing information, but rather in developing the skills and capacity

to manipulate it effectively for new applications. This indicates clearly the importance of developing management information systems that allow for cheap, easy, and logical storage and retrieval of information.

These benefits notwithstanding, in developing countries where large segments of the population are living in extreme poverty, it is often asked whether it is reasonable to invest money in technology for the education system, instead of using the same money to improve the living conditions of those in dire need. In response to such questions Osin (1998, p2) states, 'I believe that these interests are not contradictory and that the only way to reach a long-term solution for the economic problems of the population is to raise the educational level, particularly for the low socio-economic groups'. He then continues to argue that the introduction of computers into education in developing countries is also financially feasible.[10] Similarly, Potashnik & Rawlings (1996) state that:

> *a main tenet of our study is that the introduction of information and communications technology in education in developing countries should not wait until a country has reached some predetermined state of economic or educational development.*
>
> *(Potashnik et al., 1996, p3)*

Further, short-term concerns for equity at the national level, such as for example, costs of ICT provision versus health care, must be balanced by long-term concerns for equity at the international level where the level of basic ICT skills of the people in any specific country will be increasingly important for global competitiveness, and ultimately, economic growth and wealth generation. The increasing importance of ICT in a global context requires an appropriate response from developing countries, which are not immune from the effects of globalization. African countries cannot avoid the impact of ICT; the challenge becomes that of how to respond to these new global pressures in ways that will lead to the greatest benefit for the continent.

What should be of concern, however, is the tendency of some to assume that ICT is the panacea to all educational problems. This is certainly not so, either in developing or developed countries. Based on a study of the

10. *Cost issues are very important when discussing educational use of* ICT, *as difficult decisions often have to be made with limited resources. Cost issues will be discussed further below.*

use of ICT in schools in OECD countries, Venezky & Davis note that 'the central finding of this study is that ICT rarely acts as a catalyst by itself for schooling change yet can be a powerful lever for realizing planned educational innovations' (Venezky & Davis, 2002, p13). Very often the most effective use of ICT is as a lever for educational change rather than as a change in and of itself. In this same study, it was shown that all of the innovations that occurred in schools using ICT arose as part of a strategy to solve other schooling problems, often at first unrelated to ICT. It is important that ICT be seen as one strategy for improving educational provision, not as an end in and of itself.

In addition to viewing ICT in the context of educational processes more generally, it is important to consider the potential role of ICT in terms of the contextual strengths and weaknesses, which will then enable decisions to be made about the most appropriate technology to be used. All education involves processes of communication between an educator and a learner. Different communication media will be suitable under different conditions, and there are a variety of technologies that can be used to enhance this communication process. Mapp (1996, p68) notes that 'evaluation studies show that educationally successful systems are not necessarily the most technically advanced: success lies in the balancing of the technical, the educational, the institutional and the personal'.

Thus, as has already been pointed out, teaching and learning consist of combinations of different modes of communication. It is important to note the wide range of educational applications that continue to make use of print resources. Although ICT does provide additional and important educational applications, the value of print options should not be overlooked, for pedagogic as well as practical reasons, particularly in the context of limited technological resources, as is the case in most of sub-Saharan Africa. Saint (1999) also notes that mixed-media teaching has been shown to have a great impact on learning when compared to single-medium methods.

In sum, this section has argued that while ICT is becoming increasingly important for educational provision, especially in the context of the knowledge society, it should always be seen as only one aspect

impacting on the learning situation. In some cases, new ICT will not be the most appropriate means of enhancing either access to, or quality of, education. The focus must be on sound pedagogy and on how ICTs can contribute to achieving this aim. 'To "tech" or not to "tech" is not the question. The real question is how to harvest the power of technology to meet the challenges of the 21st century and make education relevant, responsive, and effective for anyone, anywhere, anytime' (Haddad & Draxler, 2002, p16).

Having covered many of the central theoretical and conceptual issues with respect to ICT and education, the following sections will focus specifically on initiatives in sub-Saharan Africa within the different educational levels.

9. ICT in Primary and Secondary Education .....

Having discussed some of the theoretical and contextual issues pertaining to ICT and education in sub-Saharan Africa, this section of the report focuses more closely on how ICT is being used in the context of schooling. The aim is, first, to provide, descriptive evidence of the types of activities taking place, and second, to consider some of the lessons learnt thus far. While the overall focus of this report is on distance education and open learning, other uses of ICTs in schools will also be considered.

Murphy, et al. (2002) note that distance education is seldom used for primary education, and, although there have been initiatives in secondary education, these are generally unsuccessful, have high dropout rates, and low levels of achievement. There are likely to be several reasons for this, including perceptions about distance education being of lower standard than conventional schooling, inadequate government funding and problems with the quality of materials. Also of significance is the fact that younger learners may need the support provided by face-to-face teaching, since success at distance education requires high levels of student motivation. Nonetheless, Dodds (2002) points out that in some countries where much of the population do not get the chance to go to or to complete their secondary schooling in the normal and formal way, distance education is often used to provide an alternative route to secondary qualification.

As noted above, there are several different technologies available for use in schools. The focus in current debates tends to overemphasize computers at the expense of print, radio, and television, all of which have important benefits for schooling. Table 9 below shows the range of technologies used in distance education at the secondary education level for selected countries that responded to a World Bank survey in 2000. The table also provides an indication of the types of distance education offerings at this level.

Table 9: Distance education for secondary equivalence and technology used

Country	Subjects offered	Enrolment (1999-2000)	Technology used
Botswana	All subjects	600 junior secondary	Print, radio
Burkina Faso	French, Maths, Physics	N/A	Radio, TV
Ethiopia	8 subjects	8 400	Print, radio, TV
Ghana	English, Maths, Science	N/A	Print, radio, TV
Guinea	French, Maths, Science	300 secondary school teachers	Print, radio, audio tapes
Malawi	N/A	80 000	Print, audio tapes
Namibia	All subjects	18 325	Print, radio, audio tapes
Nigeria	All subjects	N/A	Print
Zambia	N/A	11 138 (1990)	Print, radio
Zimbabwe	Academic subjects	25 000	Print

Source: M*urphy, et al.* (2002, *p* 9) *based on* HDNED, *World Bank* (1999)

In the above table, it is clear that print and radio were the technologies used most often, while none of the countries that responded reported using computers. Radio and also interactive radio instruction (IRI) have been most widely used in primary and secondary schooling, both in sub-Saharan Africa and in other developing countries. IRI aims to provide instruction to learners particularly in subjects that are ineffectively taught in schools. The whole curriculum is usually covered, and lessons are carefully structured to allow students to respond or take part in learning activities. The interactive component usually refers to class interaction with the teacher. Further, IRI uses an entertainment component as a means of engaging learners (Murphy, et al., 2002). Murphy, et al. (2002) report that IRI has been used in Ethiopia, Kenya, Lesotho, South Africa, Cape Verde, Guinea, and Zambia.[11] Research by Williams (2000) reports radio being used in Tanzania across all education sectors.

11. *See* M*urphy, et al.* (2002) *for a detailed description of each of these initiatives.*

Box 1 below describes an extensive IRI initiative, which was implemented in Guinea. The IRI series reaches students and teachers on a national level and is integrated with teacher development initiatives. It is used in almost all primary schools across the country, reaching some 880,000 students.

Box 1: IRI in Guinea

Since 1990, USAID has been part of a multi-donor effort to help the Government of Guinea implement a reform programme for primary education. An interactive student and teacher radio programme, which has been implemented nation-wide, forms part of this effort. All six elementary school grades benefit from the radio programme three times per week, for a 90-minute period, during 22 weeks of the school year. The show is entirely in French, is called *Under the Kapok Tree*, and has already received wide praise from school directors, parents, teachers, and, most significantly, the children themselves.

The radio show was developed by the Education Development Centre (EDC) in close collaboration with INRAP, the Guinean Government's National Institute for Pedagogical Research and Action, and uses a 'multi-channel approach', including audio, visual, and tactile-kinesthetic strategies. Children are taught language, mathematics, science, community health, early childhood development, and other pertinent subjects. While the show is being broadcast, teachers usually follow the instructions of the 'radio teachers', directing children to sing songs, answer questions, manipulate objects, draw pictures, move physically, and work in small groups to solve problems.

To support the broadcasts, wind-up radios have been distributed nationally. Additional support is provided by teachers' guides, student activity books, posters, and science kits. Introductory workshops and bi-monthly meetings are also provided to teachers to help them to adapt to an interactive style of teaching.

Source: Lartigue L. (2002)

Evaluations of IRI have shown that this method, both consistently and significantly, improves learners' performance (Murphy, et al., 2002). Bosch, Rhodes, & Kariuki (2002) explain that a number of well-evaluated

projects have revealed that students using IRI programmes show better learning achievements than students in control groups using conventional teaching methods. One of these tests was done in Guinea with second grade students using the integrated French and mathematics series described in Box 1. These students improved approximately 8% more than corresponding students who did not use IRI. Other studies have demonstrated IRI's effectiveness not only for mathematics, but for a range of subjects and age groups. Furthermore, in most cases, scholars show progressively greater learning gains over time. In South Africa, for example, it was shown that students who received fewer than 33 English in Action lessons improved by 6.7%, those who received between 34 and 66 lessons improved by 13%, and students who received more than 66 programmes improved by 24%.

Box 2 below describes a new IRI series which reaches out to students who otherwise would be without schools, in particular those who have become increasingly vulnerable due to poverty and HIV/AIDS. This example shows how IRI can by used effectively to overcome barriers of access in Africa and to ensure that more children become educated (Bosch, Rhodes & Kariuki, 2002).

Table 10 above shows three cases in which educational television has been used in secondary schools. Murphy, et al. (2002) note that Ethiopia, Ghana, Mauritius, Nigeria, South Africa, and Uganda currently use television to improve the quality of classroom teaching. Many of these projects are of a pilot study nature. In primary schools, educational television was used as early as the late 1970s in Côte d'Ivoire (see Box 3), but since then, there have been no significant initiatives in African countries (with the exception of South Africa).

The form of educational television that has been around the longest is programming transmitted by a major public broadcasting organization in the form of open-access programmes aimed at particular groups, including preschoolers and enhancement programmes for school-age children, in addition to adults who wish to acquire new skills or knowledge. A newer variety of educational television takes the form of direct instruction for various educational levels, including primary and secondary education. At this level, television can be very effective, particularly when used to reach underprivileged groups such as rural children (Wolff, et al., 2002).

Box 2: IRI in Zambia

In Zambia, IRI 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. Through IRI, basic education is being delivered to out-of-school children, in particular orphans and other vulnerable children. The programme is the result of collaboration between communities, churches, non-governmental organizations (NGOs), the Ministry of Education's Educational Broadcast Services (EBS), the Peace Corps, and the Education Development Center. The radio programmes are developed and broadcast by EBS, which also develops supplementary materials such as mentor's guides. The Ministry of Education is responsible for training mentors, as well as for supervision/monitoring at participating learning centres. The learning centre venues, mentor(s) to facilitate the radio broadcasts, radio receivers, a blackboard, and locally made materials, are provided by communities, churches, schools (both government and community), and NGOs. Communities also encourage out-of-school children to attend the learning centres. The EDC has provided training to EBS writers and producers, and has helped EBS to develop a training of trainers course for Ministry of Education resource centre staff who then train mentors to run the community-based lear ning centres.

