



## The utilization of ICT in education for sustainable development

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### General Note

Article is recommended to print as color digital version in recycled paper.

### ABSTRACT

Education is supposed to play a vital role for the development of a nation. Many countries made progression through education. Nevertheless, some of them also failed to retain the development achieved since these countries failed to utilize the ICT resources. This paper focuses on the utilization of ICT in education for sustainable development. The paper succinctly examines the importance of ICTs in education, education for sustainable development ESD and the current uses of ICTs in education for sustainable development. Three pertinent questions were also raised and the answers were provided in this paper. These are; why do ICTs need to be considered as a critical tool in education for sustainable development (ESD)? What ICTs are currently being used by educators and learners? And what can we expect to see in the near future? The key challenges in integrating ICTs in Education were also discussed. It was however concluded that ICTs have great potential for knowledge dissemination, effective learning and the development of more efficient education services. ICT will not only sustain education development but also the global energy, environmental and social challenges. It was recommended among others that private and public sector partnerships should be encouraged to fast track ICT-based projects in education for sustainable development

**Key words:** ICTs, Education, Sustainable Development, Utilization of ICT.

### 1. INTRODUCTION

Education has largely contributed to an increase in developing knowledge, providing an enabling environment for innovation and in building human capital required for a potential future knowledge economy. Global reforms in education and challenging ICT demands have made a remarkable shift in the structure

of the enabling ICT environment and the utilization of ICT technologies in education. Such technologies have become the key driver of the digital network in an era of technology-driven education.

According to Vestberg (2012), the power of ICT in spurring socio-economic development and placing the world on a path of low-carbon emissions has never been greater, stressing that "as a catalyst for more sustainable development, we have only begun to tap the possibilities of the networked society." Efforts should be made in applying innovation to market based solutions that empower people and society, creating a more sustainable world. ICT will not only sustain education development but also the global energy, environmental and social challenges. "The networked society brings many opportunities and challenges. Wherever and however we work, we want to ensure that we are a force for good, and that our technology contributes to making the world a better place."

### 1.1. ICTs in Education

The United Nations Educational, Scientific and Cultural Organization (UNESCO) use the term ICTs, or information and communication technologies, to describe: "...the tools and the processes to access, retrieve, store, organize, manipulate, produce, present and exchange information by electronic and other automated means. These include hardware, software and telecommunications in the forms of personal computers, scanners, digital cameras, phones, faxes, modems, CD and DVD players and recorders, digitized video, radio and TV programmes, database programmes and multimedia programmes" (Anderson, 2005).

There are three main questions this paper gives answer to:

1. Why do ICTs need to be considered as a critical tool in education for sustainable development (ESD)?
2. What ICTs are currently being used by educators and learners?
3. What can we expect to see in the near future?

Any kind of technology can be understood as a tool or technique for extending human capacity. In this sense, ICTs extend our human capacity to perceive, understand and communicate. The mobile phone enables us to speak from wherever we are to others thousands of kilometers away; television permits us to see what is happening on the other side of the planet almost as it happens; and the Web supports immediate access to, and exchange of, information, opinions and shared interests.

In the field of formal education, ICTs are increasingly deployed as tools to extend the learner's capacity to perceive, understand and communicate, as seen in the increase in online learning programs and the use of the computer as a learning support tool in the classroom. Although universities were certainly leaders in engineering the Internet and interoperable computer systems to connect researchers for e-mail and data exchange, the use of ICTs for education and training has lagged behind other sectors in society.

According to Tella and Adu (2010): "The use of ICT in education and training has only begun when access to ICT services and higher bandwidths become more available to learners. The danger is that we ascribe to new technologies the characteristics of previous media and accompanying educational practices without development and reflection on new and better ways to support and evaluate learning outcomes." In order to best use these technologies in education, new pedagogies and learning assessment methods may, and probably will, be required. In this rapidly advancing field, it is worth reviewing the history, current uses and trends in ICTs that will further influence how education practices may be changed in future. Educators are continuing to develop new applications and online resources to support learning objectives in all disciplines. The field of environment and sustainable development education is no exception.

## 2. EDUCATION FOR SUSTAINABLE DEVELOPMENT – ESD

Education is seen as key in the process of achieving sustainable development. However, in order for formal education to contribute to sustainability, traditional systems and methodologies need to be re-oriented (Huckle and Sterling, 1996). Pelgrum and Law (2003), for example, explains that: "Centuries of development in education have not been able to avoid that nearly one billion people in the world are illiterate, more than 130 children don't attend school, and many of those who do, acquire knowledge that doesn't sustain them or is irrelevant for their needs. There is a clear indication that yesterday's solutions are inadequate for today's problems, and there couldn't be a clearer signal that doing more of the same is not a valid solution."

