INFORMATION TECHNOLOGY AND EDUCATION

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Contents

Summary

In order to achieve sustainable development with a population that is expected to double over the twenty-first century, the world will need new advances and new understanding of peoples across the planet. Technology is playing an important and rapidly growing role in educating people for such a world.

Going back to books and printing in centuries past and to radio, television, films, and photocopying in the twentieth century, technology has helped to educate the masses. Since 1980, however, desktop computer technology has been introduced that is revolutionizing the way people learn and access knowledge. In addition to rapidly advancing and increasingly powerful computer equipment is the development of an extraordinary range of software applications that can assist teachers and teach students (even when they are not seeking to learn, for example through the use of games). Software applications and databases can provide knowledge (e.g. encyclopedias and other references) and a wide range of software tools can enable analyses of data, provide the ability to draw pictures, empower users to write and correct text quickly, and many more things.

Meanwhile, the Internet and World Wide Web have exploded, linking millions around the world and providing volumes of information and capabilities that few could ever have foreseen. Millions of sites provide information, sometimes unique, that has previously been difficult or impossible to access in many corners of the world.

The combination of all these technological advances offers the hope that the expanding population of the world will be much better educated than in the past. However, to achieve this goal will require more uniform access to these technologies around the world, improved data quality measures, and better means to identify desired information from the wealth of information available.

1. Introduction

To achieve sustainable development with a world population likely to double before it stabilizes will require more efficient use of energy, water, and other resources. It will also require increased agricultural production. Such technological advances will require well-educated individuals in many different fields.

For the population to double without permanently degrading the environment will also take improved knowledge in many different disciplines. Such knowledge will be needed in every corner of the world.

For conflict in the world to diminish in the twenty-first century will require greater communication and understanding between differing peoples and cultures. Education will be essential for such understanding. Similarly, greater equity among the peoples of the world will require education to be available more uniformly around the world.

Indeed, for world population growth to stabilize will require major advances in education, particularly in the developing world, where there are the highest fertility rates. It will be especially important that education be more readily available to women, because female fertility is inversely correlated to educational attainment.

Technology is increasingly important in education. However, its future potential is enormous.

Perhaps of all the topics in this online encyclopedia the role of technology in education is likely to be the most out of date. By the time this article appears, technologies and new applications unforeseen by the educational community undoubtedly will have been introduced that could revolutionize access, as well as approaches, to education.

Therefore, it is impossible to catalog or even to summarize the many different ways that technology is starting to influence education. What follow are highlights and examples of some of the many approaches and developments in this important field.

2. Technology in Education: Historical Perspective

One thousand years ago, education was dominated by the spoken word. History and traditions were passed from one generation to the next in the form of stories. Few were able to read or write. Books, produced by hand, could be afforded only by the wealthiest. Thus, the invention of the printing press and the mass reproduction of books had a revolutionary impact on education, making it possible for schools and students to have textbooks. Because of the printing press, those in the literate public could obtain news from newspapers and learn new ideas and principles from books.

In recent decades, technologies such as film, telephones, radio, photocopying (and more inexpensive forms of duplicating technologies), and television have greatly increased the flow of information. Classroom teaching has been similarly affected, with such technologies enabling teachers to share information from outside their locality. Both radio and television have featured documentary and educational programs. Film and filmstrip libraries have supplemented the materials available to students. In the U.S., a private firm offers televised daily programming to schools at no cost via Channel One in exchange for the opportunity to provide commercial advertisements as part of the program content.

For the average person, the introduction of radio and television in the twentieth century have revolutionized understanding of world events and have helped shape public opinion. For the first time, most citizens of the world can not only learn of events on the other side of the globe the day they occur, but can also witness aspects of them.

Such global communications have heightened understanding of inequities in the world and have increased demands for education and advancement opportunities. However, it has been difficult in many parts of the world to satisfy such demands. Technologies that have been introduced only in the late 1990s offer the hope of revolutionizing the education of students in the classroom as well as of the public. Examples of such technologies are summarized below.

3. Desktop Computing

3.1. Hardware

The first computers were developed about the middle of the twentieth century. At first these were very large machines requiring large rooms or buildings and special air-conditioning systems to keep them from overheating. The power and speed of

computers have multiplied steadily since the start. By about 1980, the first computers were developed that could fit on a desktop. These computers had at least as much speed and capacity than their much larger predecessors. They were also much less expensive.

Since then, every few years a new generation of computers is developed that is smaller, faster, and less expensive. Some computers that can fit into a shirt pocket are much more powerful than the largest computer of only a couple of decades before. These computers are often equipped with storage devices able to hold many books, full-length motion pictures, and sound.

