Chapter 1

Children in the Information Age

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LIVING IN THE INFORMATION AGE

There is little doubt that far-reaching changes have occurred throughout the world within our lifetimes that make the society in which children in the 1990s are growing up different from that for which their parents, grandparents, and teachers prepared. Information and communication technologies are a central part of these changes, both as agents and as servants. The ability to access, and treat as your own, information and computing power only available a few decades ago to a relatively few, has now become part of the daily life of an increasingly greater portion of mankind. Being able to deal with and exploit information technologies (IT) and increasingly, their convergence with communication technologies, is becoming a core expectation of literacy and social functionality.

As typical examples, within a few months in 1994, in popular newspapers in countries as geographically dispersed as the United States, Canada, Brazil, The Netherlands, France, the United Kingdom, Australia, Japan, China, and Hong Kong, we have seen on an almost daily basis articles referring to the Internet, to working and learning at home via a multimedia “information highway,” to new computer products such as CD-ROMs and new operating systems and new types of computer software to support group work and distributed computing. We have come to expect that we can communicate with people around the world, at our convenience, in a variety of ways. These of course include ordinary postal service, but increasingly just as likely, are the telephone, facsimile transmission (fax), electronic mail (e-mail), and now, just emerging, new forms of “telepresence” such as desktop conferencing.
In addition, we accept without need for elaboration that "the computer" has information about us and for us and presents decisions to us with which we often cannot argue. "The computer" prepares our bills and makes decisions about where we work and study and where we can have reservations for vacations or health care. We increasingly expect to go to computers or computer-facilitated mass media, rather than teachers or textbooks, for information we feel is relevant. Our computer-mediated retrieval needs range from tomorrow's weather to interpretations of world events. We have, in one or two decades, learned a new vocabulary, related to computers, that brings a universal feeling to language and reference that the world has never seen, even in the days of Latin and the Roman Empire. Although we worried as educators in the 1970s and early 1980s that we must be responsible to teach this vocabulary to our students, society has now taken most of the burden from us. Because of the computer's permeation throughout our working and entertainment worlds, some functional awareness of computer-related technology has become part of the normal experience of young and old, rich and poor, clever and disinterested, throughout the world.

A major indicator of the rapid growth of ITs is their pervasiveness in the office and factory. Computers are now commonplace desktop resources throughout the world, and e-mail is replacing fax as a standard form of business operation. A continual stream of new technological developments comes into the marketplace, many of which are becoming rapidly accepted in workplace practice. Consider the following list of ITs judged by commercial organizations in the United States as having the greatest impact on their business practices in 1994 (from Cook & Cohen, 1994, p. 47):

- computer-aided design
- paperless manufacturing
- groupware
- online services
- document management
- customer service technology
- point-of-sale terminals
- servers
- networks
- databases
- printers
- voice recognition
- storage protection
- fax machines
- scanners
- flash technology
- advanced fiber optics
- wireless technology
- videoconferencing
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All of these items relate to information and communication technologies. Almost all of these are new, both in concept and in skills required for utilization, especially in comparison to what we as parents and teachers and curriculum developers are familiar with in our own experience. We have little or no expertise with many of them; we cannot provide models of good practice to our children. Thus, there are radical changes in the tools and techniques of work that have already occurred and are currently set to increase geometrically, given the new convergence of telephone, television, and computer technologies poised to enter our homes and offices.

Inexorably, more and more of us are using computers the way we use automobiles, telephones, postage stamps, pens, libraries, bookstores, calculators, and credit cards— as normal tools allowing us to live and work in increasingly abnormal ways, compared to what our parents and grandparents did. Fortunately, the standards of expertise in the information society still include fundamentals that have always been central to becoming educated. These are good communication skills, the ability to solve problems using both generalizable heuristics and local knowledge, the habit of appropriate critical thought and positive attitude, the capacity to be aware of and build on relevant prior experience, and the ability to step beyond prior experience when creativity as well as craftsmanship are valuable.

These needs have not changed in the new information age, but are being challenged and extended in ways and at a speed that the majority of people have not had to grapple with in previous times. We still must communicate well and effectively, but now, not only with those of our own culture and language, and not only with those who know us and with whom we share the expectations of communicative conduct. We still need to be problem solvers, but the local knowledge that we are to apply is increasing beyond anyone's capacity for mastery and the tools we need for dealing with problem situations are themselves a major source of new problems in themselves.

In addition, where previously we learned by modeling and respectful observation, now, ironically, we have both too much to observe and too little. There is too much in the sense that even the youngest child can see and hear and interact with a range of persons and situations so broad that historically important matters like respect, attention, sustained practice, and transfer possibilities are stretched thin almost to the point of meaninglessness. There is too little to observe in the sense that models appropriate to learn from and be measured against, for functioning effectively in the emerging information age are still not easily found, beyond the seductive models of game players, hackers, pirates, electronic criminals, or fantasylike "cybernauts."

