ICT and Educational Reform in Developed and Developing Countries

Robert B. Kozma, Ph.D.
Center for Technology in Learning
SRI International
333 Ravenswood Ave.
Menlo Park, California 94025 USA
robert.kozma@sri.com

Topics:

Research work and experience in using media, methods, curricular articulations, and leanring environments in an innovative manner, paying special attention to the culture of diversity.

Studies and research that characterize and identify those factors involved in improving educational practice related to the use of ICT, as well as those elements that enhance or inhibit their generalization.

ICT and Educational Reform

Around the world, applications of information and communications technologies (ICT) are making dramatic changes in economic and social development. These changes go beyond a mere increase in the number of computers appearing in work places, homes, and schools to more fundamental changes in the foundations of economic growth and its relationship to human capital. These tectonic economic and social changes have been characterized by terms such as "knowledge economy" and "learning society", conveying the notion that knowledge and learning are now at the core of economic productivity and social development. Behind these terms is a new conception of the relationship between knowledge and society (OECD, 1999). From this new perspective, knowledge is both the engine and product of economic and social development. Knowledge is dynamic, rather than static, and the *production* of knowledge has more value than knowledge *acquisition* alone.

Education is, of course, at the core of the knowledge economy and learning society. Correspondingly, the role of ICT in schools is shifting dramatically. The traditional role of ICT has been that of a minor curricular subject, sometimes called infomatics, computer literacy, or keyboarding. Alternatively, it has been used as an instructional aid (i.e., computer-assisted instruction) to help students learn other subjects, such as math or science. However in some countries, ICT is now at the center of education reform efforts that involve its use in coordination with changes in curriculum, teacher training, pedagogy, and assessment. Countries from Singapore (Ministry of Education, Singapore, 2000) to Chile (Ministerio de Educación, Republica de Chile, 1998) to the United States (U.S. Department of Education, 1996) to Norway (Ministry of Education, Research, and

Church Affairs, Norway, 2000) have taken the position that the integration of ICT into classrooms and curricula can improve educational systems and prepare students for the 21st century learning society. Similarly, multinational organizations, such as the Organization for Economic Cooperation and Development (OECD 1998, 1999) the European Commission (1995, 2000), and the G8 nations (2000) have identified the need to prepare students for lifelong learning in the knowledge economy and they assign a central role to ICT in accomplishing this goal.

But how are these developments affecting education reform in the larger number of countries? How are they affecting what it is that teachers and students are doing and learning in schools? And can these developments benefit teachers and students in both developed and developing countries alike? This paper briefly reviews several large-scale international studies to examine the role that ICT is playing in educational change. Included in the review are studies in both developed and developing countries. The studies include a survey of educational practices in 26 primarily developed countries, initial findings from case studies in 28 countries, and a set of evaluation studies of a program designed to support the use of ICT that is currently being implemented in 26 developing countries. The studies reveal that important changes are occurring in the use of ICT in schools around the world. Whether in developed or developing countries, ICT is beginning to be used by students across many school subjects to produce knowledge products, to conduct investigations and inquiries, and to connect with other people and cultures. In this way, ICT is coming to be at the core of preparing students for successful participation in the knowledge economy and learning society.

ICT and Reform in Developed Countries

The Second Information Technology in Education Study (SITES) is a project of the International Association for the Evaluation of Educational Achievement (IEA). The study is structured in three modules. Conducted in 1998-99, SITES Module 1 (M1) involved schools in 26 countries from Europe, North America, and Asia Pacific (Pelgrum & Anderson, 1999). The study was a survey of principles and technology coordinators that addressed ICT issues related to curriculum, infrastructure, staff development, innovative pedagogical practices, and management and organization.

The findings document a significant increase between 1995 and 1998 in the number of computers in schools, although there are also significant differences between countries, in this regard. For example, Norway moved from approximately 55 students per computers in 1995 to approximately 9 students per computer in 1998. The ratio in China Hong Kong was 39:1 in 1995 and 21:1 in 1998. And Hungary decreased its ratio of 41 students to every computer to a 23:1 ratio.

