

Teaching with Technology across the Curriculum: *Making the Case for Countries in Africa*

By Dr. Kwabena Dei Ofori-Attah



Introduction

The last 40 years have seen dramatic developments, improvements and changes in the area of technology. These changes have affected the way people exchange information, do business, learn, teach, shop, or travel. As a matter of fact, it will not be too much to argue that technology has permeated every aspect of our life. All over the world, people have gradually made significant changes and adjustments in their daily activities to embrace these changes (Hall & Bannatyne,

1999; Heide & Henderson, 1994). It is common to see people using cellular phones to call others at all sorts of locations over long distances, sometimes over hundreds or thousands of miles; people use laptop and desktop computers at different locations to access the Web, chat or check e-mails; others use computers to shop online or engage in instant exchange of messages. The activities people do with modern technology appear to be unlimited or endless (Bitter & Pierson, 1999).

Fortunately for the people in Africa,

especially students, the continent has been touched by technology, though at a very low level. In 1995, only 3 countries in Africa had access to the Internet. Today, all 54 countries in Africa have access to the Internet (Economic Commission for Africa, 2003). In April 2002, African governments met in Senegal and adopted a continental program to accelerate the pace of Information and Communication Technology development in all countries in Africa. A special agency, The New Partnership for Africa's Development (NEPAD) was charged with the responsibility of making this a reality for all countries in Africa (Okpaku, 2003). This trend is an illustration of the interest people in Africa have showed in using technology to promote national development.

This paper will examine the progress countries in Africa are making to implement educational technology across the curriculum in the elementary and high schools. It will touch on the training of teachers and the implementation of educational technology across the curriculum. Finally, the paper will suggest strategies that countries in Africa may use to enhance the use of computer technology in the elementary and high

“Some schools in Benin, Burkina Faso, Cameroon, Chad, Gambia, Ghana, Kenya, Mali, Namibia, Senegal, South Africa, and Uganda participate in a global Internet-based project.”

schools. For the purpose of achieving the above objectives, the following questions would be used as a frame of reference for the paper.

- What is the status of educational technology in Africa?
- Who is providing resources for educational technology in Africa?
- How are teachers in Africa being trained to use technology in the classroom?
- What are the major problems facing educators as they push for technology in the classroom in Africa?

Finally, the paper will make suggestions for expanding and improving educational technology in the schools in Africa

What is the Status of Educational Technology in Schools in Africa?

When the Internet started over

forty years ago, perhaps no one ever imagined that people would put it several uses apart from the exchange of information among the various departments and agencies of the Advanced Research Project Agency Network of the Department of Defense (ARPANet). Today, however, as a result of the successful operations of the Internet by ARPANet, people all over the world are reaping the benefits of what started as a quest for alternative source of communication among the various departments of the United States government in case there was a disaster along the main lines of communication (Hernes, 2002).

Perhaps, it may not be out of the ordinary to argue that today every country in the world, including all countries in Africa, has heard about what technology can do to promote the economic and social development of a nation (Parks, 2004). Some countries in Africa such as Egypt, South Africa, Nigeria, Libya, Ghana, Gabon, and Algeria have all made varying degrees of progress in the use of computers in their society. In Senegal, a non-profit organization, *Joko*, collaborating with Hewlett-Packard, has introduced computer projects to assist people who cannot read or write use the Internet for personal and business activities (Carney & Firpo, 2002). In Nigeria, another private group, *Youth for Technology Foundation* has also introduced a project, *The Owerri Digital Village*, with the sole aim of providing “disadvantaged Nigerian youth in rural communities with access to technology” (Ugwuegbu, 2002, p.27).

In the countries of Egypt, Ghana, Nigeria, Kenya, Zimbabwe, Namibia, and South Africa, apart from technology giant leaps in higher education, many schools in the urban areas use technology tools such as the Internet for teaching and learning (Jensen, 2003). Some schools in Benin, Burkina Faso, Cameroon, Chad, Gambia, Ghana, Kenya, Mali, Namibia, Senegal, South Africa, and Uganda participate in a global Internet-based project. The project aims at improving “mathematics and science education across the globe, to raise environmental awareness, and to contribute to a worldwide scientific database about Earth” (Haddad & Jurich, 2002, p.37).