During 2000 and 2001, EBS produced and broadcast 30-minute lessons for grade one on a daily basis. These lessons followed the Zambian curriculum for mathematics and English and the learners were guided in the process by a facilitator. Lessons are currently being developed for grades two and three. Each IRI programme also incorporates skills in English as a second language, basic mathematical skills, and a five-minute section on life skill themes (hygiene, nutrition, social values, etc.) in an attempt to strengthen the ability of the community to support its children. Early evaluations suggest the programmes are having positive effects on learning.

Source: Bosch, Rhodes, & Kariuki. (2002)

Box 3: Educational television in Côte d'Ivoire

One of sub-Saharan Africa's most ambitious educational television experiments took place in Côte d'Ivoire. A key issue in the education system in the region was inequalities between urban and rural education. It was anticipated that television would provide a cost-effective means to address this issue, as well as contributing to improved teaching quality overall. Although not thoroughly evaluated, reports suggest that more television students reached grade six than in conventional schools, repetition rates were reduced from 30 to 10%, and students' spoken French improved.

However, in 1981 the project was discontinued due to several problems. One issue was that stakeholders were not adequately consulted at the start of the project, which resulted in resistance from teachers' unions and influential parent groups. Further, local capacity was not developed due to over-reliance on expatriate technical support. Insufficient cost planning and an ambitious time frame were also issues, both of which resulted in cost overruns (Ba, 1999). In fact, these issues are those that are often prevalent in radio interventions, but due to the higher cost implications of television, the initiative was not sustainable.

Source: Murphy, et al. (2002)

Radio and television programming for education needs to take into consideration recording and broadcasting issues, which will differ across African nations and will be easier to resolve in some countries than in others. A rise in satellites or transmission facilities is increasing the number of broadcasting opportunities in some countries. For example, national broadcasting authorities can at present buy broadcast slots on satellites such as the Worldspace AfricaStar™ satellite. This satellite covers all of Africa with digital radio signals and, in addition to providing AM and FM radio time, also sells airtime commercially for shortwave transmissions that are broadcast from a number of places outside of Africa. A final key consideration is that educational interventions that use radio and television need favourable governmental policies to regulate broadcasting (Murphy, et al., 2002).

Box 4: Computer Education Trust in Swaziland

In Swaziland, where 98% of children currently leave school never having had access to a computer, and where the average number of computers per school is less than one, there is an interesting example of a private initiative called the Computer Education Trust (CET), which is working to address this situation. A young IT professional and a successful local businessman, who aims to provide refurbished computers sourced from Computer Aid International to all the secondary schools in Swaziland, started the CET programme in 1999. In addition to the support of Computer Aid International, various other local alliances and partnerships have been an important part of funding the project.

James, Hesselmark & Subiya (2002) evaluated the CET programme in early 2002. At that time, 36 schools in Swaziland had received an average of 20 computers. This evaluation revealed several findings relevant for this study. The budget was low, total cost per school being about £2300 for the installation of 20 to 40 computers. The computers are six to eight years old and run on Windows 95 or 98. Each has a basic MS Office installation. None of the installations have been networked. Thus, the CET initiative addresses the need for computers in the classroom, but is not strictly an example of a school networking activity. The projects also highlight the need for training and maintenance support for the success of such initiatives, as many schools have experienced problems with the computers. Further, the importance of a local champion in the development and sustainability of the initiatives is apparent. It was noted above that ICT does not, in and of itself, contribute to educational enhancement, but rather is a tool to support such processes. Evidence from this study provides further support for this claim. It was found that success in computer studies was largely dependent on having an enthusiastic and committed teacher, and in particular a teacher with a facilitative approach to education. Thus, it is important that pedagogical reform in the direction of resource-based and learner-centred approaches should accompany the introduction of computers.

Source: James, Hesselmark & Subiya (2002)

The role of computers in schools is gaining increasing attention, although usage is still limited in the African context. There are, as yet, no examples of the use of computers in schools for distance education. Instead, projects focusing on computers have tended to place greatest attention on providing infrastructure to schools and on training of teachers (this will be discussed in more detail below). There is also growing evidence of computer use to improve the quality of schooling, as well as computer use to teach learners about technology (thereby ensuring they are better equipped for a society in which technology becomes ever more central).

The World Links for Development (WorLD) programme is another example of an initiative to meet the need for computers in schools in several African countries, including Uganda, Botswana, and South Africa. This programme aims to use technology to enhance education and to prepare the youth of developing countries for participation in the global information society. This programme focuses on five main areas (Addo, 2001):

- Internet connectivity for secondary schools
- Training and educational content
- Regional and global partnerships
- Telecommunications policy advice for the education sector
- Monitoring and evaluation

Several interesting projects have been implemented under the auspices of the WorLD programme (see Box 5).

Clearly there have been various success stories when it comes to the establishment of telecentres in schools. Nonetheless, there are still numerous challenges to be faced, the most significant ones being the need in many cases to find a reliable source of electric power, inadequate time for the ICT coordinator to run the telecentre whilst still having to teach, and identification of community needs in order to provide relevant services (Mayanja, 2002; Bloome, 2002). An example of an initiative where some of these issues were encountered is detailed in Box 6 below.

A recent audit of educational ICT projects in South Africa, focused at school level, revealed 34 different school-related ICT projects. A wide variety of implementation models existed, but most included the provision of ICT infrastructure, connectivity, and training for educators and/or learners. It was noted that projects focusing on curriculum development and innovation, and global communication between schools, were lacking in South Africa (SchoolNetSA, 2002).

Box 5: WorLD programme telecentre in Uganda

In Uganda the school-based telecentre approach to rural ICT access has been used as part of the WorLD programme. The aim of this model is to provide ICT for educational use within schools, as well as access to the surrounding community, after school, in the evenings, and at weekends. This is an important model to consider since the benefits of involving communities in education have been a focus of several educational projects in Africa (Watt, 2001). However, very often involving the community has been a response to an educational crisis rather than an integral aspect of educational planning that recognised the potential contribution that community involvement can make. The school-based telecentre model also addresses fundamental sustainability problems for telecentres with respect to management and relevant content generation.

The project in Uganda began in September 2001 with training provided to representatives from 14 secondary schools and one national teacher training college. The network includes 15 school-based telecentres. Very Small Aperture Terminal (VSAT) satellite technology is used to connect to the Internet. The cost for this connection is shared among the schools and is about US$200 per month, with World Links contributing US$200 per month for two years. SchoolNet Uganda provides the administration and coordination of the project, and a national coordinator, technical coordinator, and a community development and small business specialist are part of the staff. Within each school there is a local ICT coordinator who is generally also a teacher. Each school-based telecentre has a management committee who design the broad programme direction. Thus far, the project has made several important achievements. The Ministry of Education has given full support, the head teachers have taken responsibility for meeting the running costs, all ICT coordinators have been trained, teachers and students in schools are undergoing training, and in some of the communities where there was no other communication system before, the project is seen as fundamental to the community's development.

Source: Bloome (2002)

Box 6: *Internet para as Escoles* in Mozambique

The *Introducing Information and Communication Technologies in Secondary Schools in Mozambique* initiative, also known as *Internet para as Escoles,* began in Mozambique in 1998 and ran until 2001. It was initiated and funded by the International Development Research Centre (IDRC). The project had two main components:

- To facilitate the sharing of ICT among students, teachers, and educational departments using email and Internet, and
- To introduce computer literacy, as well as integrate computers, into the teaching of different subjects.

The targeted beneficiaries were 350 teachers and 4680 learners at 24 schools in Mozambique. It was envisaged that for each school, 11 computers for the lab and one for email would be installed, although these targets were not met during implementation.

The evaluation of this project, conducted by Siluma, Roberts & Browde (2002), revealed several important lessons. One is that it is essential to understand the context and plan carefully, taking contextual constraints into account. Infrastructure availability, skills levels, work conditions, and culture of technology use, must be understood and the project adapted to meet the specific contextual requirements for each of these areas. Proper management and communication channels between all stakeholders and at all levels of the project are essential. The scale of implementation should be realistic; 'start where the skills are and then progress from there'. It is often tempting to get excited by the prospects offered by ICT, yet these prospects may not be appropriate to the specific context. Objectives should be simple and clear, and all involved should understand them. Government support is essential for ICT and education projects, but this needs to be carefully managed to ensure that control of the project remains with the implementers. Finally, this project highlighted the need for sustainability plans after donor funding has ended.

Source: Siluma, Roberts, & Browde (2002)

Not only have computers in schools projects been focused on national schooling systems, but also increasingly on forging links between learners and educators globally. The ThinkQuest initiative (see www.thinkquest.org) is one such initiative. ThinkQuest is a global online learning community of learners, teachers, parents and technologists. Through ThinkQuest, young people work together in teams, use the Internet to research a topic in a variety of different subject areas and then publish their research as an educational web site for peers and classrooms around the world. Another example is that of the International Education and Resources Network (iEARN), which facilitates online collaborative projects for young people throughout the world. This project encourages lifelong learning and also assists students to address issues that are relevant to the world today (see www.iearn.org).

Collaborative learning, both among learners within a school and between different schools and across countries, is one of the important benefits ICT can bring to education. In response to a need to encourage such collaboration, the concept of school networking is gaining increasing importance. This concept includes introduction of computers in schools, use of computers in teaching and learning, and use of ICT to facilitate communication and collaborative learning between and within schools.

In response to such needs, in 2001 SchoolNet Africa (SNA) was officially launched as an independent NGO emerging out of the International Development Research Centre (IDRC) ACACIA project. Currently, SNA works with SchoolNet projects, in 28 African countries,[12] to support education through the introduction of ICT in schools. SchoolNet Africa defines a SchoolNet organization according to the rubric provided in Table 10 below. This definition is used to guide membership of SchoolNet Africa.

12. *Current member countries of SchoolNet Africa are Angola, Benin, Botswana, Cameroon, Cape Verde, Côte d'Ivoire, Egypt, Ethiopia, Gambia, Ghana, Kenya, Lesotho, Malawi, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe. See www.schoolnetafrica.net for details.*

Table 10: What Is a SchoolNet?

Structure	Services	Sustainability
▪ Establishment and ongoing operation of a school networking institution/ organization ▪ Minimum number of five schools in regular communication and interaction on learning initiatives using information and communications media and technologies	▪ Computer distribution and connectivity services offered by the SchoolNet institution ▪ Inter-school networking and collaborative projects using the broad array of information and communication technologies ▪ Content and curriculum development and sharing ▪ Teacher training in ICT use to enhance teaching	▪ Year-on-year growth of the country SchoolNet initiative ▪ Financial sustainability increases from year to year with less reliance on external resources/ funding ▪ Steady year-on-year increase in human resource capacity with less reliance on external resources ▪ Year-on-year consolidation of partnerships

Source: www.schoolnetafrica.net

Thus, it is clear that the focus of school networking is not simply on the availability of ICT in schools, but also on use of this technology as a means of working together to improve schooling opportunities across the African continent. This includes use of ICTs within the classroom and for administrative and management purposes. Therefore, school networking encompasses more than the introduction of computers into schools (although this is an important activity), since it implies that schools gain the ability to work together, to share resources and so to become more effective.