Similarly, large numbers of schools in many countries have access to the Internet. For example, approximately 85% of the schools in Canada and Denmark had access to the Internet in 1999. About 78% of the schools in Norway did. But only about 30% of the schools in China Hong Kong and Hungary had Internet access in 1999.

But more important than these findings was a finding about the number of schools engaged in innovative pedagogical practices—what Pelgrum and Anderson (1999) call an emerging new instructional paradigm. An indictor was constructed from questions related to classroom pedagogy that measured the extent to which students were actively

involved in their own learning. A number of countries in Europe and North America, such as Norway, Denmark, Hungary, and Canada, scored highly on this indicator. Countries in Asia Pacific often scored low on this indicator and higher on an indicator of traditional pedagogical practices. Also important was the fact that the use of ICT was often involved in these innovative pedagogical practices.

The second module in SITES (SITES M2) is a series of cases studies of innovative pedagogical practice using technology (Kozma, et al., 1999). The shows that there are instances of these innovative practices in many countries, even if these practices are not yet widespread. Analysis of the data is not yet completed for SITES M2, but 174 case studies were conducted in 28 countries in Europe, North America, Asia Pacific, Africa, and South America. Examples from these case studies illustrate the kinds of changes that are occurring with the use of ICT:

- Students in a lower secondary school in Norway are using the Internet to collaborate with students in a school in the US to follow two women (one Norwegian and one American) who are going across Antarctica on cross country skis. The students communicate with the women and with weather and research stations in the area to learn about the Antarctic continent.

- The "Roots Project" connects five rural primary schools in Catalonia, Spain. Students in each school did a parallel research project about their village: the history, monuments, village square, etc. They used word processing, email, and digital photography to communicate with each other and publish their reports on the Web in Catalan.

- Groups of students in a Chilean primary school are using email and the Internet to collaborate with senior citizens in Belgium on projects related to topics such as tourism and current affairs. Students in each group take on specific roles and responsibilities to produce displays, murals, and monthly presentations to the whole school with the goal of developing their reading, writing, oral expression, and social skills.

- Teachers and students in a lower secondary school in Singapore are using an integrated set of learning and teaching tools called "Learning Village" to implement a standards-based approach to students' project work. These communication and assessment tools support students' collaboration and project work in science, math, and English. They support teachers' calibration of their assessments around standards-based rubrics and benchmarks. And the tools support student and teacher project collaboration and online discussions.

- An upper secondary school in the US has been redesigned from the ground up around technology and project-based learning. The school is organized as a high-tech start-up business. Students (workers) have real world projects (academic work) consisting of complex tasks with long-range due dates for which they have individual and shared responsibility. Students use computers on a daily basis for everything from research on the Internet to a multimedia integrated design projects that combine interdisciplinary content from social studies, math, science, economics, government, and literature. Students use technology to create a range of products from their own

3

involvement in collaborative projects with classmates to address a real world issue or solve a problem.

SITES Module 3 is scheduled for data collection in 2004. It will again measure the ICT infrastructure and pedagogical practices in schools and document changes. In addition, the study will assess the impact of these changes on student learning.

ICT and Reform in Developing Countries

Unfortunately, not all countries are currently able to benefit from the developments and advances that technology can offer. Significant barriers have been identified—often referred to as "the Digital Divide"—that limit the ability of some countries to take advantage of technological developments. Access is chief among them. According to the U.S. State Department (Larson, 2000), of the approximately 275 million people online at the end of the twentieth century, less than a quarter resided outside North America and Europe. According to an UNESCO report (Blurton, 1999), while over 26% of the U.S. population are Internet users, only 0.8% of the Latin American population are Internet users. The figure for Southeast Asia is 0.5%, for Eastern Europe, 0.4%, for Sub-Saharan Africa, 0.1% and for South Asia, 0.04%.