So in this rapidly changing world, where job requirements and study requirements and fundamental literacy expectations are changing so rapidly, what about our children? What about schools? What is happening? What should be happening? Although the essence of education—to transmit the cultural heritage to successive generations and to cultivate competencies that will enable children to adapt and reconstruct the future society (Sakamoto, 1992)—does not change, educational content and methods do. As IT becomes part of society, it becomes part of schools and is changing their content and methods.
WHY INFORMATION TECHNOLOGY IN SCHOOLS?

Thus, inevitably, because educational content and methods change corresponding to social changes (see Sakamoto, 1992, for a discussion in the Japanese context), schools and educators have not been passive observers of the changes and challenges mentioned above. In the 1960s, researchers with access to the mainframe computers of the time began experimenting with the possibilities of using computers for learning. Tutorial software was developed and successfully used in the 1960s and 1970s in university settings in many countries, and these experiments soon came to include applications for schools. Informatics as an object of study spread from universities to secondary schools. When the arrival of microcomputers in the late 1970s brought personal computing empowerment to individuals, it also brought with it the conviction that all students must become computer literate, and that schools had the responsibility to prepare their students to realize the potential of the empowerment.

Thus, during the late 1970s and 1980s, computers became part of the school, in at least some of the schools in probably every country of the world. Many countries began broadscale policy initiatives relating to school computing access. Inventories and analyses of the initiatives can be found in many sources. For example, a good international overview can be seen in the many publications of the International Federation for Information Processing Technical Committee 3 (IFIP TC 3) over the period 1975 until the present. Under the auspices of IFIP, for three decades invited specialists in computers in education from countries throughout the world have regularly developed comprehensive overviews of the field. Recent examples include McDowell and McDougall (1990), Johnson and Samways (1993), and Lewis and Mendelsohn (1994).

And IFIP TC 3 is only one of many sources of analyses of trends in IT in education. In 1994, for example, there were more than 75 international scientific journals in the English language alone relating to different aspects of educational technology, generally involving computers. There are extensive local publications, books, and other resources in countries throughout the world. International agencies such as the United Nations Education, Scientific & Cultural Organization (UNESCO) and the World Bank stimulate different collections of trends and analyses.

Many analyses have been done of prospective motives for nations committing resources and policy to IT. Hawkridge (1991), for example, has noted six major motivations:

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1IFIP coordinates the work of various specialists groups professionally involved with computer technology. TC 3 relates to informatics and education.

2For a complete listing of IFIP TC3 publications as well as information about the current activities and members of its working groups, contact the international office of the IFIP Secretariat, Hofstrasse 3, A-2361 Laxenburg, Austria.

3See, for example, the Proceedings of the First World Congress, Education and Informatics Strengthening International Co-operation, UNESCO, 1989. A second UNESCO World Congress is under preparation for July 1996.
1. The social rationale: Computers are important in society, thus students should be prepared to deal with them.
2. The vocational rationale: Students should use computers to prepare for future jobs.
3. The pedagogical rationale: Computers can improve instruction in traditional subject areas.
4. The catalytic rationale: Computers will set off wide-ranging changes in the educational system itself and change the nature of teaching and learning.
5. The IT industry rationale: Supporting computers in schools will help build up a market for a country's internal hardware and software production capability.
6. The cost-effectiveness rationale: Computers can replace teachers or some of the costs of teachers.

Each of these motivations call for some kind of measure of success, or prediction of future success. Educational researchers, economists, policy makers, educational decision makers, teachers, parents, vendors, designers, teacher educators, learning psychologists, curriculum specialists, sociologists, philosophers, and politicians all have their own reasons and yardsticks for wanting to know about the impact of computers in schools. From hundreds of different perspectives research has been done and is being done, trying to assess this impact.

**RESEARCH PERSPECTIVES ON CHILDREN AND INFORMATION TECHNOLOGY**

The fact that research activity in this area continues unabated despite many years of intense activity relates to a number of factors. Clearly the field itself is continually expanding as the technology grows and offers new opportunities and learning possibilities. Multimedia and its educational applications have generated considerable research attention. The "Information Superhighway" and its current realization, the Internet, are stimulating a recurrence of possibilities in the mid-1990s parallel to those seen for computer literacy a decade earlier. For example, the director of learning technologies for the U.S. Council of Chief State School Officers made the proclamation in 1994 that:

access to the National Information Infrastructure for education will determine the haves and have-nots of the next generation. From preschool to graduate school, learners must have access to the information highway. The challenge is universal access that is affordable for communities and individuals. Learners of all ages must be able to use the technology for everything from contact with the Library of Congress to job retraining programs in adult life. All citizens, whether they are in inner cities or remote rural areas, must use these services if our people are to remain competitive in the world marketplace. (Whitrow, 1994, p. 2)
Technological advances in other forms of networked computing are stimulating new interests in cooperative work and cooperative learning (for a review, see Collis, 1994). Various theoretical frameworks for anchoring investigations of computer-use impact bring with them new surges of research activity. Examples are frameworks derived from the work of Vygotsky (1986), which considers the social environment as an integral part of the process of cognitive change, and those based on concepts of constructivism, in which learning is seen as intrinsically motivated problem solving based on personal discovery (Cooper, 1993). One can foresee the possibility of another round of research emerging from virtual reality as viewed in Vygotskyan and constructivist frameworks.