Drawing on experiences from the World Links for Development Programme, Robert Hawkins (2002) details ten lessons for ICT (in this case computers specifically) and education in the developing world. These are:

- Computer laboratories take time and money, but they work
- Technical support cannot be overlooked
- Non-competitive telecommunications infrastructure, policies, and regulations impede connectivity and sustainability

- Wireless technologies are usually more effective
- Get the community involved
- Private-public partnerships are essential
- ICT initiatives should be linked to broader education reforms
- Training is fundamental
- Technology empowers girls
- Technology motivates students and energises classrooms

(Hawkins, 2002)

Many of these lessons have been highlighted in the examples provided in this section (see also Trucano & Hawkins, 2002). However, another essential lesson that this section has highlighted is the need to work with a broad definition of what ICT means. In many instances, considerable educational value can be gained from using 'older' technologies such as radio and television, and the importance of print resources is fundamental in many sub-Saharan African countries where technological resources remain scarce. In summary, ICT has many important contributions to make for schooling in Africa, but only when guided by a careful understanding of the educational context, and when grounded in clear educational goals.

10. ICT and Tertiary Education .....

> *At the University of Dar es Salaam we have realized that the ongoing information revolution has, and will, continue changing the way we teach and learn, the way we do research, and above all else, the way we provide our services to the community at large.*
>
> *(Prof. M.L. Luhanga, Vice Chancellor, University of Dar es Salaam, cited in Levey, 2002, p3)*

The effects of globalization on learning are perhaps most felt in the tertiary education sector where there is increasing competition between institutions, both within countries and internationally. As e-learning, 'virtual' education, and distance education methods become increasingly popular, sub-Saharan African countries will find themselves under increasing pressure to provide quality tertiary education that meets the skills needs of their countries. Saint (1999) notes that tertiary distance education is the world's fastest growing educational sector. Distance education and ICT have important roles to play in the improvement of tertiary education delivery, quality, and access. As noted above, however, use of 'new' ICTs is still limited in many tertiary institutions because of infrastructure constraints, lack of instructional materials, lack of skilled faculty, and because ICT-based pedagogy is still new for many. Although some universities in sub-Saharan Africa have embraced the challenge – as is noted above in the quotation from the Vice Chancellor of the University of Dar es Salaam – others have been slower to respond.

This section will briefly explore some initiatives making use of ICT within the tertiary education sector. It is useful to begin with a look at Table 11, which provides some indication of the extent of distance education in the tertiary sector, the types of courses offered, and the technology used. Table 12 provides further information about technology use in the tertiary sector.

Table 11: Distance education technology use at higher education institutions

Country	Institution	Courses offered	Technology used
Botswana	Centre of Continuing Education	Certificate in Adult Education; Masters in Educational Planning	Print (audio and video being considered)
Côte d'Ivoire	FVU	Economic Development Computer Science (graduate level) Environmental Science	Satellite, CD-ROM, video, print
	ENS	Mathematics	Print
Ethiopia	Addis Ababa University	Masters in Education, Curriculum Studies and Education Planning	Print (will add audio)
	OKOU	MBA	
	African Virtual University (AVU)	Computer Engineering, Computer Science, Electrical Engineering	Satellite broadcasts, Internet, fax, phone and print
	Civil Service College/ World Bank Learning Network	23 courses	V-Sat, 11 networked computers
Ghana	African Virtual University (AVU)	Computer Science, science, English, French, B.Sc	Satellite broadcast, Internet, fax, phone, print
	University of Science and Technology	B.Sc Building Technology	Print

Table 11: continued

Country	Institution	Courses offered	Technology Used
Guinea	Higher Institute of Education	School Administration	Computers, print
	FVU	Computer Science, Economic Development, Environmental Science	Satellite, CD-ROM, video, print
	Agency of Technical and Cultural Cooperation	Vocational skills	Radio, TV, print
	National Directorate of Technical and Professional Training	School Administration	Computers, print
	Gamal Abdel Nassar University of Conakry	Public Health Human Rights	Computers, print
Mauritius	University of Mauritius	IT, Communication Skills, Management, Economics, Math, Law, Statistics	Print, Internet, computers, audio, video, tapes
Namibia	Centre for External Studies	Nursing, African Languages, School Library, Science	Print, some audio tapes, radio
	University of Namibia		Print, radio

Table 11: continued

Country	Institution	Courses offered	Technology used
Nigeria	University of Abuja	Law, administration, history, accounting, economics, political science, sociology, geography, English	Print, some audio tapes, radio
	Most other universities	Part-time and 'sandwich' programmes	
Senegal	African Virtual University (AVU)	Engineering, Sciences	Satellite broadcasts, Internet, print
	FVU	Computer science, Economic development, Environmental Science	Satellite, CD-ROM, video, print
Swaziland	Institute of Distance Education	B.A. in Education, Humanities, Diploma in Commerce, Law Certificate, French	Print, radio
	Emlalatini Development Centre	Certificate and Diploma in Adult Education	Print, radio
Tanzania	Open University of Tanzania	Multiple degrees	Print, radio
	Institute of Adult Education	8 subjects	Print, radio, audio tapes
Uganda	Makarere University	B.A. Commerce	Print, audio tapes
Zimbabwe	Zimbabwe Open University	B.A. Education, B.S. Agriculture, Diploma in Education, MBA	Radio, television

Source: Murphy, *et al.* (2002) *taken from* World Bank (1999)

Table 12: Percentages of tertiary institutions/ programmes using different kinds of media

Types of Media	Anglophone %	Francophone %	Lusophone %
Print	96	88	90
Telephone	8	2	0
Fax	0	0	0
Audiocassettes	17	15	20
Videocassettes	13	31	0
Radio	2	12	70
Audio Conferencing	3	3	40
Video Conferencing	0	0	0
Satellite	2	18	0
Internet/ CD-ROM	5	34	0
No Information Provided	6	5	10
Number of Institutions/ Programmes	66	67	10

Source: Komane & Mays (2001), *taken from* Roberts & Associates (1998)

Both of the above tables show that, as was found for schools, print and radio are still the most widely used technologies for distance education in the tertiary sector. There are, however, much higher levels of computer and Internet use in the tertiary sector than the primary and secondary sectors. As has already been mentioned, several studies have shown that it is not the medium itself, but how it is used, that influences learning. Further, multiple media tend to be the most effective. Nonetheless, Saint (1999) notes that print media are likely to remain the best choice for many African countries. It is also important to consider possible use of cellular telephones. It was noted that cellular telephony reaches more people than fixed line telephony. Anecdotal evidence from the South African context indicates the potential for cellular telephones as a suitable communication device for use in distance education programmes, and in many cases the reach of the Short Message System (SMS) is likely to be far greater than that of email.

On the continent, there is some growth of web-based programmes, especially in South Africa. Such programmes require that students have access to computers and the Internet, and enrolments in these programmes therefore tend to be much lower than for paper-based

programmes. Programmes offered in this mode are generally targeted at niche markets and/or offered at Master's level. In this model, the Internet, World Wide Web, and CD-ROM are used to deliver programmes. In some instances, programme delivery by means of the World Wide Web or CD-ROM actually constitutes paper-based distance education, meaning that the technology is primarily used to download content. In addition to content delivery, however, many of the programmes offered through this mode provide learner support and administrative services, using web-based software packages such as Web CT and Embanet.

Another ICT-based delivery model is to bridge the spatial divide between learners and teacher, using technologies such as satellite broadcasting to offer face-to-face lectures at satellite and learning centres. In essence, these programmes are traditional contact programmes that employ innovative strategies to make them more accessible to learners who work full-time or who are spatially removed from the institution.

The following two boxes provide examples of the introduction of computers at the University of Dar es Salaam and the University of Namibia.

Box 7: ICT Use at the University of Dar es Salaam

The University of Dar es Salaam has established a university-wide data communication network, connecting all 26 academic buildings on the main campus with an 8km fibre-optic cable, as well as two regional campuses with a 2-Mbps wireless link. Full Internet connectivity is provided to the campus. A virtual distance learning system is being established, using the fibre-optic and wireless backbone and Internet infrastructure. Plans are to ensure that all university graduates will be computer literate within two years. Many aspects of the administrative system have been computerized. Though the current (2000) computer-student ratio is 1:60, it is expected to fall to 1: 10 very soon. Computers are installed in every residence hall.

Source: Murphy et al. (2002, p19)

Box 8: ICTs at the University of Namibia

The University of Namibia has a campus in the capital city Windhoek and also in Oshakati, a much smaller town in the North of the country. Many of the courses offered at Oshakati are offered through distance education. Video-conferencing technology is available (the first in Namibia), so a lecturer in Windhoek can teach students in Windhoek and Oshakati at the same time. The Oshakati campus has its own library that is connected to the Internet, although the connection is often slow. Library users in Oshakati have access to the University of Namibia's Online Public Access Catalogue. They can also access tables of contents of various journals, as well as full text articles in certain cases. In addition, the local community of Oshakati is also allowed access to the library and can make use of the Internet for a charge of approximately US$1.50 per hour. A new library resource centre is currently being constructed which will have many computer access points and two computer laboratories with 15 computers each.

Source: Levey (2002)

Perhaps the most well-known and commonly cited example of an initiative to make use of ICT for expanding access to, and enhancing quality of, tertiary education is that of the African Virtual University (AVU), a project of the World Bank (see Box 9 below).

One of the components of open learning is that of collaborative learning. ICT provides new opportunities for collaboration and facilitates collaborative learning within distance education. An interesting example of such collaborative learning is the Global Graduate Seminar: Globalization and the Information Society, which is described in Box 10 below.

Also of importance for a discussion of ICT and tertiary education is the role of the university library in the context of open learning. Saint (1999) notes that libraries and librarians will be central in efforts to improve higher education quality using ICTs and in helping higher education institutions to adapt to the information society. This is the case because it is no longer possession of information and knowledge that is most important as an outcome of education, but rather the ability to find information and to be able to adapt it for new applications—that is, to be

Box 9: The African Virtual University (AVU)

The AVU was started in 1997 as a pilot project of the Africa Department of the World Bank. AVU is a technology-based distance education network, involving 12 African, European and North American universities. It is now an independent, non-profit organization headquartered in Nairobi. The goal of the AVU initiative was to use ICT in sub-Saharan Africa to enhance access to quality higher education in subject areas of importance for economic development. The World Bank (2002) describes the AVU as a 'university without walls' that uses modern ICT to enhance access to science and engineering through direct access to high quality faculty, curricula and learning resources from across the world. Thirty learning centres, in 17 tertiary institutions across Africa, have been established. Thus, although the courses provided are based on distance methods, the learning still takes place at a tertiary institution, and courses are often also done by students registered for contact courses.