Although the penetration of technology in the elementary and high schools is at very low level in Africa, indications from the few schools that are using technology in teaching and learning make the case for a full scale integration of technology into the curricular of all educational systems on the continent.

At first, it may sound a little odd for any one to argue for the use of technology in the schools in countries in Africa where poor infrastructure, corruption, poverty, illiteracy, social unrest, health-related issues, poor school buildings, poor teaching facilities or laboratories, hamper the smooth functioning of educational institutions. However, it is for these very reasons that every country in Africa should now plan and implement a national policy to implement technology across the curriculum. As Capper (2003) has pointed out, a



review of over 100 research reports of the integration of technology in the curriculum suggests that the use of technology:

- Improves students' attitudes and confidence and is especially beneficial for "at risk" students
- Provides instructional opportunities otherwise not available
- Increases student collaboration on projects
- Significantly improves students problem-solving skills
- Increases the preparation of students for most careers and vocations
- Tends to shift teaching styles from traditional direct approaches to a

more student-oriented approach. (p. 60)

Norton & Sprague (2001) also add that integrating technology into the curriculum makes students, active, constructive, collaborative, intentional, conversational, and reflective in the learning process. They argue further that technology can contextualize learning and promotes learning tasks "that are situated in real-world tasks or simulated through some case-based or problem-based learning environment" (Norton & Sprague, 2001, p.5). Provenzo (2002, p. 7) argues, "No matter how isolated or poor, a child with a connection to the Internet and the World Wide

"...integrating technology into the curriculum makes students, active, constructive, collaborative, intentional, conversational, and reflective in the learning process."

Web can have access to the great museums and libraries of the world.” Perhaps, this argument more than any other statement, sums up the case for integrating technology into the curricular of all schools in Africa, since on this continent, many students live in isolated rural areas where school facilities, if any, are poor (Economic Commission for Africa, 2003).

Who is Providing Educational Technology Tools to Elementary and High Schools in Countries in Africa?

The integration of technology in education in Africa is gradually getting the attention of educational planners and curriculum developers in Africa. African governments and private agencies collaborate to make this possible. In many cases the contributions made by the private sector appear to be greater than the national governments.

African governments have designed educational policies that give priority to the use of educational technology in the school system after years of foot-dragging. Nigeria, for instance, has set up a separate governmental agency, National Information Technology Development Agency (NITDA), charged with the promotion of information communication and technology in all sectors of the economy including education (National Information Technology and Development Agency, 2001). However, for several reasons, these policies

remain to be fully implemented. It is in light of this that the new educational policy in Botswana is worthy of noting. According to Africa National SchoolNet 2004:

Botswana is one of the few African countries with a national, government-led programme on ICTs in education that targets all schools. A government policy entitled The Revised National Policy on Education highlighted the need for all learners to be given computer skills at all levels of schooling in Botswana. The Revised National Policy on Education released in 1994 recommended the introduction of Computer Science as a subject option in senior secondary schools and computer awareness for the three years of junior secondary school. As a result, a new curriculum for computer awareness has been developed and piloted in eleven junior secondary schools. The curriculum aims to equip learners with computer skills that can be applied in all subjects. The department has adopted an ‘infusion strategy’, whereby all teachers and learners are equipped with basic computer skills. The department has taken care to train all teachers, irrespective of subject specialization. This is intended to counter the historic focus on mathematics and science teachers, which has developed a kind of aloofness amongst these teachers in schools. The department aims

to give a message that everyone can use computers (Africa National SchoolNet, 2004).

The Private Sector

Over 50 international agencies and private organizations and companies are in the forefront for the provision of technology in nearly all African countries. For the purpose of this discussion, only 4 of these will be mentioned. These are the *United States Department of State, World Links, Schools Online, and Africa SchoolNet*.