Similarly, there are printers available that are small, relatively fast, and quiet. Some of these can produce color output on paper, transparencies, and other materials. Such printers continually get more powerful at ever-decreasing cost of both purchase and operation.

Thus, the introduction and evolution of such machines are presenting whole new educational opportunities. With ever-increasing computing capability available at dramatically lowering prices, desktop and portable computers are proliferating in schools, business, and even homes.

3.2. Software Applications

The proliferation of such machines, along with the development of standardized operating systems software to run them, created markets for increasingly sophisticated software applications that work with the operating systems. The availability of ever more powerful software tools for programmers has facilitated the development of software applications with many different and increasing capabilities. Examples of some of the categories of software applications that are affecting education follow.

3.2.1. Tools for Teachers

Some of the applications of desktop computers in education are extensions of earlier technologies. Instead of typewriters, teachers can now use word processing software, such as Microsoft Word or WordPerfect, to prepare class materials. Because the information is stored in an electronic form, it can easily be revised and updated for future use. Corrections can more easily be made and the final product can look much better than the handwritten or typed products of the past.

Similarly, there are many different software applications that can aid teachers to design presentations. Whether an outline, a graph, or a table, a wide range of different applications software (e.g. Microsoft PowerPoint, Harvard Graphics, or Corel's Quattro Pro) can make eye-catching presentation materials. If the teacher has a computer projector or palette available, the presentations can even include motion.

Desktop publishing software (e.g. Adobe PageMaker or Quark Express) can make presentation materials look even more professional than word processing software. Thus, fancy newsletters, brochures, and even books can be produced directly by teachers with such applications.

Other applications can be used to give students computer-based tests. These can be immediately graded and analyzed, so that a study plan can be developed to overcome any weaknesses exhibited by individual students. For example, the Scholastic Aptitude Test (SAT) used widely in the U.S. for evaluating college applicants is available on computers both as practice exams and for student evaluation. Thus, desktop computers with modern application software can extend the ability of teachers to teach in traditional ways.

3.2.2. Games

There is a huge and growing market for video and computer-based games. While these are entertaining and enjoyable for students, many also have educational value. Some of the games are intellectually challenging (e.g. chess games or those based upon the Japanese game of go). Some involve puzzle solving (e.g. Minesweeper) and others are quiz-based (e.g. You Don't Know Jack), and both types will also challenge students to learn. "Where in the World is Carmen San Diego?" is a game that leads students to learn about different cities and countries around the world. While some games are combat-based, many have educational value. In fact, here is where the distinction between games and educational programs is often blurry.

3.2.3. Educational Programs

Many software applications have been developed that are explicitly educational. There are many designed for all different age groups, from those too young to go to school to adults. Programs for young children range from shape matching and drawing to simple arithmetic, reading, and spelling programs. Examples of programs designed for preschool and early school years include Sesame Street Kindergarten, Maisy's Playhouse, and Reader Rabbit Personalized Kindergarten. Programs for primary school children include The Magic School Bus Explores the World of Animals, Orly's Draw-A-Story, and Madeline Thinking Games Deluxe. Educational programs for older children include Sim City 3000, Where in the World is Carmen Sandiego, Star Wars Pit Droid. Adult-oriented software can range from those designed for children up to applications designed to train programmers in advanced software development techniques. Many of these applications, particularly those directed at young children, are available free or at low cost. Sources for these programs will vary depending upon the country. Many are available as downloads from sites across the Internet. The more polished educational programs tend to be sold as commercial products through traditional distribution channels.

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Technology & Learning. Monthly Magazine. *www.techlearning.com* [This is the Web site for one of the major commercial publications that addresses the uses of technology in education. The Web site includes reviews of educational software.]

Telecampus *www.telecampus.edu* [This Web site lists over 10 000 classes offered at colleges and other teaching organizations internationally.]

Biographical Sketch

Dr. Warren R. Muir is a chemist and epidemiologist who served for more than a decade in senior environmental policy positions in the U.S. government. Dr. Muir was a key formulator of the *Toxic Substances Control Act* (TSCA) at the President's Council on Environmental Quality and was the first director of the USEPA office implementing the law. Dr. Muir is co-author of *Cutting Chemical Wastes* and *Environmental Dividends*, two books about pollution prevention for which he shared the 1992 U.S. EPA Administrator's Award. Since 1970, he has conducted research and lectured around the world on pollution prevention, risk assessment, chemical management, and the use of environmental data. Since 1983, he has been president of Hampshire Research, a research, policy, and software development firm. Hampshire Research has developed unique software tools to enable broad audiences to learn about complex multidisciplinary issues and to assess risks in their local environments. From 1981 to 1999, Dr. Muir was on the faculty of the Johns Hopkins School of Hygiene and Public Health, where he taught environmental health policy courses at the graduate level.