By 2002, about 3,500 hours of instructional programmes had been provided and over 24,000 students had registered in semester-long courses. The teaching and learning model was composed of a mix of videotapes and live lectures delivered via one-way video, two-way audio, digital satellite broadcast, and email interaction. No formal evaluations have yet been done, but it is estimated that dropout rates are approximately 15%, which is low for a distance education programme.

Levey (2002) notes that the project has received criticism because all the courses provided have been developed in the Northern hemisphere. Murphy *et al.* (2002) note that, during recent strategic reviews, it was decided that AVU will not aspire to be a university in its own right, but will rather help to expand access to higher education by delivery of courses from other universities through distance programmes. In addition, AVU resource centres will provide technological support for partner institutions. The digital library, which is a core component of the initiative, offers access to full text journals and a catalogue of subject-related web links.

Sources: Murphy et al. (2002), World Bank (2002), Levey (2002)

Box 10: Global Graduate Seminar

A professor at the University of Michigan runs this seminar with participants from two other American universities and three South African universities, namely, the University of the Witwatersrand, University of Fort Hare and the University of Pretoria. This seminar is an initiative of the Collaboratory of Technology Enhanced Learning Communities (Cotelco) with support from the Alliance for Community Technology (ACT). Each of the universities involved offers the seminar as a credit course for one of their masters or PhD programmes. At each university, learners are located in a computer laboratory, but learning takes place in a globally distributed collaborative learning environment of cross-national learning teams. Web-based collaborative tools, both synchronous and asynchronous, are used to create this globally distributed learning network. Both a distance component and a face-to-face component are included. The professor leading the seminar spends an equal amount of time at each participating university to provide face-to-face contact with the students. For the rest of the time, students work using only the online collaborative tools. Each student takes part in two group projects, one face-to-face with students at the same university, and one globally distributed group.

The project has a strong research component exploring on-line collaborative learning. Findings thus far have shown that students feel that they learn better when working in face-to-face teams than distributed ones. However, almost half of the participants found no difference in the seminar whether the professor was physically present or not. This provides tentative evidence that online distance methods are a suitable substitute for contact teaching (Cogburn, 2002, Cogburn et al. 2002). This is especially important in the context of sub-Saharan Africa where skills educators, especially in the tertiary sector, are in short supply.

Source: Cogburn (2002); Cogburn et al. (2002)

able to use it. Developing these capacities should become an essential component of education at all levels, including the tertiary level, and since many tertiary education institutions have the most advanced information infrastructure, their role in this regard should not be underestimated. Saint (1999) and Levey (2002) argue that libraries will become interactive information resource centres for both universities and the surrounding community. Eventually, libraries will merge into 'electronically linked regional and global knowledge webs' (Saint, 1999, p15). One example of the beginnings of this is the SYFED-REFER programme, which is an Internet-linked electronic network of media resource centres in universities in 11 Francophone countries. Further, libraries in Africa should take on the role of distributing African research, thus showing that Africa is also a knowledge producer.[13]

To do this, libraries need access to technological resources. In addition, librarians need to be trained in use of ICT, and there needs to be an increasing recognition of the role of the library for tertiary institutions. The AVU described in Box 9 above includes a digital library that contains the following main components:

- A Z39.50 library interface gateway which provides access to several databases;
- 3,800 primary URL links to research papers and working papers from universities and research centres across the world; and
- Electronic access to 1,200 full-text scientific journals with abstracting and index services.

Many of these materials are not available in local libraries. African universities taking part in the AVU project can currently access the digital library free of charge during the pilot period. Later, an annual subscription rate will be charged. The aims are for this virtual library to be a catalyst for the automation of African university libraries, to facilitate the digital preservation of rare African collections and to disseminate scholarly work through online publishing (Saint, 1999).

13. *This point takes us to the important issue of local content production. Although this issue is not addressed directly in this report, it is an important consideration since many African countries do not have the capacity to produce their own content and thus must 'import' content from elsewhere. Not only does this raise the question of the relevance of content, but also perpetuates the view of Africa as not producing information and knowledge. This devalues the wealth of knowledge that is produced in Africa.*

11. ICT and Teacher Training.....

This section considers two distinct but related issues with respect to teacher training and ICT. On the one hand, ICT provides support for general teacher training programmes (pre and in-service) and continuous upgrading programmes, many of which, in the African context, use distance methods. On the other, training of teachers in use of ICT for teaching, in an integrated manner, is an essential component of successful use of ICT across the education sector. Thus, ICT is a tool to enhance the education and training of teachers and ICT is also a tool that teachers can use to enhance their teaching (for which training is also needed).

Professional development is a complex and sophisticated process that involves training in content, pedagogy and a wide range of skills. It also should take place throughout the professional life of a teacher (Haddad, 2002). While there are many teacher-training colleges, courses and programmes across the continent, many have not been very successful in delivering high quality courses. Murphy, et al. state that

> *the wide perception of ineffectiveness of conventional programs of teacher development and the relatively high level of public expenditure going into these programs have provided a strong rationale for seeking alternatives that would make more effective use of distance education and ICTs as part of the teacher development effort.*
>
> *(Murphy, et al., 2002, p13)*

ICT shows considerable promise for solving some of the ongoing problems plaguing professional development for educators. ICT is seen both to enhance the quality of teacher training and also reduce the cost of face-to-face training. ICT can also be used to reach many more teachers on a more ongoing basis, allows the incorporation of a host of new topics and issues into the educational curriculum, and encourages more fundamental pedagogical reforms (Fontaine, 2002).

Various significant and unique opportunities are provided by ICT when used for teacher development, namely,

- New technologies allow for stimulation of specific skills through mini- and micro-lessons, which can be watched, manipulated, and tested. ICT can also provide demonstrations of real teachers in real classroom settings, representing a range of subjects, approaches,

and methodologies. These demonstrations can then be dissected, analysed, watched again, and assessed over time without disrupting an actual class.

- Technologies such as radio, television, and computers enable teacher education to be provided at a distance to the trainee's location, thereby saving travel time and cost, and also avoiding disruption of classroom routines as teachers can learn in their own time.
- ICT allows teacher education to take place any time and in any place. ICT also allows teachers to learn things on demand, so that teaching is not just supplied irrespective of whether teachers feel the need for it or whether they are ready to learn it.
- Initial and specialized training is never sufficient for the entire professional life of a teacher. Teachers often have to deal with changes in knowledge, methodologies, pedagogical issues, students, and school culture. ICT can break professional isolation by allowing educators to communicate, exchange information, interact in chat rooms and on bulletin boards, and hold discussion forums and virtual conferences.
- Use of technology for teacher training also familiarizes the teacher with technology (Haddad, 2002; Haddad & Jurich, 2002).

The quality of teachers is known in almost all countries (rich and poor) to be a key predictor of student learning. In poor parts of poor countries, many teachers are usually inadequately trained for their jobs. Therefore, teacher training is very important. Use of technology to train teachers is particularly important not only because training a teacher can leverage impact on many more beneficiaries, but also because teachers can become intermediaries for bridging the digital divide for the many millions of low literate or illiterate youth and young adults who may be in some kind of education programme, but have little previous access to IT (Wagner, 2001). In effect 'teachers remain the gatekeepers for students' access to educational opportunities afforded by technology: they cannot and should not be ignored' (Carlson & Tidiane Gadio, 2002, p119).

Perhaps because of the appropriateness of taking education to practising teachers and because of high levels of underqualified teachers, teacher-training initiatives have benefited the most from distance education methods in the sub-Saharan African context. Murphy, et al. (2002) note that in Francophone and Anglophone countries, teacher training accounts for three-quarters and half of all distance education programmes respectively. Given the significant shortage of teachers

noted above, as well as the fact that in some sub-Saharan nations, student enrolments are outpacing the number of teachers available (Fontaine, 2002), application of distance education supported by ICT requires extensive support. Table 13 below provides an outline of the kinds of distance education programmes used for teacher training, as well as the educational technologies employed.

The table illustrates that, although a range of technologies is used, the print medium is still predominant. The same was shown for both school and tertiary education. While radio and audio are still used more than computers, there is increasing use of computers and Internet. In support of such efforts, UNESCO is currently piloting the Creating Learning Networks for African Teachers project. This project aims to provide computers and full Internet access to a maximum of four teacher education colleges in each of 20 different African countries. This infrastructure will then form the base for development of local, national, and regional networks of teachers. Curriculum design, especially for science and mathematics, as well as the creation of national education websites, are also planned outcomes of the project.

Fontaine (2002) states that conventional teacher training approaches should not be discarded completely, but that combining computers with occasional face-to-face training can be highly effective. ICT should also always be used with the understanding that it is neither a quick nor an inexpensive fix. Furthermore, teachers need easy access if they are expected to become comfortable with using ICT. Expecting teachers to travel long distances to use a computer either for training or classroom use is unreasonable. Even if the computer centre is conveniently located, restrictive security measures or limited operating hours will mean that only the most dedicated professionals will use the computers on a daily basis (Fontaine, 2002).

Two computer-based teacher-training projects, which are fairly similar in approach, are described in Boxes 11 and 12 below.

This takes us to the second issue noted above, that of training teachers to make use of ICT for teaching and learning purposes. Many ICT and education projects focusing on the school level have included a component of teacher training in ICT use – some with more successful results than others. Box 13 below is an example of a successful project, developed and implemented by SchoolNet South Africa, to provide teacher development with respect to ICT.

Table 13: Teacher development programmes and the use of educational technologies

Country	Institution	Pre-Service	In-Service	Technologies
Benin	Participation in CIFFAD Programme		Yes	Print, satellite
Côte d'Ivoire	WorLD Programme		Yes	Computers, satellite
Ghana	Winneba College of Education; University of Cape Coast World Links Programme	Yes	Yes	Print, audio cassettes, satellite (through the AVU)
Kenya	University of Nairobi, Institute of Education/ Ministry of Education	Degree	Yes	Print, audio and video cassettes, face-to-face teaching
Malawi	MASTEP	Special programme		Print, audio and video-cassettes, face-to-face
Mozambique	Teacher Improvement Institute		Yes	Print, face-to-face instruction
Namibia	Centre for External Studies, University of Namibia	Yes		Print, computers, Internet, video, audio
Nigeria	NTI; COSIT; a number of other universities	NCE; B.Ed	PGCE	Print, radio, audio
Senegal	WorLD Programme		Yes	Computers, satellite
South Africa	Several universities and colleges of education	Yes	Yes	Print, computers, Internet, video, audio
Tanzania	Open University of Tanzania	Yes	Yes	Print, audio and video cassettes, face-to-face
Uganda	NITEP; MITEP; TDMS; Makerere University	Special programmes B.Ed	Yes	Print, audio and video cassettes, face-to-face
Zambia	University of Zambia	B.Ed		Print, face-to-face instruction
Zimbabwe	Zimbabwe Open University	B.Ed	ZINTEC	Print, radio, telephone, face-to-face

Source: M*uphy, et al.* (2002, *p*14) *taken from* M*odupe* (1999)

Box 11: Teacher Training with Technology in Namibia and Uganda

In collaboration with the USAID missions and education leaders in five countries, LearnLink is implementing computer-mediated professional development activities that take advantage of the potential of ICTs to improve training and support services for teachers. Two African countries are involved, namely Namibia and Uganda, and the activities in each country are as follows:

Namibia:

The Computer Assisted Teacher Training (CATT) project is part of a greater plan to improve teacher training nationwide. The project is a collaboration among USAID/Namibia, AED/LearnLink, and educational leaders in Namibia, and includes the following components:

- Developing computer assisted training courses for teachers, facilitators, and other educators
- Constructing a communications network linking educators through the Internet
- Designing prototype curriculum-based training materials for primary school students
- Introducing teaching/learning technology concepts into the national policy dialogue

Uganda:

The CONNECT-ED (Connectivity for Educator Development) project is designed to improve professional development for primary school teachers with a focus on computer-assisted teacher training. Multimedia teacher training laboratories in four Primary Teacher Training Colleges in both rural and urban areas give teachers access to their training curriculum through computer-mediated learning environments and digital library resources. A broad range of activities involving computers and connectivity are being explored to determine the most effective approaches.