American sponsored schools in the urban areas of 36 countries in Africa have perhaps the best technology equipment in their school systems. By the close of the year 2003, the United States had 40 sponsored schools in Africa¹. Some of the classrooms have access to state-of-the-art technology resources. In the American School in Lagos for instance, “each classroom has at least one networked computer workstation, and a portable computer cart containing a full classroom set

“By the close of the year 2003, the United States had 40 sponsored schools in Africa”

of laptops with wireless networking capacity on each level. The library holds over 20,000 volumes and is approximately 2800 square feet in size and incorporates a group instruction area, individual reference and study areas, primary age student reading room, computer lab, periodical section and an audio-visual resource facility” (United States Department of State, Office of Overseas Schools, 2004). In some cases, the quality of computers and computer programs exceed those that are used in many developed countries, including the United States of America.

Another non-governmental agency actively involved in the development and promotion of educational technology in Africa is *World Links*. “The mission of World Links is to improve

educational outcomes, economic opportunities, and global understanding for youth in developing countries through the use of technology and the Internet” (World Links, 2004). In tune with its mission statement, World Links has established a number of schools in Africa. The countries include Botswana, Burkina Faso, The Gambia, Ghana, Mozambique, Rwanda, Senegal, South Africa, Uganda, and Zimbabwe. World Links collaborates with other non-profit agencies such as the International Education and Resource Network (IERN) to promote its educational activities. In Botswana, *World Links* has established working relationship with the Ministry of Education to accelerate the pace of technology for schools in the country. It has helped

equip over 15 schools in the country with computers and other technology tools to enhance teaching and learning (Ratsatsi, 2002).

Schools Online is another private organization active on the continent of Africa in the development of educational technology in the classroom. The mission of *Schools Online* is to “help students gain access and use the communication and information resources of the Internet for learning and cross-cultural dialogue” (Schools Online, 2004). The countries in Africa involved in the programs organized by Schools Online by the end of 2003 included Egypt, Ghana, Kenya, Senegal, Tanzania, Uganda, Zambia, and Zimbabwe. In each country, Schools Online selected a few schools for initial participation in its technology programs.

Egypt had 11 schools, Uganda had 10 elementary and high schools; Senegal had 3 schools, Ghana had 17 schools; South Africa had 4; Kenya had 1; Tanzania had 3; and Zimbabwe had 30 schools. See Table 1.

Communication technology in the schools in Africa has projects in about 34 African countries. These include Algeria, Angola, Botswana, Benin, Burkina Faso, Burundi, Cameroon, Congo, (Democratic Republic), Cote D’Ivoire (Ivory Coast) Egypt, Ethiopia, The Gambia, Morocco, Lesotho, Namibia, South Africa, Swaziland, Mozambique, Rwanda, Senegal, Sierra Leone, Kenya, Mauritania, Tanzania, Tunisia (See figure 1 on next page).

Each country sets its own agenda

Table 1

Countries in Africa Participating in Technology Programs Organized by Schools Online by 2003

Country	Number of Elementary and High Schools
Egypt	11
Ghana	17
Kenya	1
Senegal	3
South Africa	4
Tanzania	3
Uganda	10
Zimbabwe	30

Source: *Schools Online* (2004). <http://www.schoolsonline.org/sitemap.htm>
SchoolNet Africa is another major non-profit making organization involved in Information

