ICT technologies and trends in education

ICTs stand for *information and communication technologies* and are defined, for the purposes of this primer, as a "**diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information**." These technologies include *computers, the Internet, broadcasting technologies (radio and television), and telephony.*

In recent years there has been a groundswell of interest in how computers and the Internet can best be harnessed to improve the efficiency and effectiveness of education at all levels and in both formal and non-formal settings. But ICTs are more than just these technologies; older technologies such as the telephone, radio and television, although now given less attention, have a longer and richer history as instructional tools. For instance, radio and television have for over forty years been used for open and distance learning, although print remains the cheapest, most accessible and therefore most dominant delivery mechanism in both developed and developing countries.6 The use of computers and the Internet is still in its infancy in developing countries, if these are used at all, due to limited infrastructure and the attendant high costs of access.

Allama Iqbal Open University (AIOU) combines the use of print, recorded audio and video, broadcast radio and television as well as online education for promoting distance based education and non-formal education in Pakistan. AIOU has also started online courses and is also providing access to online resources. Similarly, Virtual University (VU) in Pakistan is offering distance education through internet and television technologies. Video recording of lectures of different courses of VU are also available in CDs from different recommended educational centers and their other educational resources are also available online to students like E-library and course lectures. The Open University of the United Kingdom (UKOU), established in 1969 as the first educational institution in the world wholly dedicated to open and distance learning, still relies heavily on print-based materials supplemented by radio, television and, in recent years, online programming.

WHAT IS E-LEARNING?

Although most commonly associated with higher education and corporate training, e-learning encompasses learning at all levels, both formal and non-formal, that uses an information network—the Internet, an intranet (LAN) or extranet (WAN)—whether wholly or in part, for course delivery, interaction and/or facilitation. Others prefer the term *online learning. Web-based*

learning is a subset of e-learning and **refers to learning using an Internet browser** (such as Netscape or Internet Explorer).

WHAT IS BLENDED LEARNING?

Another term that is gaining currency is blended learning. **This refers to learning models that combine traditional classroom practice with e-learning solutions.** For example, students in a traditional class can be assigned both print-based and online materials, have online mentoring sessions with their teacher through chat, and are subscribed to a class email list. Or a Web-based training course can be enhanced by periodic face-to-face instruction. "Blending" was prompted by the recognition that **not all learning is best achieved in an electronically-mediated environment, particularly one that dispenses with a live instructor altogether. Instead, consideration must be given to the subject matter, the learning objectives and outcomes, the characteristics of the learners, and the learning context in order to arrive at the optimum mix of instructional and delivery methods.**

WHAT IS OPEN AND DISTANCE LEARNING?

Open and distance learning is defined by the Commonwealth of Learning as "a way of providing learning opportunities that is characterized by the separation of teacher and learner in time or place, or both time and place; learning that is certified in some way by an institution or agency; the use of a variety of media, including print and electronic; two-way communications that allow learners and tutors to interact; the possibility of occasional face-to-face meetings; and a specialized division of labour in the production and delivery of courses."

WHAT IS MEANT BY A LEARNER-CENTERED ENVIRONMENT?

The National Research Council of the U.S. defines learner-centered environments as those that "**pay careful attention to the knowledge, skills, attitudes, and beliefs that learners bring with them to the classroom.**" The impetus for learner-centredness derives from a theory of learning called constructivism, which views learning as a process in which individuals "construct" meaning based on prior knowledge and experience. Experience enables individuals to build mental models or schemas, which in turn provide meaning and organization to subsequent experience. Thus knowledge is not "out there", independent of the learner and which the learner passively receives; rather, knowledge is created through an active process in which the learner transforms information, constructs hypothesis, and makes decisions using his/her

mental models. A form of constructivism called social constructivism also emphasizes the role of the teacher, parents, peers and other community members in helping learners to master concepts that they would not be able to understand on their own. For social constructivists, learning must be active, contextual and social. It is best done in a group setting with the teacher as facilitator or guide.

ICTs IN EDUCATION

For developing countries ICTs have the potential for increasing access to and improving the relevance and quality of education. It thus represents a potentially equalizing strategy for developing countries. [ICTs] greatly facilitate the acquisition and absorption of knowledge, offering developing countries unprecedented opportunities to enhance educational systems, improve policy formulation and execution, and widen the range of opportunities for business and the poor. One of the greatest hardships endured by the poor, and by many others who live in the poorest countries, is their sense of isolation. The new communications technologies promise to reduce that sense of isolation, and to open access to knowledge in ways unimaginable not long ago.

However, the reality of the Digital Divide—the gap between those who have access to and control of technology and those who do not—means that the introduction and integration of ICTs at different levels and in various types of education will be a most challenging undertaking. Failure to meet the challenge would mean a further widening of the knowledge gap and the deepening of existing economic and social inequalities.

HOW CAN ICTS HELP EXPAND ACCESS TO EDUCATION?