Research shows that even in developed countries, educational levels are high; the education system has not succeeded in influencing choices and behaviors that would support sustainable development. According to Pelgrum and Law (2003) "We know that in the USA, more than 80% of the population has higher education. We also know that the rates of energy use and the generation of waste in the USA are among the highest in the world. Higher levels of education have not led to more sustainability. Simply educating citizens to higher levels has not been sufficient to attain sustainable societies." In 2005, UNESCO launched the "Decade for Education for Sustainable Development," which aims to accelerate the implementation of a new vision in education. The Decade is a call for a collaborative process to re-orient educational policies, programs and practices so that education can better play its part in building the capacities of all members of society to work together to build a sustainable future (UNESCO, 2003). According to UNESCO (2003) "This vision of education emphasizes a holistic, interdisciplinary approach to developing the knowledge and skills needed for a sustainable future as well as changes in values, behaviour, and lifestyles."

Recent research conducted by Paas (2004) finds that many changes called for in ESD could be supported through greater integration of ICTs in the learning environment. The next section briefly traces the history of technological advances and technology policy as drivers for using ICTs in education, and describes the limitations the traditional education system may have in terms of supporting ESD. Paas & Creech (2008) emphasizes that ICTs play an important role in advancing ESD in two ways: By increasing access to educational materials about sustainability (e.g., via distance learning, educational networks and databases); and by helping to promote new ways of interacting in order to facilitate the learning called for in ESD that emphasizes not just knowledge, but choices, values and actions. Explaining these two ways, Paas & Creech put forward that at their most basic level, ICTs enable the presentation of course content using multimedia (images, text and sound) and facilitate archiving of that content. But they also provide new means of interactivity and simulation, thereby offering opportunities to improve learning and making new ways of understanding possible. The use of new technologies, thus, can offer exciting new possibilities to promote the changes in education methodologies called for in ESD.

## 3. CURRENT USES OF ICTS IN ESD

Current uses of ICTs in ESD fall into three broad categories:

1. Information resources, tools and portals for educators;
2. Supplements to classroom-based activities; and
3. Tools for distance/online learning.

### 3.1. Information resources, tools and portals for educators

It almost goes without saying that the Web provides extensive links to information on ICTs in education; platforms for educators to exchange knowledge and publish articles and lesson plans; and connections to support materials for ESD. However, when looking specifically for research on the use of ICTs for Education for Sustainable Development, including educational policies, pedagogical approaches and classroom uses of ICTs for ESD, there is not much available to date. This may be because ESD has grown from the tradition of environmental/outdoor education, which aimed at getting learners outside to experience and

learn about the natural world. Early proponents of the use of ICTs in education were from the civics fields—promoting media awareness activities (researching TV shows, Internet resources, etc.) and cultural understanding activities that use collaborative Internet technologies. However, as educators from diverse disciplines are increasingly embracing ESD, more examples of ICT use for ESD are emerging.

The field of geography is one of the first where experts are increasingly using ICT tools as central to the curriculum, including Mapping and Graphics software, Geographic Information Systems (GIS) and Global Positioning Systems (GPS). David Mitchell (Institute of Education, University of London, U.K.) promotes the development of an “e-confident” Geography Department for the secondary school level. He covers the use of a range of tools such as electronic weather stations, data projections, interactive whiteboards, digital cameras, mobile phones, spreadsheet/graphing software, and video and photo editing software. Mitchell notes that “GIS are rarely used in a practical way (as opposed to theoretical) in school geography, but they are widespread in industry and form a key part of geographical analysis. Efforts are being made in the geography education community to develop GIS in the geography curriculum.” Although Mitchell also explores how the teaching of geography is an essential part of ESD, he falls short of making direct connections between ESD and ICT use (Tella and Adu, 2010).

### 3.2. ICTs as a supplement to classroom-based activities

ICT applications are being designed to promote collaboration, connectivity, “real-world,” experience based learning, and systems thinking, which are emerging as key pedagogical methods conducive to education for sustainability. Examples provided are from primary as well as in universities. These include: collaboration and connectivity, real time real world learning, system thinking, etc. Distance/open learning, e-learning and online learning- ICTs are currently most applied in “distance learning” (DL). Originally distance learning was delivered principally via print, and later gradually including telephone/fax support, audio/video broadcasting, audio/video teleconferencing, and computer-aided instruction (via CD-ROMs & Software). DL finds itself in the current generation of being delivered in online learning environments (Moore & Kearsley, 1997). It is now common to find terms such as distributed learning, virtual learning, online learning, e-learning, open learning, virtual learning, collaborative learning, mobile learning and distance education being used interchangeably, although these terms represent applications that can differ widely in target audience, pedagogical/administrative structure and combinations of learning tools provided.