Access is only the most obvious problem. Developing countries are faced with other challenges in using ICT to improve and reform education, challenges related to teacher preparation, curriculum, pedagogy, and assessment.

To address these problems, the World Bank Institute, a unit of the World Bank, launched the World Links for Development, or WorLD, Program (www.worldbank.org/worldlinks/) in 1997. In 1999, a sister, non-profit organization was established to direct the Program: the World Links for Development Organization (www.world-links.org/). The aim of the WorLD Program is to link secondary school students and teachers around the world in order to improve education in developing countries, enhance cultural understanding across nations, and help develop skills that youths need for obtaining jobs in the 21st century.

The WorLD Program has five components:

- Internet connectivity for secondary schools in developing countries.
- Training in the use of technology to improve teaching and learning.
- School-to-school partnerships, as well as regional and global partnerships with public, private, and non-governmental organizations.
- Telecommunications policy advice for the education sector.
- Monitoring and evaluation.

The WorLD Program began as a pilot project in Uganda but by 1998 had spread to 15 countries in Africa, Latin America, Eastern Europe, and the Middle East. It provided training for teachers in five languages: English, Spanish, French, Portuguese, and Turkish. Currently, the Program is in 26 countries, having spread to Central America and Southern and Southeast Asia.

As a result of these resources and training, WorLD teachers and students were more likely to use email, search engines, bulletin boards, and the Internet more often than computer-using teaching and students in non-WorLD schools (Kozma & Mcghee, 1999; Mcghee & Kozma, 2000). More importantly, WorLD teachers and students were more

likely to use computers to engage in a number of classroom activities associated with the information society, such as gathering data for a research project, collecting information about another country, exchanging information with students elsewhere, and collaborating with students in other schools on learning projects.

An example of this kind of classroom work comes from schools in Paraguay and Mexcio. In a project called "Ciencia a Conciencia" (Conscientious Science), students study environmental issues that include: deforestation, pollution, ozone depletion, and toxic wastes. Students conduct research projects, collect data, and share findings, as they explore solutions to these problems in their local communities. Findings from student investigations are posted on the Web. This and other projects engage students in the use of ICT to conduct collaborative investigations, communicate with peers and experts in other countries, create cultural content, and design Web pages in their own languages.

A 1998 evaluation of the Program (Kozma & Mcghee, 1999) found that 90% of the students expressed satisfaction with their participation in the Program. The most highly rated impact of the Program was on students' ability to get better jobs upon graduation. Furthermore, a large number of students rated the Program very high for its positive impact on their technology skills, their communication skills, and their ability to reason with information. They also said that the Program improved their attitudes toward school and their attendance. A large majority indicated that their knowledge about other cultures increased as a result of their participation.

Teachers agreed with the students' assessments. A large majority of teachers agreed that students improved their information, communication, collaboration, and technological skills and attitudes, as a result of their participation in the Program. The assessments of both teachers and students of the impact of technology on student learning were significantly higher for WorLD students than for computer-using non-WorLD students. The results were equivalent for girls and boys. Also, a large percentage of both teachers and administrators felt that teachers, as well, acquired new skills and attitudes in both technology and pedagogy.

Surveys of teachers in 15 countries in 1999 (Mcghee & Kozma, 2000) resulted in similar findings. A large majority of teachers in WorLD schools felt that the Program had a large positive effect on student knowledge about computers, as well as other information and communication skills. Again, they found that the impact was similar for girls and boys. Likewise, teachers felt the impact of the Program was significant in their own acquisition of skills and attitudes. For example, teachers felt participation in the Program increased their ability to design and prepare projects for students, learn more about their subject matter, and help students work in groups.

In addition, an assessment study (Quellmalz & Zalles, 2000) demonstrated the impact of the Program on student learning. For this study, a special assessment instrument was designed that measures students' technology knowledge and use, their reasoning with information, and their communication skills. Students from 6 schools in Uganda who had been participating in the Program took the assessment, along with students in 4 schools that had not participated in the Program. Students in WorLD schools outperformed non-World students on all measures.