Source: Fontaine (2000)

Box 12: The Bindura Internet Learning Centre in Zimbabwe

In 1999, 13 computer and Internet centres were opened at school and community-oriented centres in Zimbabwe. These centres were established through a partnership between the Zimbabwe Ministry of Education, Sport and Culture and the World Bank-sponsored Zimbabwe-World Link for Development Programme (WorLD). Three of the sites are at secondary schools, nine in educational resource centres and one is in a mobile van. One of the sites is called the Bindura Internet Centre.

As an example of these centres, the Bindura Centre uses ten networked computers and Internet access to provide training in how to use these tools for educational and professional development. Because of its size the Centre can only serve a limited number of clients at one time, typically 10 to 20 people, but the impact of the training offered is considerable. IT resource teachers were recruited nationally and were given special training to prepare them for the training and facilitation they do in the Centres. The facilitators provide instruction in computer literacy, software applications, and online collaboration.

Students and teachers at the Bindura Centre are using the resources and IT training to complement their classroom activities, Open University students are downloading useful research information and private clients are developing skills to improve their professional and organisational productivity. It is a successful model of a dual-use telecentre, i.e., serving students and teachers during the day and the general community and adult learners in the evenings, weekends and holidays. The Bindura Centre serves approximately 180 students and teachers.

Source: Bloome (2000)

Box 13: School-Net SA Educator's Network in South Africa

SchoolNet South Africa has developed a project to address the need to provide teacher training for the use of ICT in teaching and learning. In response to this need, the Educator's Network was developed. The Educator's Network is an educator development programme available both online and on CD-ROM. The approach is based on the following key principles for educator development:

- Educational goals must be primary to the project.
- There is no single best practice or general recipe for success.
- Educator development must be needs-driven.
- There must be flexibility in access, modes of delivery and content, in order to make learning possible in a meaningful and equitable way.
- Educators must receive situated/experiential learning support.
- Educators must reflect on their practice while implementing new ideas involving the integration of ICT.
- Educators must reflect on change as they learn and plan strategies to implement new ideas.
- Teaching practice, including classroom organisation, must change if ICT is to be implemented effectively.
- Workshop leaders and mediators must model desirable educational practice in training.
- Quality educator development is a process and not a product.
- The most effective approach to skills development is to have context, use the just-in-time approach and use the adult learning style.
- Ongoing support cannot be over-emphasized.

Based on these underlying principles, the Educator's Network project makes use of both face-to-face and distance methods. Distance methods make up the bulk of delivery, and the learner is supported by a mentor throughout the learning process. In addition, a 'community of learners' is developed by encouraging teachers to work together, to share their work and ideas, and so to support one another. Six modules are currently available. These are:

- Learning strategies for ICT (questioning skills, the outcomes-based approach, thinking skills, classroom management).

- Telecollaboration.
- Project-based learning.
- Information skills.
- Using the WWW to enhance teaching and learning.
- Integration of ICT with subject teaching.

These modules highlight the approach of providing training that is of relevance to current classroom practice, and through using ICT during the education process, the relevant ICT skills are learnt.

Source: www.schoolnet.org.za/edict/edict

Initiatives that train teachers to integrate ICT into education successfully are often not well financed or implemented. At a minimum, there are four issues that have prevented successful implementation of such training, namely:

- Programmes often cover only computer literacy and do not train teachers in the instructional use of technology.
- Most programmes are supply-driven, in that it is assumed that, if training is supplied, classroom success is ensured. But the demand side is also very important. The demands of teachers should be taken into consideration, including their needs, interests, and attitudes.
- The benefits of using ICT are often overstated considerably, which leads to fanaticism and frustration. Training should be grounded in realism and educational context, including the limitations of ICT.
- Once-off training is never enough. Training in use of ICT for instructional and learning purposes takes time and individual assistance. There are many reasons for this: even the most knowledgeable and enthusiastic teacher is faced with time constraints and competing demands to learn new things; technologies are unreliable, especially the more sophisticated and promising ones; hardware, software and educational applications keep changing; and teachers need to establish what works best for their particular needs in the classroom (Haddad, 2002).

ICT for teacher education and teacher education for ICTs are two complementary endeavours that hold significant potential. But, like any innovation that involves individuals and organizations, success does not happen through mere application. There are complicated, multi-faceted, and unpredictable conditions that must be provided, continuously as-

sessed, and modified accordingly. As with any ICT application, the learner (in this case, the teacher) should continue to be the centre of any strategy and the measure of any success (Haddad, 2002). In the context of ICT and education it is important to remember that 'learning is only one component of the educational process, and quality learning cannot be attained without good teaching' (Haddad & Jurich, 2002, p36).

12. ICT and Adult/Basic Education .....

Because an enormous expansion of the formal education system alone cannot address existing, let alone future, basic learning needs (see www.unesco.org/education), sub-Saharan Africa must seek ways to harness the powers of distance education to meet the needs of adults who were earlier in their lives deprived of opportunities to go to school. This section looks at the importance of adult basic education, or literacy education, in sub-Saharan Africa, the appropriateness of ICT and distance education for teaching adults, and explores various initiatives where ICTs have been used to tackle basic literacy needs.

The term 'literacy' covers a wide range of skills which essentially fall into the category of human competencies, and include reading, mathematics, linguistic and multi-linguistic fluency, content knowledge in specific areas, eye-hand coordination, and typing (and 'mousing') skills (Wagner, 2001). Technology literacy, the ability to use technology hardware and software, is increasingly being seen as an important part of basic education (Haddad & Draxler, 2002). Most often, it is the poorest of the poor who suffer in these areas, and a lack of these skills is a major barrier to economic development, social advancement, and poverty alleviation. The United Nations estimates that there are currently about one billion illiterate adults in the world (about one quarter of the world's adult population), most of whom live in Africa and South Asia. Even this is probably a severe underestimation (Wagner, 2001), and there are perhaps two to three times as many who would be deemed 'technologically illiterate'. Disadvantaged youth and adults in the developing world are generally diverse in origin and background, including women, ethnic and linguistic minorities, refugees and migrants. This diversity is significant when narrow or 'one-size-fits-all' education programmes, often using complex technology, are introduced (Bridges to the Future Initiative, see http://literacy.org_ili).

Basic education is a human right, and there are several reasons to support adult basic education programmes. Adult basic education (ABE) is significant in terms of achieving equity goals and is an essential contributor to poverty reduction. ABE programmes also succeed better than most other forms of education in reaching women. Women's education has been shown to have a significant impact on enhancing agricultural productivity, improving the health status of the family and reducing fertility. ABE is also important because it helps to empower the poor, build strong societies, improve governance and strengthen

democratic institutions (Lauglo, 2001). Furthermore, adults who cannot read or write are excluded from all education in the broadest sense. Therefore, education and poverty reduction are closely related: poverty is a barrier to development, and educational deprivation perpetuates and reinforces poverty (Watt, 2001). Furthermore, poorly educated parents are ill-placed to assist their children, leading to a situation in which academic under-performance becomes entrenched (Learning to Bridge the Digital Divide, see www1.oecd.org/media/published).

Adult basic education programmes, also referred to as 'non-formal education' and 'literacy education', are aimed at adults and out-of-school youth. These programmes usually include basic elements of literacy and numeracy, as well as other fundamentals determined by demand and context. 'Adults' are deemed to be persons older than age 15, and are therefore typically those thought to be too old to go to primary school (Lauglo, 2001). In sub-Saharan Africa, the case for prioritizing ABE is especially strong because primary school enrolments have remained low, often as a result of continued turmoil, sustained poverty, socio-cultural marginalization, inadequate numbers of schools and/or qualified teachers, or barriers such as restricted time schedules, age limitations, instruction fees, or language of instruction (Lauglo, 2001). The structure and content of ABE learning activities should equip not only adults, but also children and youth, with the knowledge, skills, values, and attitudes they need to survive, to improve their quality of life, and to empower them to participate fully and responsibly in the life of their communities and countries. Education should also equip adults to both initiate and adjust to the changing conditions of their environment, and to continue learning according to their individual needs and interests (Haddad & Draxler, 2002). Such capacities are central to a global environment where life-long learning has become increasingly important.

ICT has a very important role to play in expanding educational opportunities for adults. This is particularly true since the benefits of ICT are well suited to the problems of basic and technological literacy:

- Poor people in developing countries are generally demographically diverse and tend to be widely dispersed; ICTs incorporate distance education methods that can be adapted to diverse populations.
- There is a limited number of teachers who are well-trained for adult literacy, and good teachers are a critical requirement for quality teaching and learner motivation; ICT for teacher education has proved to be very effective.

- The linguistic and cultural content of tools used in literacy courses are seldom appropriate for diverse populations. In particular, teaching materials in native languages are few; today's ICTs make it relatively easy to adapt materials to other languages.
- Lastly, ICTs in literacy and basic education often ensure the development of 'technological' or 'digital' literacy skills, which are essential competencies in today's economies.

(http://literacy.org_ili)

Thus, not only do ICTs offer new means of education provision, but ICT skills are also in and of themselves an important educational output.

To date, Africa has primarily used the media of mass communication and distance education for non-formal education. By the late 1960s, there was a range of experimental projects using radio and simple printed materials for agricultural, health and community/civics education for adults, typically aimed at adults with little or no formal schooling. In 1964, Ghana – and, in 1966, Zambia – followed the Canadian and Indian model of Radio Farm (or Rural) Forums (see Box 14 below). Around this time several countries in West Africa introduced the Clubs Radiophoniques (or radio clubs). In a few countries, such as Côte d'Ivoire and Niger, Teleclubs were introduced for non-formal education. In Tanzania in 1966, a small experimental series of radio campaigns was introduced which was expanded to reach up to three or four million adults, and was later copied in Botswana and Zambia. All of these interventions used the same basic methodology of regular educational radio programmes accompanied by simple printed materials, studied in controlled listening groups and involving regular organized feedback (Dodds, 2002).