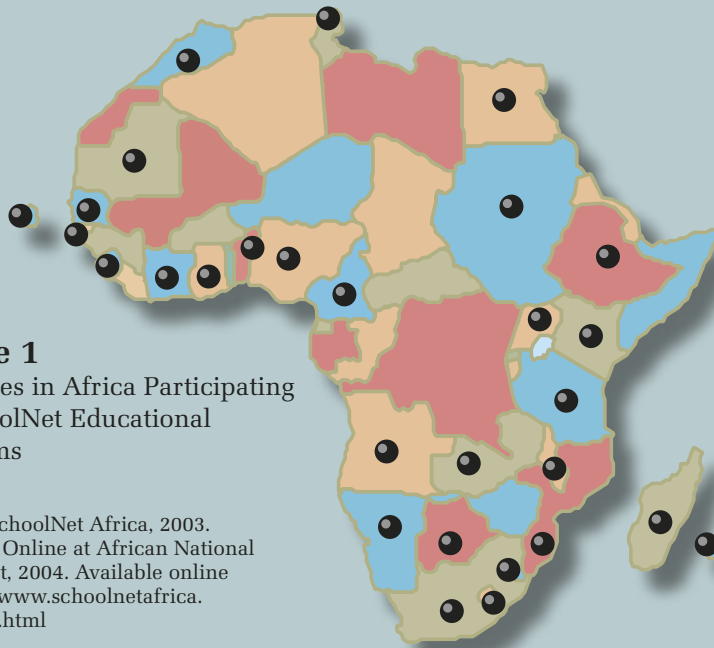


Figure 1
Countries in Africa Participating in SchoolNet Educational Programs

Source: SchoolNet Africa, 2003. Available Online at African National SchoolNet, 2004. Available online at: <http://www.schoolnetafrika.net/289.0.html>

and objectives in pursuit of the implementation of policies that will promote the development and the use of educational technology in the elementary and high schools. In Nigeria for instance, the local chapter of SchoolNet has stated among other things that one of its main objectives is “to ensure that Nigerian schools are given the opportunity to allow their students to cross the ‘Digital Divide’, and use ICTs to enhance their learning experience.” It is the ultimate goal of the *SchoolNet* Nigeria to reach all schools in the country and equip them with computers and other communications technology. In Mozambique, as a result of the activities of SchoolNet Mozambique, and World Links, over 20 schools have access to the Internet via TV cabling (Cossa & Cronjé, 2004).

Technology Training for Elementary and High School Teachers

The implementation of technology in the schools in Africa, like elsewhere in the world, would not be possible without proper and adequate training for teachers. This is so because the skills teachers’ possess in the classroom can make a difference in the achievement of students not only in content areas but also in the use of technology. Effective teaching in all areas in the 21st century classrooms requires the services of teachers who can master and handle technology in the delivery of instruction (Mehlinger & Powers, 2002).

Over 80% of the teachers in the classrooms in Africa started teaching before the integration of technology gained the attention of curriculum planners. This means that technology

training was not part of the curriculum they followed for their teacher education programs (SchoolNet Africa, 2004). The implication of this is that educational planners in Africa have to find a way of making these teachers competent in handling technology in the classroom. The normal route is through the traditional in-service training programs for teachers (Fontaine, 2002). Few countries, such as Uganda, South Africa, and Kenya, have made technology part of the pre-service teacher education programs. In this direction, African and foreign governments, as well as private organizations are very active in helping teachers in the different countries in Africa make the grade in handling technology in the classroom. One of such non-profit organizations involved in the technology training of teachers in Africa is World Links. It is involved in teacher technology programs in

“Effective teaching in all areas in the 21st century classrooms requires the services of teachers who can master and handle technology in the delivery of instruction”

several countries including Ghana, Gambia, Mauritania, Mozambique, and Burkina Faso. As Carlson & Gadio (2002) point out:

World Links has been a pioneer in developing and delivering teacher professional development programs in the use of technology to improve teaching and learning in developing countries. It is by no means the “definitive” program, nor is it the most easily replicated and scaled. However, for purposes of illustration, the complete World Links Teacher Professional Development program includes 200 hours of training, equivalent to five 40-hour weeks. This takes teachers with no prior contact with computers to full competency over a two- to three-year period. (p.122)

In Ghana, World Links has been very active, training teachers to be competent in using technology since 1997. It has helped trained over 1000 teachers since the introduction of their program in the country. It relies upon financial support from local and international sources to promote its technology programs for teachers, students and others in the larger Ghanaian society.