### 3.3. Distance/open learning, e-learning and online learning

Perhaps the area of education where ICTs are currently most applied is “distance learning” (DL). From its origins of being delivered principally via print, to gradually including telephone/fax support, audio/video broadcasting, audio/video teleconferencing, and computer-aided instruction (via CD-ROMs & Software), DL finds itself in the current generation of being delivered in online learning environments (Moore & Kearsley, 1997). Currently, terms such as distributed learning, virtual learning, online learning, e-learning, open learning and distance education are all being used interchangeably, although these terms represent applications that can differ widely in target audience, pedagogical/administrative structure and combinations of learning tools provided. Anderson (2005) depicts the differences in DL terms according to media uses. He said that online learning refers to learning that occurs purely via the Internet. E-learning is broader than online learning, since it includes off-line electronic media (such as CD-ROMs). Distance learning is broader than both online and e-learning, because also uses non-electronic media (e.g., printed material).

## 4. KEY CHALLENGES IN INTEGRATING ICTS IN EDUCATION

Although valuable lessons may be learned from best practices around the world, there is no one formula for determining the optimal level of ICT integration in the educational system. Significant challenges that policymakers and planners, educators, education administrators, and other stakeholders need to consider include educational policy and planning, infrastructure, language and content, capacity building, and financing.

### 4.1. Educational policy and planning

Attempts to enhance and reform education through ICTs require clear and specific objectives, guidelines and time-bound targets, the mobilization of required resources, and the political commitment at all levels to see the initiative through. According to Carlson and Gadio 2002, some essential elements of planning for ICT are listed below.

- A rigorous analysis of the present state of the educational system. ICT-based interventions must take into account current institutional practices and arrangements. Specifically, drivers and barriers to ICT use need to be identified, including those related to curriculum and pedagogy, infrastructure, capacity-building, language and content, and financing.
- The specification of educational goals at different education and training levels as well as the different modalities of use of ICTs that can best be employed in pursuit of these goals. This requires of the policymaker an understanding of the potentials of different ICTs when applied in different contexts for different purposes, and an awareness of priority education needs and financial and human resource capacity and constraints within the country or locality, as well as best practices around the world and how these practices can be adapted for specific country requirements.
- The identification of stakeholders and the harmonizing of efforts across different interest groups.
- The piloting of the chosen ICT-based model. Even the best designed models or those that have already been proven to work in other contexts need to be tested on a small scale. Such pilots are essential to identify, and correct, potential glitches in instructional design, implementability, effectiveness, and the like.
- The specification of existing sources of financing and the development of strategies for generating financial resources to support ICT use over the long term.

### 4.2. Infrastructure-related challenges in ICT-enhanced education

A country's educational technology infrastructure sits on top of the national telecommunications and information infrastructure. Before any ICT-based programme is launched, policymakers and planners must carefully consider the following (Bates, 2000).

- In the first place, are appropriate rooms or buildings available to house the technology? In countries where there are many old school buildings, extensive retrofitting to ensure proper electrical wiring, heating/cooling and ventilation, and safety and security would be needed.
- Another basic requirement is the availability of electricity and telephony. In developing countries large areas are still without a reliable supply of electricity and the nearest telephones are miles away. Experience in some countries in Africa point to wireless technologies (such as VSAT or Very Small Aperture Terminal) as possible levers for leapfrogging. Although this is currently an extremely costly approach, other developing countries with very poor telecommunications infrastructure should study this option.
- Policymakers should also look at the ubiquity of different types of ICT in the country in general, and in the educational system (at all levels) in particular. For instance, a basic requirement for computer-based or online learning is access to computers in schools, communities, and households, as well as affordable Internet service.

In general, ICT use in education should follow use in society, not lead it. Education programs that use cutting-edge technologies rarely achieve long term success:

It is cheaper, and easier, to introduce a form of technology into education, and keep it working, where education is riding on the back of large-scale developments by governments or the private sector. Television works for education when it follows rather than precedes television for entertainment; computers in schools can be maintained once commercial and private use has expanded to the point where there is an established service industry (Bates, 2000).

### 4.3. Challenges with respect to capacity-building

Various competencies must be developed throughout the educational system for ICT integration to be successful.