ICTs are a potentially powerful tool for extending educational opportunities, both formal and non-formal, to previously underserved constituencies—scattered and rural populations, groups traditionally excluded from education due to cultural or social reasons such as ethnic minorities, girls and women, persons with disabilities, and the elderly, as well as all others who for reasons of cost or because of time constraints are unable to enroll on campus.

• **Anytime, anywhere**. One defining feature of ICTs is their ability to transcend time and space. ICTs make possible asynchronous learning, or learning characterized by a time lag between the delivery of instruction and its reception by learners. Online course materials, for example, may be accessed 24 hours a day, 7 days a week. ICT-based educational delivery (e.g., educational

programming broadcast over radio or television) also dispenses with the need for all learners and the instructor to be in one physical location. Additionally, certain types of ICTs, such as teleconferencing technologies, enable instruction to be received simultaneously by multiple, geographically dispersed learners (i.e., synchronous learning).

• **Access to remote learning resources**. Teachers and learners no longer have to rely solely on printed books and other materials in physical media housed in libraries (and available in limited quantities) for their educational needs. With the Internet and the World Wide Web, a wealth of learning materials in almost every subject and in a variety of media can now be accessed from anywhere at anytime of the day and by an unlimited number of people. This is particularly significant for many schools in developing countries, and even some in developed countries, that have limited and outdated library resources. ICTs also facilitate access to resource persons— mentors, experts, researchers, professionals, business leaders, and peers—all over the world.

How does the use of ICTs help prepare individuals for the workplace?

One of the most commonly cited reasons for using ICTs in the classroom has been to better prepare the current generation of students for a workplace where ICTs, particularly computers, the Internet and related technologies, are becoming more and more ubiquitous. Technological literacy, or the ability to use ICTs effectively and efficiently, is thus seen as representing a competitive edge in an increasingly globalizing job market. Technological literacy, however, is not the only skill well-paying jobs in the new global economy will require. EnGauge of the North Central Regional Educational Laboratory (U.S.) has identified what it calls "21st Century Skills," which includes digital age literacy (consisting of functional literacy, visual literacy, scientific literacy, technological literacy, information literacy, cultural literacy, and global awareness), inventive thinking, higher-order thinking and sound reasoning, effective communication, and high productivity. (See Table 1 for a brief explanation of each skill.)

Table 1. Skills Needed in the Workplace of the Future

Functional literacy	Ability to decipher meaning and express ideas in a range of media; this includes the use of images, graphics, video, charts and graphs or visual literacy
Scientific literacy	Understanding of both the theoretical and applied aspects of science and mathematics
Technological literacy	Competence in the use of information and communication technologies
Information literacy	Ability to find, evaluate and make appropriate use of information, including via the use of ICTs
Cultural literacy	Appreciation of the diversity of cultures
Global awareness	Understanding of how nations, corporations, and communities all over the world are interrelated

Inventive Thinking

Adaptability	Ability to adapt and manage in a complex, interdependent world
Curiosity	Desire to know
Creativity	Ability to use imagination to create new things
Risk-taking	Ability to take risks

Higher-Order Thinking Creative problem-solving and logical thinking that result in soundjudgments

Effective Communication

Teaming	Ability to work in a team
Collaboration and interpersonal skills	Ability to interact smoothly and work effectively with others
Personal and social responsibility	Be accountable for the way they use ICTs and to learn to use ICTs for the public good
Interactive communication	Competence in conveying, transmitting, accessing and understanding information
High Productivity	Ability to prioritize, plan, and manage programs and projects to achieve the desired Results Ability to apply what they learn in the classroom to real-life contexts to create relevant, high-quality products

Source: Adapted from EnGauge. North Central Regional Educational Laboratory. Available Online at
http://www.ncrel.org/engauge/skills/21skills.htm. Accessed 31 May 2002.

The potential of ICTs to promote the acquisition of these skills is tied to its use as a tool for raising educational quality, including promoting the shift to a learner-centered environment.

How can the use of ICTs help improve the quality of education?

Improving the quality of education and training is a critical issue, particularly at a time of educational expansion. ICTs can enhance the quality of education in several ways: by increasing learner motivation and engagement, by facilitating the acquisition of basic skills, and by enhancing teacher training. ICTs are also transformational tools which, when used appropriately, can promote the shift to a learner-centered environment.

Motivating to learn. ICTs such as videos, television and multimedia computer software that combine text, sound, and colorful, moving images can be used to provide challenging and authentic content that will engage the student in the learning process. Interactive radio likewise makes use of sound effects, songs, dramatizations, comic skits, and other performance conventions to compel the students to listen and become involved in the lessons being delivered. More so than any other type of ICT, networked computers with Internet connectivity can

increase learner motivation as it combines the media richness and interactivity of other ICTs with the opportunity to connect with real people and to participate in real world events.