Box 14: Radio Farm Forum in Zambia

In Zambia, the decision to use radio in agricultural development was based on the size of population, the types of roads, literacy levels, the need to disseminate agricultural knowledge, information and skill, as well as the need to increase household and national food security. Radio Farm Forum (RFF) was established to give farmers the opportunity to assemble, listen to a particular problem introduced to them on radio, talk it over and decide on an appropriate solution. The

programme is a 30-minute discussion session broadcast in English and seven local languages.

Through the RFF initiative, the radio has become many farmers' most faithful teacher. Some of the information needs addressed include information on new farming methods, new varieties of seed, types and application of fertilisers, types and spacing of seeds, types and application of pesticides and types and treatment of certain crop diseases. The programme has a close relationship with an existing Zambian functional adult literacy programme.

Problems have been experienced with the RFF, including a lack of availability of radio batteries in rural areas, difficulties reaching Forums for supervision in the rainy season due to inaccessibility by roads, regional differences in terms of language and farming practices, and poor radio reception in some parts of the country. Nonetheless, it was found that members of the Forums attend meetings regularly after harvesting; at other times they meet and listen to the programme as long as they have batteries and good reception.

In terms of achievements, the RFF programme has supported the dissemination of agricultural information to many small-scale farmers in remote rural areas who cannot be reached by other means. The farmers themselves have expressed satisfaction with the system. More recently, the programme has also achieved the introduction of free-play radio sets to replace battery-powered sets and there has also been success in awareness campaigns to educate the farmers on the need for self-reliance in running the affairs of the RFF groups.

Source: Sibalwa D.M. (2000)

The Bridges to the Future Initiative (BFI) in South Africa is part of a global effort (similar initiatives are being introduced in India, Ghana, and Mexico) aimed at using ICTs to support basic education provision to the poorest of the poor. BFI will focus on assisting poor, disadvantaged, and marginalized youth and adults in developing countries to take advantage of new ICTs for acquiring basic literacy and technological literacy skills as a means to participate in the changing civil, social, and

economic life of these countries.[14] The BFI in South Africa will be the first major project in literacy and adult basic education to use ICTs to help illiterate, unschooled, and out-of-school youth and adults (Learning to Bridge the Digital Divide, see www1.oecd.org/media/published).

Dodds (1996) carried out a worldwide study of 73 projects in non-formal education using distance education, 31 of which were from Africa. Extensive and growing use is being made off distance education methods to carry out non-formal and adult basic education. Africa has the technology and is rapidly gaining access to new technologies that will increase the number of learning opportunities for adults, ultimately improving the quality of life of those involved. However, there appears to be little evidence that governments are prepared to invest significant resources in such programmes, signifying an apparent lack of attention to this critical issue.

Although incapable of teaching literacy on its own, radio is used extensively in adult basic education as a backup to conventional teaching methods. The advantages of radio for ABE are its wide distribution and the fact that, for illiterate adults, it is much more widely obtainable than any other distance education medium (Lauglo, 2001). In Uganda, of the adults participating in functional adult literacy courses, approximately 40% said they had a working radio (Okech, Carr-Hill, Katahoire, Kakooza & Ndidde, 1999, in Lauglo, 2001), and many more are likely to have listening access to a working radio (Lauglo, 2001). Adult working sessions can be coordinated with relevant radio transmissions, allowing direct support to the ABE teaching, by for example, giving learners further insight into the subject matter and providing an entertainment component to liven

14. *While both the role of* ICT *in adult education and the importance of* ICT *skills and technological literacy in today's world should not be underestimated, it is also important that the acquisition of* ICT *skills not be seen as a panacea in the context of development and of enhancing employment opportunities in particular. Research in South Africa has indicated that many adults have unrealistic expectations of the outcomes of basic computer training courses and many assume that once they have basic computer skills they will no longer have difficulty finding employment. While technological literacy is increasingly a requirement for employment this alone is not a sufficient condition, especially for those with low levels of general education, and many other, often structural factors, need to be addressed. Those providing the education and training should carefully mediate expectations about new possibilities once* ICT *skills have been acquired. If not,* ICT *skills training may in some instances be disempowering for those already marginalized.*

up and support literacy classes. However, such coordination can be difficult to achieve, as was experienced in the Ghana literacy programme (Siabi-Mensah, 2000) (see Box 15 below).

Box 15: Ghana: Use of Radio in National Literacy and Functional Skills Development

The National Functional Literacy Programme (NFLP) was created by the Ghanaian government in 1986 to coordinate all non-formal education activities. Emerging from the NFLP was the Literacy and Functional Skills Project (LFSP), which was launched in 1992. The aim of this project was to improve the quality of life of poor people in Ghana, especially the rural poor and women, and to reduce the level of illiteracy among the 5.6 million adult illiterates in the country. This programme had a radio component, the purpose of which was to support classroom teaching and discussion with more detailed information than the facilitator could provide. Until 1996, various problems were experienced which meant that the radio support did not play a very meaningful role in the process.

Because radio was considered very important in supporting teaching and learning of literacy, in 1996 the Use of Radio to Support Functional Literacy project was initiated. For radio to provide effective support to the learning of literacy, it was expected that:

- There would be radio lessons on selected themes, arranged sequentially to follow the teaching of the themes at face-to-face meetings.
- The radio programmes would be broadcast at predetermined times known, and convenient, to facilitators and learners.
- Learners would be featured prominently on the radio programmes.

Siabi-Mensah (2000) conducted a review of the radio component of the literacy classes. Some of the issues identified included:

- Electricity issues meant that some radio transmissions were dependent on unreliable and expensive generators.
- Radio coverage was not achieved across all regions.
- Not all literacy classes were provided with radio sets.
- Radio stations were not effectively managed, lacked key resources for work, were overstaffed

yet unproductive and were often unsatisfactorily monitored.

- There tended to be poor synchronisation between the face-to-face teaching and the radio component and the content of the radio programmes.

Despite these issues, the radio component of this initiative is influencing the lifestyles of learners in various ways:

- Improved understanding was gained on topics such as legal issues, bushfires, breastfeeding and teenage pregnancy.
- The family planning topic opened the way for more discussion and acceptance of this practice in some households.
- Radio created a large amount of awareness about the importance of literacy and provided information on other important issues such as health, agriculture, and the need to modify customs and traditions.
- Women found the programmes of particular importance

Source: Siabi-Mensah (2000)

In the Ghanaian example quoted above, the radio series was intended to lead classes to form discussion groups about the selected themes, but in practice they supported the classes chiefly by focusing on developing functional themes, presenting news and information about the classes, and providing a means for learners to demonstrate and practise their skills. Although it is perhaps true that the predominance of one medium, in this case radio, weakens the effectiveness of the educational programmes, radio not only enhanced the implementation impact of programmes, but also has greater potential for improving the overall effectiveness of programmes. Despite issues of poor reception in certain countries, wider-reaching and wider-ranging radio programmes obviously can successfully support literacy programmes and other basic educational initiatives (Siaciwena, 2000).

However, effective use of radio for such initiatives clearly depends on carefully planned systematization of radio programmes and forum discussions or literacy lessons in terms of timing, content, and structure of programmes. In addition, formal links and effective collaboration between the provider/coordinator of the non-formal programme and the broadcasting organization must be established. The roles and responsibilities of each party must be clearly defined and mutually agreed. A final imperative for successful management and delivery of

such programmes is involvement of government agencies or departments, as well as of local communities (Siaciwena, 2000).

In addition to radio programmes, cassettes can also be useful. They can more easily be coordinated with ABE courses and can be used as direct tools in, for example, teaching basic literacy. Cassettes require fairly simple technology for use but need a system of making and distributing recordings, which adds costs and complexity to the process (Lauglo, 2001).

In South Africa, as companies learn to adapt to the pressures resulting from re-entry into the international economic and business arena, human resource development in the area of ABE is being seen increasingly as a strategic intervention to facilitate the broad skills development required for capacity building (Hunter, 1988). South Africa is also one of the very few African countries able to cope with the high costs and logistical requirements of computers. Various computer programmes, with backup from a teacher, have been used to teach literacy and for various other skills development programmes within both industry and educational settings (Lauglo, 2001).

Carney and Firpo (2002) stress the importance of demystifying technology, the Internet in particular, in order to open doors for economic development as a goal of adult education. This goal is being pursued in Senegal as is described in Box 16 below.

Box 16: Senegal: Internet training for illiterate populations

Senegal is one of the first sub-Saharan African countries to make significant investments in technology, and is currently benefiting from a relatively high rate of penetration and growth of technology-related services.

Joko is an organization that aims to make the opportunities of the Internet accessible and relevant to Africans. In August 2001, the Joko pilot was launched: two cyber cafes, called JokoClubs, were opened, and additional venues are being planned and launched in 2002, the aim being to have 50 JokoClubs across the country by the end of that year. The JokoClubs have successfully introduced more than 3,000

people to the Internet. However, since two thirds of the Senegalese population is illiterate, there was considerable pressure on Joko to cater for individuals who are unable to read or write. As a result, training based on community requirements became a central Joko activity.

JokoClubs offer various courses in computers and the Internet, but an approach specifically adapted for the needs of adult illiterates has also been developed. This programme enables learners to acquire insight into what new information technologies can offer, but also gives them the ability to select the most useful and immediate functional skills for their own development. Through this process, adult illiterates are rapidly and effectively moving towards literacy. This has been achieved by starting to include learning of the French alphabet. A large keyboard is painted on the wall of each JokoClub, as a teaching tool, and a CD-ROM is used so that the look and the sound of each letter can be covered simultaneously. Other software helps learners develop keyboard skills and later on in the course arithmetic and calculations are covered.

The demand to join the JokoClubs has been overwhelming; a waiting list for the programme of more than 1,500 has at times existed.

Source: Carney & Firpo (2000)

Clearly ICT has a contribution to make to the basic education of adults. If basic education is looked at only in terms of basic literacy, numeracy, and rudimentary life skills, then technology could be considered a luxury. However, basic education for all in the modern world incorporates more than the conventional elements and has to equip individuals and nations to function in a world that is increasingly globalized and technologically advanced. Therefore, not only do the illiterate adult population of sub-Saharan Africa need to develop a range of basic functional skills, they also need to develop a level of understanding and proficiency in many of the new technologies that are now available.

13. Financial Implications.....

The benefits of, and uses for, ICT cannot wholly be appreciated without considering the financial implications of using such tools. Issues related to infrastructure and programme design can determine success, but the greatest obstacle to expanding use of ICT in Africa is the associated costs of such technology (Murphy, et al., 2002). Similarly, Williams (2000) claims that costs are the single most important limiting factor in use of appropriate technologies for learning. This section of the report highlights key issues in costing and financing use of ICT in education.

Economic analysis is useful in understanding the choices an educational provider faces when considering introduction of educational technology. However, what has to be remembered is what economics, and technology, cannot do. They cannot set objectives; rather, it is education providers, very often governments, who set objectives and decide whether costs are most important, or effectiveness, or efficiency, or whether it is another issue such as equity that must be given the highest priority. Technology and economics are means, not ends (Puryear, 2002).