In addition, the sheer increase in the numbers of computers in schools and the amount of time and effort that has been expended on training teachers, preparing learning materials, and exploring possibilities for the technology, is starting to generate a call for accountability, for "results" and evidence of cost-effectiveness, alongside the calls for more exploration, more provision, more time, and more support. In the Netherlands, for example, after 10 years of extensive Ministry support for national initiatives relating to the development of educational software, teacher training, and hardware and software provision to schools, the Ministry policy in the mid-1990s has now become one of standing back and letting schools decide for themselves how they wish to continue with IT. The assumption is that applications of perceived worth will be chosen by the schools, that there has been enough time for preliminary exploration with computers, and that schools and teachers can now make their own decisions about how best to choose and proceed (Van Deursen & Moonen, 1991). Thus, reasons for continued research on the impact of computer use in schools remain prominent and even increase, especially as the practitioner is increasingly becoming more responsible for personal decision making about computer applications for learning support.

But parallel to the accumulation of research activity with respect to the impact of computers in education has been an accumulation of comment about the limitations and inadequacies of much of the ongoing research. Clark (1985) for example, stimulated much debate with his arguments about confounding in educational computing research, a debate that is far from settled. Many have argued the interrelationship of any sort of impact of computer use on an individual learner with cultural artifacts and social processes outside the individual (see, e.g., Newman, 1990). The need for broad, naturalist perspectives, for comparative analysis transcending the boundaries of the circumstances and interpretation of the individual researcher, is one response to these limitations and interrelationships.

However, wide-scale, multicultural, multivariable research studies are complex activities requiring infrastructure, opportunity, and a mix of initiatives, circumstances, and financial support beyond the possibilities of the majority of those interested in the impact of IT in education, and in particular on children. Thus, relatively few research studies (as compared to inventories or compilations of

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4See, for example, the special issue of the journal Educational Technology Research and Development (Rens, 1994).
trends) have been carried out that systematically involve large numbers of countries, cultures, subjects, comparative situations, and common measurement procedures. If the impact of IT on children is to be understood in a generalizable way, then such wide-scale studies are invaluable, not only to document the impacts that seem to transcend local variabilities, but also to document what impacts are inextricably culture and context sensitive. And not only should such studies involve the characteristics of multiculturalism and standardized observation; they should also bring a variety of perspectives into focus. At the very least, the school as an organization, the classroom, the teacher, the content and methods of instruction, and the skills, insights and attitudes of the children themselves all must receive attention.

One particular issue is the nature of the impact on the child himself. Given the many possibilities for IT in society and education, it is natural that its impact on something more than production variables, such as time to learn particular skills, should also be an object of research. Variables relating to growth in higher level cognitive functioning, such as increased habits of self-reflection and self-evaluation, increased consideration of alternatives in a problem situations, more effective planning, and more positive attitudes about learning and one's self as a problem solver, are also important to study in a cross-cultural perspective.

WHY THIS BOOK?

Fortunately, these characteristics and perspectives have been brought together in three large-scale, long-term international research projects, all relating to the impact of computer use in education on children. These three projects are the focus of this book, and are introduced in chapter 2 before they are discussed in detail in chapters 3, 4, and 5, and synthesized and reflected on as a set in chapter 6. Each of these research projects—CompEd, ITEC, and YCCI—has its own particular history and context but there is interlinkage among them, to a certain extent because some of the key researchers involved were associated with more than one of the projects, but more fundamentally because each supplies a particular focus or insight that complements the others.

CompEd takes the broadest view, looking at schools as organizations through the impressions of their principals, their computer coordinators, and their teachers, and through overviews of student activities and functional competencies with IT. ITEC focuses on the classroom and studies in more depth the interactions of teachers, students, and computers in classroom settings. YCCI continues the focusing in process, moving into the impressions and thoughts of children themselves relative to IT and its impact on them. Although each of these research projects has itself generated a wide range of literature, the opportunity has not yet occurred for the three projects to be brought into synergy with each other—until this book.

Thus, even as IT is having immeasurable impact on society as a whole, it is also having an impact on education, on its content and methods. But how is it affecting
children themselves? Through the three international studies analyzed in this book we will be in a stronger position to give a response to this question.

REFERENCES