Conclusions

The results of these studies demonstrate that around the world, both developed and developing countries are beginning to use their investment in ICT to reform education. ICT is transforming schools and classrooms by bringing in new curricula based on real-world problems, providing scaffolds and tools to enhance learning, giving students and teachers more opportunities for feedback and reflection, and building local and global communities that include students, teachers, parents, practicing scientists, and other interested parties. The results of these studies argue for the value of ICT investments in schools.

The results also argue for other investments in teacher professional development, curriculum, and assessment. Too often, curricula emphasize and assessments still test the memorization of facts and procedures. This pushes ICT to the periphery. When WorLD teachers were asked what the barriers were to the use of ICT in their classes (Kozma & Mcghee, 1999), they often mentioned that there was no room in the curriculum for ICT activities nor was ICT included in national assessments. This made it very difficult for them to find time in their planning and the school day to integrate ICT into their courses. Teacher training and pedagogical change need to be aligned with curriculum and assessment reform that emphasize skills in solving complex real-world problems, producing knowledge products, conducting investigations, and communicating and collaborating with others. ICT needs to play a central role in this alignment and it needs to be integrated throughout the educational system.

These changes require a significant commitment on behalf of developed and developing countries, especially when there are conflicting needs for limited resources. But the results of these studies make it clear that through this kind of investment, students in both developed and developing countries can participate in the information economy and learning society.

References

Blurton, C. (1999). New directions in ICT-use in education. Paris: UNESCO.

European Commission (2000). Communication from the commission to the council and the European Parliament: The elearning action plan – Designing tomorrow's education. Brussels: Commission of the European Communities.

European Commission (1995). European Commission white paper on teaching and learning: Towards the learning society. Brussels: Commission of the European Communities.

G8 Countries (2000). Okinawa Charter on the Global Information Society. http://www.dotforce.org/reports/it1.html.

Kozma, R.. & McGhee, R., (1999). World Links for Development: Accomplishments and challenges. Monitoring and evaluation annual report, 1998-1999. Menlo Park, CA: SRI International.

Kozma, R., Pelgrum, W., Owston, R., Vogt, Y., & McGhee, R. (2000). Qualitative studies of innovative pedagogical practices using technology: Research design for the Second Information Technology in Education Study Module 2. Menlo Park, CA: SRI International.

Larson, A. (2000). Remarks delivered at the Sovereignty in the Digital Age Series. Washington, D.C.: Woodrow Wilson Center.

McGhee, R. & Kozma, R. (2000). World Links for Development: Accomplishments and challenges. Monitoring and evaluation annual report, 1999-2000. Menlo Park, CA: SRI International.

Ministerio de Educación, Republica de Chile (1998). Reform in progress: Quality education for all. Santiago, Chile: Ministerio de Educación.

Ministry of Education, Singapore (2000). Mission with a passion: Making a difference. Singapore: Ministry of Education.

Ministry of Education, Research, and Church Affairs, Norway (2000). ICT in Norwegian Education: Plan for 2000-2003. (http://odin.dep.no/archive/kufbilder/01/03/IKTiu005.pdf).

Organisation for Economic Cooperation and Development (1999). Knowledge management in the learning society. Paris: OECD/CERI.

Organisation for Economic Cooperation and Development (1998). Education policy analysis. Paris: OECD/CERI.

Pelgrum, W. & Anderson, R. (1999). ICT and the emerging paradigm for life long learning: a worldwide educational assessment of infrastructure, goals, and practices. Amsterdam: IEA.

Quellmalz, E. & Zalles, D. (2000). World Links for Development: Student assessment Uganda field test. Menlo Park, CA: SRI International.

U.S. Department of Education (1996). Getting America's students ready for the 21st century: Meeting the technology literacy challenge. Washington, DC: US Government Printing Office.

World Bank (1998). Latin America and the Caribbean: Education and technology at the crossroads. Washington, DC: World Bank.