#### 4.3.1. Teachers

Teacher professional development should have five foci: 1) skills with particular applications; 2) integration into existing curricula; 3) curricular changes related to the use of IT (including changes in instructional design); 4) changes in teacher role; 5) underpinning educational theories (Brown and Duguid, 2000). Ideally, these should be addressed in pre-service teacher training and built on and enhanced in-service. In some countries, like Singapore, Malaysia, and the United Kingdom, teaching accreditation requirements include training in ICT use. ICTs are swiftly evolving technologies, however, and so even the most ICT fluent teachers need to continuously upgrade their skills and keep abreast of the latest developments and best practices. While the first focus—skills with particular applications—is self-evident, the four other foci are of equal, if not ultimately greater, importance. Research on the use of ICTs in different educational settings over the years invariably identify as a barrier to success the inability of teachers to understand why they should use ICTs and how exactly they can use ICTs to help them teach better. Unfortunately, most teacher professional development in ICTs is heavy on “teaching the tools” and light on “using the tools to teach.” According to Curban (2002) Teacher anxiety over being replaced by technology or losing their authority in the classroom as the learning process becomes more learner-centered—an acknowledged barrier to ICT adoption—can be alleviated only if teachers have a keen understanding and appreciation of their changing role.

#### 4.3.2. Education administrators

Leadership plays a key role in ICT integration in education. Many teacher- or student-initiated ICT projects have been undermined by lack of support from above. For ICT integration programs to be effective and sustainable, administrators themselves must be competent in the use of the technology, and they must have a broad understanding of the technical, curricular, administrative, financial, and social dimensions of ICT use in education.

#### 4.3.3. Technical support specialists

Whether provided by in-school staff or external service providers, or both, technical support specialists are essential to the continued viability of ICT use in a given school. While the technical support requirements of an institution depend ultimately on what and how technology is deployed and used, general competencies that are required would be in the installation, operation, and maintenance of technical equipment (including software), network administration, and network security. Without on-site technical support, much time and money may be lost due to technical breakdowns. In the Philippines, for example, one of the major obstacles to optimizing computer use in high schools has been the lack of timely technical support. In some extreme cases involving schools in remote areas, disabled computers take months to be repaired since no technician is available in the immediate vicinity and so the computers have to be sent to the nearest city hundreds of kilometers away (Curban, 2002).

#### 4.3.4. Content developers

Content development is a critical area that is too often overlooked. The bulk of existing ICT-based educational material is likely to be in English or of little relevance to education in developing countries (especially at the primary and secondary levels). There is a need to develop original educational content (e.g., radio programs, interactive multimedia learning materials on CD-ROM or DVD, Web-based courses, etc.), adapt existing content, and convert print-based content to digital media. These are tasks for which content development specialists such as instructional designers, scriptwriters, audio and video production specialists, programmers, multimedia course authors, and web-developers are needed. Like technical support specialists, content developers are highly skilled professionals and are not, with the exception of instructional designers, historically employed by primary and secondary schools. Many universities with distance education programs, and those who otherwise make use of ICTs, have dedicated technical support and content development units.

### 4.4. Challenges related to finance

What are the challenges related to financing the cost of ICT use? One of the greatest challenges in ICT use in education is balancing educational goals with economic realities. ICTs in education programs require large capital investments and developing countries need to be prudent in making decisions about what models of ICT use will be introduced and to be conscious of maintaining economies of scale. Ultimately it is an issue of whether the value added of ICT use offsets the cost, relative to the cost of alternatives. Put another way, is ICT-based learning the most effective strategy for achieving the desired educational goals, and if so what is the modality and scale of implementation that can be supported given existing financial, human and other resources?

Aston 2002 suggests the following potential sources of money and resources for ICT use programs:

1. Grants
2. Public subsidies
3. Private donations, fund-raising events
4. In-kind support (e.g., equipment, volunteers)
5. Community support (e.g. rent-free building)
6. Membership fees
7. Revenues earned from core business:
  - Connectivity (phone, fax, Internet, web pages)
  - Direct computer access to users
  - Office services (photocopying, scanning, audiovisual aids)
8. Revenues earned from ancillary activities:
  - Business services (word-processing, spreadsheets, budget preparation, printing, reception services)
  - Educational services (distant education, training courses)
  - Community services (meeting rooms, social events, local information, remittances from migrant workers)
  - Telework and consulting
  - Specialized activities (telemedicine)

- Sales (stationery, stamps, refreshments, etc.)

## 5. RECOMMENDATIONS

Private and public sector partnerships should be encouraged to fast track ICT-based projects in education for sustainable development. This is a strategy that has gained currency among Ministries of Education in developing countries. These partnerships take many forms, including private sector grants with government counterpart contributions, donations of equipment and education-related content by corporations to state-run schools, and the provision of technical assistance for planning, management, and strengthening human resources at the grassroots level. Multilateral organizations and international aid agencies have also driven many of the most significant ICT in education efforts in the developing world.

## 6. CONCLUSION

More schools and communities now have access to ICT resources to join the global economy with knowledge workers who have 21st century skills and are inspired by life-long learning. ICTs have great potential for knowledge dissemination, effective learning and the development of more efficient education services. ICT will not only sustain education development but also the global energy, environmental and social challenges.

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