In Namibia, since 1992, the Swedish government has been supporting teacher education programs to help local teachers acquire skills in using technology in the classroom. Through a project called Teacher Education Reform Project (TERP), the Swedish

**“In South Africa,
technology is one of the
8 mandatory academic
areas for all students in
grades 1 through 9
and beyond.”**

government collaborates with the Namibian government to support the implementation of teacher education programs (Craig, Kraft, & Plessis, 1998). The Namibian government and the USAID, AED/LearnLink have collaborated to institute another teacher training project, called Computer Assisted Teacher Training (CATT). Among other things, the goal of this project is to:

- Support the National Institute for Educational Development (NIED) and its designated staff in acquiring the necessary tools and skills to develop computer-assisted training courses for advisory teachers, inspectors, and others in the four education regions where USAID is assisting the Ministry of Basic Education, Sport and Culture (MBESC);
- Support NIED in the development of a communications network for the training of advisory teachers, inspectors, and others involved in

the lower primary phase by linking them to NIED through the Internet and other key computer-assisted delivery mechanisms;

- Support the development of prototype curriculum-based teacher training materials for primary school;
- Support the expansion of an administrative framework at the level of the MBESC and NIED to include “Master Information Teachers,” who champion the use of teaching/learning technologies; and,
- Contribute to discussions of national policies, strategies, and guidelines on the use of teaching/learning technologies in the basic education sector. (Learn Link, 2002; Soule, 2003)

In South Africa, technology is one of the 8 mandatory academic areas for all students in grades 1 through 9 and beyond. This policy became part of the new curriculum introduced in the country in 1998. Since then the government of South Africa has been collaborating with other non-governmental agencies to provide teachers with technology skills. One such prominent non-governmental agency is Programme for Technical Careers (PROTEC). Since 1995, PROTEC has been working with the South African government to introduce technology as a formal school subject. In 1999, PROTEC provided technology training for more than 600 teachers (Kramer, 1999).

Teachers in South Africa are also getting help, learning how to cope

with technology through the Shoma Education Foundation. Through this foundation, the government of South Africa is actively working with multiple public and private organizations to help teachers acquire skills in integrating technology in the curriculum. One of the main objectives of the computer-based training is, like the Namibian case, to develop teacher's computer literacy skills essential in implementing the new curriculum. On the continent of Africa, Egypt is another nation where integration of technology in the school curriculum appears to be steadily gaining grounds. Apart from promoting the use of information communication and technology in every sector of the economy, the educational institutions receive a fair share of the government's funding and administrative support. In March 2002, the Egyptian government, in collaboration with UNESCO, organized a successful technology workshop for Egyptian high school teachers. The main objective of the workshop was to provide technology skills to teachers that were deemed essential in teaching science and mathematics in the high school (Gholam, 2002). In Uganda, the Connectivity for Education Development, a project sponsored by the Bureau Leland Initiative and the USAID Global Bureau LearnLink, is designed to help primary and secondary school teachers acquire computer skills necessary to be competent users of technology in the classroom. Eight of the 45 teacher training institutions were selected for pilot training

programs in 2002. The teachers were trained to use several computer programs including Microsoft Word, Microsoft PowerPoint, Microsoft Access, and Inspiration. The teachers also had training in online collaboration, electronic mails, and Web page development. By the end of 2003, 1,902 teachers from the selected teacher training institutions had received technology training. Among the activities undertaken were:

1. Training the three Kyambogo University (then the Institute of Teacher Education Kyambogo (ITEK) core staff;
 2. Computer-assisted teacher training course development;
 3. Local office and multimedia development laboratory set up;
 4. User laboratory/training laboratory set up;
 5. Refurbishment and equipping of computer laboratories in primary teacher training colleges (PTCs);
 6. Internet connectivity;
 7. Public and private sector participation; and,
 8. Professional development computer training.
- (Connectivity for Educational Development, 2003)

In spite of the efforts of all the groups mentioned above (and those not mentioned in this paper such as Microsoft Partners in Learning and Intel's Teach to the Future), the integration of technology in the curricular of schools in Africa has been very slow, unreliable and in some cases

“Africa’s high illiteracy rate is a major problem for development on the continent.”

very disappointing. Some students and teachers in many elementary and high schools in several countries in Africa have never seen a computer or used the Internet (Cawthera, 2001). Many of the teachers who use technology in the schools mastered the skills on their own with the help of others. Over 60 percent of the schools have no access to telephones, television or radio sets. This is especially the case in remote and rural areas on the continent (Jensen, 2003). Asking such schools to make the necessary adjustments to embrace technology into teaching and learning will be like erecting a tent to cover the entire sky. In the next section some of the major problems hampering the integration of technology into the curriculum in the schools in Africa will be examined.