Facilitating the acquisition of basic skills. The transmission of basic skills and concepts that are the foundation of higher order thinking skills and creativity can be facilitated by ICTs through drill and practice. Educational television programs such as *Sesame Street* use repetition and reinforcement to teach the alphabet, numbers, colors, shapes and other basic concepts. Most of the early uses of computers were for computer-based learning (also called computer-assisted instruction) that focused on mastery of skills and content through repetition and reinforcement. *(See section below on Computer- Based Learning.)*

Enhancing teacher training. ICTs have also been used to improve access to and the quality of teacher training. For example, institutions like the Cyber Teacher Training Center (CTTC) in South Korea are taking advantage of the Internet to provide better teacher professional development opportunities to inservice teachers. The government-funded CTTC, established in 1997, offers self-directed, self-paced Web-based courses for primary and secondary school teachers. Courses include "Computers in the Information Society,""Education Reform," and "Future Society and Education." Online tutorials are also offered, with some courses requiring occasional face-to-face meetings.15 In China, large-scale radio and television-based teacher education has for many years been conducted by the China Central Radio and TV University,16 the Shanghai Radio and TV University and many other RTVUs in the country.

At Indira Gandhi National Open University, satellite-based one-way video- and two-way audio-conferencing was held in 1996, supplemented by print-materials and recorded video, to train 910 primary school teachers and facilitators from 20 district training institutes in Karnataka State. The teachers interacted with remote lecturers by telephone and fax.

HOW CAN ICTS HELP TRANSFORM THE LEARNING ENVIRONMENT INTO ONE THAT IS LEARNER-CENTERED?

Research has shown that the appropriate use of ICTs can catalyze the paradigmatic shift in both content and pedagogy that is at the heart of education reform in the 21st century.19 If designed and implemented properly, ICT-supported education can promote the acquisition of the knowledge and skills that will empower students for lifelong learning.

When used appropriately, ICTs—especially computers and Internet technologies— enable new ways of teaching and learning rather than simply allow teachers and students to do what they have done before in a better way. These new ways of teaching and learning are underpinned by constructivist theories of learning and constitute a shift from a teacher-centered pedagogy—in its worst form characterized by memorization and rote learning—to one that is learner-centered. *(See Table 2 for a comparison of a traditional pedagogy and an emerging pedagogy enabled by ICTs.)*

• **Active learning.** ICT-enhanced learning mobilizes tools for examination, calculation and analysis of information, thus providing a platform for student inquiry, analysis and construction of new information. Learners therefore learn as they do and, whenever appropriate, work on real-life problems in-depth, making learning less abstract and more relevant to the learner's life situation. In this way, and in contrast to memorization-based or rote learning, ICT-enhanced learning promotes increased learner engagement. ICT-enhanced learning is also "just-in-time" learning in .which learners can choose what to learn when they need to learn it.

• **Collaborative learning.** ICT-supported learning encourages interaction and cooperation among students, teachers, and experts regardless of where they are. Apart from modeling real-world interactions, ICT-supported learning provides learners the opportunity to work with people from different cultures, thereby helping to enhance learners' teaming and communicative skills as well as their global awareness. It models learning done throughout the learner's lifetime by expanding the learning space to include not just peers but also mentors and experts from different fields.

Table 2. Overview of Pedagogy in the Industrial versus the Information Society

Aspect	Less ('traditional pedagogy')	More ('emerging pedagogy' for the information society)
Active	• Activities prescribed by teacher • Whole class instruction • Little variation in activities • Pace determined by the programme	• Activities determined by learners • Small groups • Many different activities • Pace determined by learners
Collaborative	• Individual • Homogenous groups • Everyone for him/herself	• Working in teams • Heterogeneous groups • Supporting each other
Creative	• Reproductive learning • Apply known solutions to problems	• Productive learning • Find new solutions to problems

Integrative	• No link between theory and practice • Separate subjects • Discipline-based • Individual teachers	• Integrating theory and practice • Relations between subjects • Thematic • Teams of teachers
Evaluative	• Teacher-directed • Summative	•Student-directed • Diagnostic

Source: Thijs, A., et al. Learning Through the Web Available Online http://www.decidenet.nl/Publications/

Web_Based_Learning.pdf Accessed 31 May 2002.

• **Creative Learning.** ICT-supported learning promotes the manipulation of existing information and the creation of real-world products rather than the regurgitation of received information.

• **Integrative learning**. ICT-enhanced learning promotes a thematic, integrative approach to teaching and learning.This approach eliminates the artificial separation between the different disciplines and between theory and practice that characterizes the traditional classroom approach.

• **Evaluative learning.** ICT-enhanced learning is student-directed and diagnostic. Unlike static, text- or print-based educational technologies, ICT-enhanced learning recognizes that there are many different learning pathways and many different articulations of knowledge. ICTs allow learners to explore and discover rather than merely listen and remember.