'New' ICTs, and distance education delivery approaches, are popular among educational economists seeking cheaper ways of making education available (Dodds, 2001). Such tools generally substitute for personal classroom teaching and have a built-in cost advantage in that they obviate many of the personnel costs of conventional schools. This is particularly the case when students are widely dispersed or living in remote areas. Research suggests that distance education programmes for training teachers, for example, can be developed at a cost of between one- and two-thirds of conventional programmes (Puryear, 2002). Unfortunately, rapid development in ICT makes investment decisions risky, but, if used wisely, ICT can provide solutions to inequalities through its contributions to access and quality of education (Learning to Bridge the Digital Divide).

13.1 ....Four Cost Concepts

Managing education programmes that use ICT often involves crucial decisions related to the costs of creating courses, selecting technology for course delivery, and determining 'break even' points for course enrolments. Such analysis requires costing and planning skills, and, according to Murphy, et al. (2002), should take into consideration four important concepts:

- Calculate all costs involved;
- The relationship between fixed and variable costs when comparing ICT to conventional education approaches;
- Do not exclude opportunity cost;
- Bear in mind the unit of comparison when comparing different educational approaches.

In terms of calculating all of the costs, it is very important to understand that providing hardware is a very small component of the total cost package associated with the introduction of any technology (Murphy, et al. 2002). Incorporated in this is inclusion of both fixed and variable costs, and, as will be shown below, the need to consider how many students are to be served (Puryear, 2002).

The relationship between the fixed and variable costs of education is also critical (Murphy, et al. 2002). Fixed costs are the upfront investments needed to put in place the necessary infrastructure for making technology available, regardless of the number of learners served. These include the investment costs of, for example, developing and distributing lessons, broadcasts, and software (Murphy, et al. 2002). Fixed costs may also include the cost of setting up a central management and training system necessary to produce, distribute, implement, and maintain the technology (Puryear, 2002).

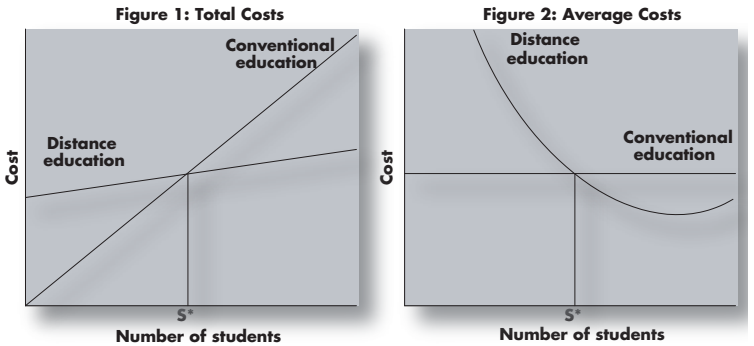
Not surprisingly, fixed costs are different for different kinds of technology. For example, the fixed costs of radio and television include payments to produce and broadcast programmes, which are generally much higher than those of print material. But fixed costs are always spread over all the students served, which can result in significant economies of scale. By contrast, some approaches that have low fixed costs, such as conventional teaching, but rely exclusively on the time of teachers, offer no significant economies of scale (Puryear, 2002).

Variable costs are those costs which vary with the number of students in the system after it has been set up. It is the cost of serving an additional student (Puryear, 2002). These are costs that depend directly on the number of learners in the system and generally comprise educators' salaries, facilities, books, and other materials. For example, the number of radios, televisions, and computers required in a programme often depends on the number of learners (Murphy, et al. 2002). Training educators to use new technology is also principally a variable cost: they must be trained every time a new technology is introduced in

another classroom (Puryear, 2002). Like fixed costs, variable costs are also different for different technologies.

As was mentioned above, the fixed cost of a course becomes more economical as it is spread among more users. This is where distance education systems often have a cost advantage over traditional systems. However, the cost advantage is only gained when student numbers are high. As Figure 1 in Chart 8 below shows, total costs increase more slowly in distance education systems than in conventional systems. Therefore, once the system has enrolled a particular number of students (s* below) the total cost of a distance education system can become less than the total cost of a conventional system. The average student cost for conventional instruction can be high because of the costs of educators' salaries, policies that limit educator-to-student ratios, and costs of building and maintaining facilities. The average cost of distance education programmes can be lower when the fixed costs are spread over large numbers of learners, as well as because of the reduction in the amount of educator time in the learning process and because learning often does not take place within regular educational facilities. This is shown in Figure 2 (Murphy, et al. 2002).

Chart 8: Adult literacy in selected African countries



Source: *Murphy, et al.* (2002)

In conventional education, the average cost for each student and the marginal cost, which is what it costs to add an additional student, are often more or less the same. In education programmes that use communications media, the skill in labour (the trained teacher, for example) is replaced by technologies or a combination of technology and a less expensive facilitator, and therefore the marginal cost of adding an additional student is always lower than the average cost. To maximize

economies of scale, it makes economic sense to increase the number of students until the marginal cost of adding another student approaches the average cost (Murphy, et al. 2002). For example, in terms of non-formal education, on the basis of having large numbers of citizens in these programmes and the positive impact recorded, Siaciwena (2000) concluded that media-based non-formal education programmes are more cost-effective than traditional face-to-face programmes. Indeed, costing evidence from Uganda suggests that such courses are about two and a half times cheaper than their equivalent in more traditional face-to-face training methods.

When comparing costing issues of two systems such as distance education and conventional schooling, a third important concept is opportunity cost. For the student who is taking part in a distance education programme, she will probably save herself the costs of room and board, and the opportunity costs of unemployment. Unlike in campus-based programmes, the students in a distance education programme can work throughout the school year (Jurich, 2000).

The fourth concept to consider is the unit of cost comparison. The unit used most commonly is the cost per pupil or per student, but this can be misleading since graduation rates are often lower at distance education institutions than at residential colleges or conventional schools (Jurich, 2000). When comparing conventional education to distance education, it may be more applicable to use cost per course completer, or the cost per graduate. However, this too will be inappropriate since there are students who study distance courses simply to further their education and not necessarily to graduate, and in this case cost per module of learning may be more appropriate (Murphy, et al., 2002).

Puryear (2002) highlights a fifth concept which is important when analysing costs of educational technology, described as the conditions in which technologies are expected to operate, or how these technologies fit into the educational system. When educational technology is adopted, it is critical to ensure that the appropriate combination of factors or conditions necessary to make it work are present. For example, certain technologies require talented and highly motivated educators, while others need reliable electrical and telephone connections (Puryear, 2002).

13.2....Cost Considerations for Different Types of ICTs

Having understood the concepts important for evaluating the cost-effectiveness of educational technology (and how these are connected to considerations about distance education), it is relevant to apply some of these concepts to different types of ICTs, most significantly three primary technologies that are incorporated in the definition of ICT used in this document, namely radio, television, and computers and Internet.

Unfortunately, there is little detailed information available about radio in terms of issues such as costs and effectiveness. Nonetheless, most would agree that use of radio has been a low-cost and consistently effective means to improve access and quality in subjects taught at many educational levels. Usually developing IRI programmes comes at a relatively high cost at the outset (Murphy, et al. 2002). This is because the fixed cost of radio is more than just the cost of the receiver. It includes costs associated with developing programmes, broadcasting programmes, training educators in how to use programmes, and assisting with maintenance (Puryear, 2002). In some countries, adapting radio programmes that have been developed elsewhere can considerably reduce these set-up costs (Murphy, et al. 2002). Also significant when considering radio is the cost of ensuring a regular power supply, a particularly critical issue where electricity is costly and in rural areas that do not have electricity (of which there are many) (Murphy, et al. 2002). The variable cost of radio is low, since radios are generally already fairly widely available and can be run on batteries if necessary (Puryear, 2002).

Pilot projects and initial phases of IRI programmes have often been financed by external funding agencies, most often USAID and more recently NORAD, UNICEF, and others. However, even if external investment covers initial costs, many countries will need help meeting the ongoing costs of programme delivery and maintenance (which although not high by some standards still pose a challenge for many sub-Saharan African countries). Fortunately, there is an increasing number of technological possibilities to reduce recurrent costs, particularly those associated with poor infrastructure. The wind-up radio, which is now being used widely in Africa, removes the need for batteries. Unfortunately, however, some countries using wind-up radios have reported a high rate of breakage of the wind-up mechanism. In the informal sector, power for radio is also generated using car batteries (Murphy, et al. 2002).

In the case of television, fixed costs tend to be high as they are costs

incurred when establishing a broadcasting capacity and producing programmes (Puryear, 2002). Television nearly always costs considerably more to produce than radio; one estimate suggests 25 times more (Puryear, 2002). But, for both radio and television, the fixed cost per student drops rapidly as more students are served because of economies of scale. The fixed cost of an educational television programme that serves just 1,000 students would be about the same as the fixed cost of a programme that serves 100,000, or 1,000,000, so the fixed cost per student will drop rapidly for the larger number of learners. The variable cost of educational television is higher, perhaps ten times as high as radio, since televisions cost more to purchase, have greater power requirements, and need more maintenance (Murphy, et al. 2002; Puryear, 2002).

For computers, hardware represents no more than 25 percent of the total cost (TAC, 1997, in Murphy, et al. 2002). A major fixed cost component also comes from the need to write appropriate educational programmes, as well as from peripherals, software, network infrastructure, support and maintenance, and training[15] (Murphy, et al. 2002). The variable costs of computers are derived from the cost of providing and maintaining each additional computer and its programmes, plus the additional cost of providing electricity, and – when Internet and email are included – a telephone service. Thus, the variable cost tends to be perhaps 100 times more than radio. Computer costs have dropped significantly in the past few years, but they are still high compared to traditional per-student costs in developing countries (Puryear, 2002).

13.3....Cost Implications of ICT for Access and Quality

The cost implications of educational technologies need to be considered in terms of two broad goals that may be applicable when decisions are made to use ICT, namely:

- Costs of expanding access to education; and
- Costs of improving the quality of education.

The costs of expanding access to education can be reduced considerably if distance education substitutes for face-to-face meetings with a teacher or lecturer. Costs will also be reduced because such distance education programmes reduce costs associated with conventional schools such

15. *For more details on costing models for computers in schools see Potashnik & Adkins (1996) and Cawthera (2001).*

as classroom use, since students either get together infrequently or in makeshift buildings (Murphy, et al. 2002; and Puryear, 2002). As an example, although many computer- and Internet-based initiatives in teacher development are just beginning and there is little information on costs and benefits, experience and analyses done to date suggest that reducing face-to-face teacher development through distance education and ICT offers a valuable means of reprogramming constrained educational budgets. However, many of these savings are, in fact, achieved without use of ICTs, but often because of a strong reliance on print materials to replace classroom instruction. Regardless of the technology used, savings such as these enable institutions to increase the size of the enrolment being served at the same cost (Murphy, et al. 2002).

By contrast, educational technology with the objective of improving the quality of conventional educational programmes usually results in increased per-student costs of providing education. This is true if ICTs are used to complement the traditional activities of a teacher, but still require significant supervised face-to-face teaching that takes place in existing facilities. These programmes usually incur both the costs of conventional schooling and those of new technology, and may also bring 'hidden' costs by requiring new curricula, new roles for educators, and a new managerial system. Such programmes are only justified if the learning increment is worth the additional cost (Puryear, 2002).

Sometimes improved quality in education is desirable, and it is understood that an extra cost will be incurred. If the learning increment can be obtained more economically using ICT than using more conventional means, then the extra costs of ICT can more easily be justified. Add-on costs will be different depending on technology used, the nature and quality of programming provided, and the amount of time students spend learning with the technology. Per-student costs have varied between about US$3 and $8 for radio, and from US$72 to $98 for computers, in examples where such costs have been calculated. Such cost differences tend to constrain the potential use of technologies like television and computers and favour the use of print and radio, particularly for many institutions in sub-Saharan Africa (Murphy, et al. 2002).

Cost issues are only one side of the coin. Whether the aim is to improve access or quality, the cost of ICT can only ever be justified if the technology implemented is effective in achieving its intended purpose. Any new

educational technologies can be effective in improving learning if they are used under the right circumstances and with sufficient resources. Furthermore, although economies of scale are often significant, it is not always necessary to implement ICT on a large scale if the technology fulfils a specific narrowly defined purpose in the classroom, and complements other educational goals (Puryear, 2002). According to Puryear (2002), research does not support the notion that more expensive or more complex technologies produce better educational outcomes.

In the context of the Bridges to the Future Initiative, though, a somewhat different view is given (see Box 17 below). There is, however, little research to date on the learning outcomes of computer and multimedia approaches or on comparisons of the cost-effectiveness of ICTs (Murphy, et al. 2002; Puryear, 2002).

Cost and effectiveness should be taken into consideration together in terms of cost-effectiveness. Costs will be incurred to make technology effective, but the extent of the costs required to do so must be carefully considered. It is important to know whether the cost of successfully incorporating technology is a good investment (Puryear, 2002). Consequently, decisions must be made regarding trade-offs between alternatives. Such trade-offs may occur in terms of learning outcomes, systems or technologies, and media used (Williams, 2000). Again, research here is limited, but does suggest that some approaches are better than others. For example, interactive radio instruction has been shown to be more

Box 17: Bridges to the Future Initiative in South Africa

The Bridges to the Future Initiative (BFI) (which was discussed in the previous section) aims to use ICT to help illiterate, unschooled, and out-of-school youth and adults. Some of the core principles on which this initiative is based fall into the context of financial considerations:

- Even in the poorest sectors, ICT is now too cheap to ignore. While once it could be said that ICT would take money away from other simpler technologies (such as chalk and blackboards), new approaches can show cost-effective benefits when employed carefully.
- Advanced ICT tools may be relatively more cost-effective for the poor than

for the rich. It was often thought that old ICT (for example, radio) was necessarily the best route to reaching poor people, while advanced ICTs were only relevant for the rich.

A provisional budget for this project is under preparation, and is expected to total approximately US$3.7 million over its first three years. In the past, it was often the case that ICT hardware and software were provided on a donation basis to 'programmes in need' with little quality control or impact analysis. The BFI will engage experienced researchers and evaluators—both local and international—to assess, from the beginning, the progress and impact of the initiative.

Source: http://literacy.org_ili and Wagner, 2001

cost-effective than textbooks under some circumstances. Generally, however, research suggests that technology has a greater potential for improving effectiveness or expanding access than it does for reducing unit costs. Therefore, when considering cost-effectiveness, it is often necessary to decide to pay for improved learning (Puryear, 2002).

Generally, costs are not easy to measure, and they very often depend on the specific local context. Michaelowa (2001) showed that the relationship between primary education expenditure and educational outcomes is not straightforward. Financial resources are much more efficiently used in some countries than in others. At the higher end of education outcomes, for example, Cameroon clearly predominates over Côte d'Ivoire, and at the lower end Madagascar and Burkino Faso clearly rank above Senegal in terms of efficiency. These efficiency positions depend on various political, economic, social, geographical, and cultural factors.

A final word on cost-related issues in ICT is that the most useful way to approach such issues is in terms of 'costing and financing' rather than simply 'costs'. Costs that are seen as absolute and as add-ons are difficult to justify. Costing is a different issue, which takes into consideration the fact that different technology, and more importantly, different combinations of technologies, can be costed across time, across programmes, and even across institutions, to yield different and improved learning and institutional outcomes. There are also more complex issues than costs to be considered, including financing, business plans, securities,

servicing debts, and a host of investment and change management issues (Williams, 2000).

13.4 ...Cost and Policy

Financial issues are critical, but research and experience suggest that another major obstacle to adopting educational technology successfully is establishing the political and institutional framework necessary to sustain initiatives (Puryear, 2002). Financing telecommunications development is complex and impacted by national and international telecommunications and trade regulatory policy. Telecommunications privatization in Africa is accelerating, and, while it is expected to lower the cost of telephone access, government regulators can require service providers, public or private, to subsidize costs or reduce tariffs for education institutions (Murphy, et al. 2002). Use of Internet technologies for education in particular requires explicit tariff structures and long-term infrastructure investment commitments that are not forthcoming in most countries (Williams, 2000).

Policy makers need to ensure that clear planning takes place when introducing new technologies. If the purpose of educational application of technologies is to achieve cost savings, plans need to indicate whether there will be real savings and how these savings will be effected, rather than simply transferring costs to students (most of whom are unlikely to be able to afford them, particularly in the sub-Saharan African context) (Jurich, 1999). Policy-makers and planners in African countries can do the following to ensure a greater return on investments in ICTs:

- With educational reform in mind, develop national strategies and build capacity for using technology within the overall framework of the country education system.
- Build on what has worked, including support for teacher development, improving quality in primary education, and increasing access to tertiary education.
- Invest in innovation, particularly to improve the quality of mathematics, science, and technology education at secondary and tertiary levels.
- Analyse costs carefully and support long-term financing through budget allocations and cost sharing at higher levels of education (Murphy, et al. 2002).

14. Conclusion

'For many of us, the important thing is that so much has been done with so few resources' (Levey, 2002, p13).

The objective of this report has been to explore the various issues relating to use of technology in education in sub-Saharan Africa, maintaining a particular focus on how education can be supported by ICT and how educational technology tools can help to bring more effective education to the majority of people in Africa, (many of whom are currently excluded from educational opportunities), with a specific focus on open and distance learning. To this end, the broader context within which education takes place was described, as well as some uses of ICT in education in sub-Saharan Africa. The challenges facing educational development for the continent are many, but it is hoped that the report's focus on some initiatives in the area of ICT and education has provided evidence of how much has been done with limited resources. The challenge now is to take many of these pilot projects to the next stage of implementation, so that ICT might begin to have the kind of impact that in many cases has been promised but remains unfulfilled.

In focusing on use of ICT in education we have presented tables of examples of types of education programmes and the educational technologies employed (see Tables 9, 11, and 13). At each educational level reviewed, the medium of print is still the dominant one used for distance education, followed by radio and other audio technologies. In only a fairly limited number of programmes are 'newer' ICTs being widely used. This trend requires careful consideration, because not only does it highlight the need to improve ICT infrastructures and training such that the potential benefits can be realized, but also because we should not focus on computers and the Internet to the extent that we provide less support for those 'older' technologies that are currently most widely used.

In summary, then, the report has illustrated a need to take account of the following fundamental strategic issues, amongst others:

1. Educational principles and issues have to form the foundation of decisions about what technologies to use and how. There has long been an apparent tension between the agendas of technology providers and good educators, which has often resulted in failed educational initiatives. Technology providers have tended to focus on 'getting things done' and fast rollout of plans, while good educators, realizing the contextual and immensely complicated nature of

education, have tended to implement plans slowly and thoroughly, continually reflecting on the quality of what they have done. However, it is possible to exploit the creative possibilities of this tension, using them effectively to overcome weaknesses inherent in each approach. The only solution is to go through rigorous, thorough processes of planning, implementing, and evaluating initiatives in a sustained effort to give expression to the educational principles fundamental to current South African educational policy.

2. Before making any contractual commitment, test the viability of using the particular technology or technologies for the intended educational purposes by exploring its potential in a chosen area with the best available educators. These educators should, for preference, come from a work environment that will serve to guarantee that relevant educational needs, contexts, and principles - and not the attractions of the technology - will form the basis for their exploration.
3. Ensure that the choice of technology does not lead to imbalances in fixed and variable costs. As has been indicated above, it can make educational and financial sense to direct significantly larger proportions of total expenditure to the design and development of high quality resources. Similarly, the history of distance education has demonstrated that it is possible to shift patterns of expenditure to achieve economies of scale by amortizing identified costs (for example, costs of administration and systemic communication) over time and large student numbers. Often, however, the choice of technologies militates against such use of money, particularly when one intends using expensive technologies (such as broadcasting). This can result in very expensive, but educationally ineffective, provision of learning opportunities.[16]

16. *There are examples in South Africa of attempts to use satellite technology where the expense of investing in physical infrastructure and equipment, together with the high costs of broadcasting, have encouraged use of the technology simply to broadcast live lectures. On the face of it, this makes financial sense, as it avoids the expense of producing high quality video material. In South Africa, where the legacy of fundamental pedagogics is based on the mistaken, teacher-centred notion of education as a process of transmitting information from educators to mostly passive learners, it is also appealing to many people who grew up with this as their only experience of education. When systems based on this logic have become operational, two features are notable. First, the failure of the system to provide an interactive learning environment - even where feedback to the central studio is possible - leads to the introduction of local support in the form of (often poorly prepared) tutors who are present throughout broadcasts. This leaves one with an expensive satellite system and an equally expensive face-to-face system running in parallel. Second, there is a notable absence of fixed investment in educational resources or administrative and management systems that can provide the basis for future programmes. The most common results of this are educational failure, resource wastage, and learner and educator disillusionment.*

4. Ensure that technological resources are affordable and cost-effective. Sustainability is a major issue in the introduction of resources for learning. This requires careful costing, not only of the purchase of equipment, but also of its security, maintenance, the ongoing acquisition of software, and the training required for educators, learners, and administrators who are going to use it. This also needs to be linked to qualitative questions, which can help to determine cost-effectiveness. These might include: Can the impact of the technology be measured and how does this compare with its cost? Are there in fact cheaper and more effective alternatives? Once again, these are complex issues which need to be built into the planning and evaluation process from the start so that the experience gaine d can be directly related to whether the learning objectives are being achieved in ways that are sustainable in the long term.
5. Regardless of technological choice (often influenced by intersecting educational, financial, social, political, and economic interests), ensure that sufficient time for planning, designing, and developing an effective educational intervention is scheduled. This time should not mistakenly be equated with calendar time. Rather, it should be calculated in terms of person time. For example, it is no use setting aside a year to plan and develop an intervention if there are only one or two people working part-time allocated to this task.

As is noted by Manuel Castells (2001, p155), 'human resources are the essential infrastructure, without which technology means nothing'. The importance of making careful, well-planned, and pedagogically sound use of ICTs to enhance education across the diverse African continent should not be underestimated. These efforts are important not only for reform within the education sector but also for development of the continent more broadly. While there are at present several initiatives seeking to integrate and use ICT for education, there is still much to be done and many lessons to be learned.

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