The Challenge of Integration

As already pointed out, many educational reform activities on the continent of Africa during the last decade have in no measure promoted the integration of technology into teaching and learning. This change of trends in educational development

“Where the buildings meet minimum security standards, there may not be electricity or telephones connected to the schools. Such buildings require huge capital to implement technology in the curricular of the school system.”

in Africa is due primarily to the fact that educational planners share the view of Bitter & Pierson (1999, p.5) that the educational sector is a force that, when functioning properly, promotes literacy or, when failing, causes illiteracy, regardless of policies and practices. Africa's high illiteracy rate is a major problem for development on the continent. Technology is seen as a tool that can help distribute educational facilities to all parts of the continent. Therefore, many educational planners in Africa want to take advantage of technology to accelerate the pace of literacy on the

continent. However, as compared to other regions of the world, Africa as a whole solidly remains behind the digital wall. This is the result of several factors that for years have combined to make Africa, in many respects, the poorest continent on the face of the earth (Otuka, 2003). These problems include poor infrastructure, poverty, unreliable telephone systems and energy supply.

In nearly all countries in Africa, urban as well as rural, many schools do not have secure buildings to house school property. Many of the school buildings are in such a poor state that at the end of the day, school principals and teachers carry important school property home. Some of the school buildings have no doors or windows. Some teachers teach their classes under poorly erected structures or sometimes under trees. Because of this, in some of the schools, parents encourage their children to bring home their chairs, tables, and books at the end of the school day, for lack of security. In such poor schools, technology will not be a priority for any one working there.

Where the buildings meet minimum security standards, there may not be electricity or telephones connected to the schools. Such buildings require huge capital to implement technology in the curricular of the school system. In many cases, the funds are just not there to wire the schools with fiber optics to extend telephone services or cables to extend electricity to all the classrooms in the school (Cawthera,

2001). The start-up costs for technology in schools like these may demand a large share of the education budget for the school district. In a continent where the education sector is the first to suffer from budget cuts during financial crisis or sometimes in normal budgeting seasons, most of the time, parents and other significant people in a community are asked to bear the full burden of refurbishing school infrastructures so as to make them modern enough to meet the standards required by technology integration (Cossa & Cronje, 2004). In Mozambique, South Africa, Ghana, Botswana, and Nigeria parents and other significant people in the school community have come together to assist several schools become equipped with technology tools to facilitate teaching and learning.

“This vivid description of poverty and equity in the distribution of technology in rural or poor and urban or rich schools in Africa does not instill hope in many of us.”

Poverty appears to be a problem for all governments in Africa. Poor rural communities can hardly generate enough funds to support the efforts of local governments to provide adequate facilities such as technology for teaching and learning. Students in many rural communities walk over 3 miles everyday to attend school. Roads are either poor or non-existent. Some of these rural communities had hardly been touched by modern amenities such as telephone, television sets or electricity. Some “have never made a phone call and don’t live within easy walking distance of a telephone” (Association for Progressive Communications and Communication Rights in the Information Society, 2003, p.24). These facilities are essential for the development of educational technology in a school. Commenting on poverty and equity in technology distribution in the developing world, this is what Hernes (2002) had to say about the situation in Africa:

Bissau has more than 95% of the telephone lines in Guinea-Bissau, and Freetown has more than 85% of the lines in Sierra Leone. A majority of villages ... lack electric power, let alone Internet connectivity. Elsewhere there has been a gradual deterioration of public services access is poor, functioning is irregular, prices are high, and service is scanty. (p. 24)

This vivid description of poverty and equity in the distribution of technology in rural or poor and urban or

rich schools in Africa does not instill hope in many of us. For instance, in Zimbabwe, whereas poor high school have to do with old refurbished computers with unreliable or no access to the Internet, some urban rich schools have modern computers installed in air conditioned computer laboratories with full access to the Internet (Cawthera, 2001). The same situation can be seen in South Africa, Ghana, or Egypt and other urban schools on the African continent.

In the face of the above problems, what can countries in Africa do to bridge the digital divide in order to accelerate the pace of educational technology in the schools on the continent?

Haddad & Jurich (2002) and Mehlinger & Powers (2003) offer suggestions for all governments in Africa including:

- Preparing a vision and mission statement;
- Preparing leadership for technology;
- Investing in infrastructures;
- Revise the teacher education curriculum;
- Reviewing fiscal policy to favor educational and nonprofit use of technologies;
- Deregulating telecommunication monopolies while protecting educational use of telecommunications;
- Reorienting funding policies to serve students, rather than institutions;
- Funding technology-mediated projects directly or encourage these

projects through tax relief and other benefits;

- Funding projects that ensure access to technology for underrepresented populations;
- Promoting teacher training that uses technology to familiarize teachers with these tools; and,
- Implementing standards of quality for distance education courses.

Conclusion

This paper has made it clear that implementing technology in all classrooms in the schools in Africa is an enormous task. At the same time, the benefits are such that educational planners cannot overlook a project that has the potential of changing and restructuring the educational system to be more responsive, relevant and effective in meeting the needs of the people of Africa (Cradler, 2003).

By all standards, integrating technology into the curricular of the elementary and high school systems in Africa is a complex process. However, as Dhanarajan (2002, p.74) has pointed out, global “experience already is beginning to demonstrate what is possible, how it is done, and what tools can be applied to the task.” This implies that educational planners in Africa should not take a detour but stay the course to create enabling infrastructure environments to complete an educational mission that, at the moment, appears to be impossible.

Dr. Ofori-Attah is an Associate Professor of Education at Cumberland College.

References

- Association for Progressive Communications (APC), & Communication Rights in the Information Society (CRIS) (2003). *Involving civil society in ICT policy: The world support on the Information Society*. Johannesburg, South Africa: STE Publishers
- Bitter, G. G. & Pierson, M. E. (1999). *Using technology in the classroom*. Boston: Allyn and Bacon.
- Capper, J. (January-March, 2003). Complexities and challenges of integrating technology into the curriculum. *TechKnowlogia*. 60-63. Available online at <http://www.TechKnowlogia.org>. Accessed July 22, 2004.
- Carlson, S. & Gadio, C. T. (2002). Teacher professional development in the use of technology. In W. D. Haddad & A. Draxler (Eds.), *Technologies for education*, pp. 118-132. Paris & Washington, D.C: UNESCO and the Academy for Educational Development.
- Carney, L. (July-September, 2002). Internet training for illiterate populations: Joko pilot results in Senegal. *TechKnowlogia*, 30-33. Available online at Available online at <http://www.TechKnowlogia.org>, accessed July 12, 2004.
- Cawthera, A. (2001). *Computers in secondary schools in developing countries: An analysis of costs*. Washington, DC: The World Bank.
- Connectivity for Educational Development, (2003). *USAID/Uganda Final Report*. Available online at <http://www.connected.ac.ug/connect/reports/final%20report.pdf>
- Cradler, J. (2003). Technology's impact on teaching and learning. *Leading and Learning with Technology*. 30(7), 54-57.
- Craig, H. J. & Kraft, R. J., & Plessis, J. (1998). *Teacher development: Making and Impact*. Washington, DC. World Bank.
- Cossa, G. G. & Cronjé, J.C. (2004). *Computers for Africa: Lessons learnt from introducing computers into schools in Mozambique*. *International Journal of Learning Technology*, 1(1), 84-99.
- Dhanarajan, G. (2002). Objectives and strategies for effective use of ICTS. In W. D. Haddad & A. Draxler (Eds.), *Technologies for education*, pp. 58-74. Paris & Washington, D.C: UNESCO and the Academy for Educational Development.
- Economic Commission for Africa. (2003). *Making the Internet count: A manual for African Policy Makers*. Addis Ababa: Author
- Fontaine, M. (2002). Teacher training with technology: Notes from the field. In W. D. Haddad & A. Draxler (Eds.), *Technologies for education*, pp. 176-179. Paris & Washington, D.C: UNESCO and the Academy for Educational Development.
- Gholam, G. (2002). National training workshop for teachers: Use of ICT in science and mathematics education in secondary schools in Egypt. *UNESCO International Science Technology and Environmental Educational Newsletter*, 28(3-4), 7-8.
- Haddad, W. D. & Jurich, S. (2002). ICT for Education: Potential and potency. In W. D. Haddad & A. Draxler (Eds.), *Technologies for education*, pp. 42-56. Paris & Washington, D.C: UNESCO and the Academy for Educational Development.
- Hall, R. A. & Bannantyne, M.W. M. (1999). Technology education and the 21st century. *UNESCO International Science, Technology and Environmental Education Newsletter*, 29(4), 1-3.
- Heide, A. & Henderson, D. (1994). *The technological classroom*. Toronto, Canada: Irwin.
- Hernes, G. (2002). Emerging trends in ICT and challenges to educational planning. In W. D. Haddad & A. Draxler (Eds.), *Technologies for education*, pp. 20-26. Paris & Washington, D.C: UNESCO and the Academy for Educational Development

References continued

- Jensen, M. (2003). The current status of information and communications technologies in Africa. In J. O. Okpaku, (Ed.) *Information and communication technologies for African development*, pp.55-78. New York: United Nations ICT Task Force
- Kramer, D. (1999). The PROTEC Technology education project. *UNESCO International Science, Technology and Environmental Education Newsletter*, 29(4), 9-10.
- Learn Link. (2002) *Computer assisted teacher project*. (2003). Available online at <http://www.edsnet.na/Edutech/LearnLink.htm>
- Mehlinger, H. D. & Powers, S. M. (2002). *Technology and teacher education*. Boston: Houghton Mifflin
- National Information Technology Development Agency. (2001). *Nigeria national policy for information technology*. Abuja, Nigeria Available online at <http://www.nitda.gov.ng/nigeriaitpolicy.pdf>
- Norton, P. & Sprague, D. (2001). *Technology for teaching*. Boston: Allyn and Bacon.
- Okpaku, J. O. Sr, (2003). Background information and communications technologies for development in Africa. In J. O. Okpaku, Jr. (Ed.) *Information and communication technologies for African development*, pp.23-45. New York: United Nations ICT Task Force.
- Otuka, J.O. E. (2003). Innovative ideas and techniques for science, technology and mathematics education in Africa. In R. S. Pillai, (Ed.). *Strategies for introducing new curricula in West Africa: Final report of the seminar/Workshop held in Lagos, Nigeria, 12-16 November 2001*, pp. 13-18, Geneva: UNESCO International Bureau of Education
- Parks, B. (August 2004). Technology map of the world. *Business 2.0*, 111-118
- Provinso, E.F. (2002). *The Internet and the World Wide Web*. Boston: Allyn and Bacon.
- Ratsatsi, D. M. (July-September, 2002). Botswana: Equity and access in ICTS. *Techknowlogia*, 45-48. Available online at <http://www.TechKnowlogia.org>, accessed July 12, 2004.
- SchoolNet Africa. (2003). African National SchoolNet, 2004. Available online at: <http://www.schoolnetafrika.net/289.0.html>
- SchoolNet Africa. (2004). *Towards a Strategy on Developing African Teacher Capabilities in the Use of ICT*. Available Online at <http://www.schoolnetafrika.net/index.php>
- Soule, H. (2003). What do you mean by ICT integration?. *Journal for Educational Reform in Namibia*, 6, 1-11
- Ugwuegbu, N. (July-September, 2002). The Owerri digital village. *Techknowlogia*, 27-29. Available online at <http://www.TechKnowlogia.org>. Accessed July 22, 2004.
- United States Department of State, Office of Overseas Education. (2004). Available online at <http://www.state.gov/m/a/os/1253pf.htm>
- World Links. (2004). Mission Statement. <http://www.world-links.org/>. Accessed, July 27, 2004.

Endnotes

- ¹ Morocco had 3 schools, Nigeria had 2, Egypt had 2 and the rest, one school each. The beneficiaries of these schools included Angola, Botswana, Burkina Faso, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Malawi, Mali, Mauritania, Namibia, Ethiopia, Niger, Sierra Leone, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe.