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ABSTRACT

The purpose of this paper is to describe four aspects of computer technology in education in the United States: (1) the number of computers available to students and teachers, the number of schools using software for word processing, drill and practice, educational games, and tutorials, and the number of journals and professional associations devoted to computers in education; (2) where computers are located and how they are used, and the social and vocational rationales behind computer use; (3) the impact of computers in education; and (4) hypotheses about computer non-use, limited use, and inappropriate use, as well as conditions that hinder the implementation of instructional innovations such as computers. It is concluded that most students in most elementary and secondary schools have access to computers, albeit limited access, and there exists a genuine desire to integrate computers into the classroom; however, computers are most frequently used for word processing and least used for integrated subject-matter instruction, and the course most frequently taught using computers is computer literacy. It is noted that conditions for implementation are not always present in schools, and that there is no national plan or strategy for diffusing or gaining acceptance for this innovation for instructional purposes. (9 references) (DB)

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Computers in Schools and Universities in the United States of America

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When it comes to Education, no one person or body speaks for the U.S.A.

When it comes to computers in Education in the United States, diversity defies description with more than 109,000 public and private primary and secondary schools and over 3,500 tertiary institutions. The common thread is that virtually every student, teacher and administrator has computer access but beyond that one similarity, all other aspects are different.

It is my purpose to describe four aspects of computer technology in Education in the United States: (1) the quantitative story: how many computers are available to students and teachers; (2) the qualitative story: where these computers are located and how they are used; (3) the impact of computer use; and (4) hypotheses about non-use, limited use, and inappropriate use.

The Quantitative Story

Ninety-six percent (96%) of the elementary and secondary schools in the United States have microcomputers (Quality Education Data, 1990). The numbers that are more interesting are the microcomputer densities, that is, the ratio of students to computers. Eight percent (8%) of the schools have 1 to 9 students per computer; 23% have 10-19 students per computer; 20% have 20-29

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students per computer; 24% have 30-59 students per computer and 26% have 60 or more students per computer. (Within the last figure, 17% have 90 or more students per computer.) Apple computers are found in 91% of the schools, IBM (or compatibles) in 36% of the schools; Radio Shack in 33%; and Commodore in 26%. Macintosh computers are found in only 8% of the schools.

Who controls the computers? Most frequently, there is a computer supervisor (13,569); next, special education personnel (9,386); then curriculum and instruction staff (probably school media specialists are the dominant group) (6,594) and finally reading teachers (4,690) and business education staff (3,368).

Comparable data are not available for higher education although it is not overly optimistic to estimate that almost every institution of higher education in the United States has computers that are available to students, faculty, and administrators. But there is a mystery about the nature and amount of software available that is oriented to higher education alone. A recent article (Turner, 1990) indicates that "Higher education barely makes a dent in the $3.4 billion software-publishing industry." Business accounts for about 80% of that amount; 10% is estimated for "recreational" software (games, etc.) and 10% for education, most of it elementary and secondary. The article further reports that "...professors around the country are writing their own software" and "...most of them are happy to share their work with their colleagues." As for access and distribution of the software, ten agencies have been established for the purpose of software dissemination in higher education circles. Some of the organizations have received support from commercial computer manufacturers and others have support of federal agencies, foundations, and the universities themselves.

Software Use in Elementary and Secondary Schools

In a recent study of computer using teachers (n=608) who have integrated computers into classroom practice, Sheingold and Hadley (1990) discovered that software was used in the following manner:

Text processing tools	95%
Instructional software	89%
Analytic and Information Tools	87%
Programming and Operating Systems	84%
Games and simulations	81%
Graphics and Operating Tools	81%
Communications	49%
Multimedia	25%

Within the area of instructional software, the following uses prevailed:

Problem solving program	75%
Tutorial programs	73%
Drill and practice programs	72%
Software accompanying a textbook	37%
Conceptual tools	30%

These figures are confirmed by Plomp and Pelgrum (1990) who studied school computer use in eight countries for the International Evaluation Association. They discovered by that the software programs most commonly available in U.S. schools were: (1) word processing (93%); (2) drill and practice (92%); (3) educational games (91%); and (4) tutorial programs (81%) (Appendix, p. 6).

The dominant use, by far, in the Sheingold and Hadley study was word processing which was used by nine out of ten teachers who participated. "They are used at all grade levels. Not only do teachers use these tools, but, when asked to give examples of

their 'most productive and interesting use of the computer in the curriculum they teach,' those who responded (75% of the sample) gave more examples of writing and language projects than of any other uses (p. 9)".

Other Quantitative Indicators

There are 13 journals completely devoted to computers in education that are widely read in the United States. Other professional journals contain additional articles devoted to computer-based instruction. There also are journals devoted to computers and specialized fields, e.g., humanities, science, engineering, information science, and so forth.

In 1989, ERIC, the national Education information system, entered 507 items into the database from which 323 were selected for the publication, Computer-Based Education: The Best of ERIC 1989 (McLaughlin, 1989). These are documents only, not journal articles.

Besides ADCIS, there is a growth in the number of professional associations devoted largely to computers in Education: the National Education Computing Conference (NECC); the Society for Advanced Learning Technology (SALT); and the Association for Educational Communications and Technology (AECT). Other professional meetings in subject matter fields include many sessions devoted to computers in special subjects and fields.

There is no doubt about the ubiquitous nature of computers in schools and institutions of higher education in the United States. Why is it so?

Rationale for Computer Use in Schools

In a recent book by Hawkridge, Jaworski and McMahon (1990), four basic rationales for computers in schools are proposed:

The Social Rationale Policy makers want to be sure that all children should be "...aware and unafraid of how computers work." The argument goes that "...computers are pervading industrial societies and are likely to be important in all countries (p. 16)." Therefore, learners should be prepared to understand computers and be aware of their role in society.

The Vocational Rationale Learning to operate computers is an important competency. "Teaching children programming gives them some confidence in their ability to control computers, and may be a foundation for a career in computer science (p. 17)." There will be employment opportunities for individuals who have the proper computer skills.

The Pedagogic Rationale Students can learn from computers. "Computers can teach." There are advantages to using computers to learn over other traditional methods.

The Catalytic Rationale "...Schools can be changed for the better by the introduction of computers." Computers become a facilitating factor to bring about change. They are symbols of progress. They encourage learning. "Computers are seen as catalysts, enabling desired change in education to occur (p. 17)."

In the United States, the social and vocational rationales seem to dominate. The relatively rapid and extensive adoption of computers in almost every school in the country reinforces the notion that computers are symbols of "modern" schools and that awareness of computers, usually through familiarization (or

computer "literacy") classes, will confirm the fact that the schools are up-to-date. In some schools, learners acquire competencies of computer operation with the idea that there are increasing numbers of jobs in the information industry. These individuals who are trained to operate computers may do some some programming in BASIC but they generally do not acquire the conceptual competencies required for creative problem-solving.

The pedagogic rationale does not appear to be as strong as the social and vocational rationales. The study of Plomp and Pelgrum (1990) shows from the sample population that 53% of the mathematics teachers, 43% of the science teachers, and 44% of the English teachers in U.S. secondary schools use computers in teaching (Appendix, p. 8). The extent of use is not indicated. Sheingold and Hadley (1990) conclude that "...overall in United States schools computers are not an integral part of subject matter instruction (p. 2)."

The catalytic rationale is more difficult to understand. Essentially it says that computers are vehicles for change. There is some evidence that teachers change in their motivation and commitment to their students' learning (Sheingold and Hadley, p. 23). D'Amico (1990) reported that teachers involved in a year-long study of computer use in small community elementary schools made "...their instructional planning tasks easier and more effective and many were anxious to push their own and their students' use beyond drill and practice (p. 106)." Most teachers who become involved in computer-based instruction are never the same again. But, in the United States, that number is relatively small when compared with the entire population of elementary and secondary teachers and university professors.

Impact of Computers in Education

On a national scale, one would have to conclude that computer-based instruction in U S. schools and universities has had minimal impact. By any measure of learning achievement, of significant changes in styles of teaching and learning, or of curriculum reform, the conclusion is "little or no effect." However, where deliberate efforts have been made by individual teachers or by entire institutions (schools or universities) one would have to say that, in those circumstances, the teachers and learners will never be the same again. They have gained new skills, new perceptions of how to learn, increased motivation, and renewed enthusiasm for teaching and learning. The sheer numbers of computers in schools and universities can be misleading as can the results of research on student learning which show, in most cases, no significant difference between learning through computer-based instruction and traditional teaching. Just because virtually every school and university has computers, and the fact that many of them are used in some educational context, does not mean that they are being used optimally or for the appropriate learning objectives. Justification for computer use is often sought in research findings that "prove" their value in acquisition of knowledge as tested by traditional means. Perhaps there are other measures of success that have not been tested or are beyond testing such as attitudes toward learning, willingness to pursue problems until they are solved, and changing the role of the teacher from a presenter of information to a facilitator of learning. Perhaps the "right" questions have not been raised.

If insights into impact are to be found, the literature reporting the behaviors and outcomes of computer-using teachers are more useful than some of the quantitative reports. For example, Sheingold and Hadley (1990) discovered:

1. Teachers "devote considerable time and effort to teaching with computers in their classrooms, and are supported in their efforts."

2. "The key incentive for them in teaching with computers is their students' using these tools effectively for their own learning."

3. "These teachers work in schools that have extensive technology as well as experience in using technology for instruction."

4. "These teachers use the computer as a multipurpose tool."

5. "Using the computer has changed their teaching."

6. "It takes time for these teachers to master computer-based practices and approaches--fuly five to six years of teaching with computers."

7. "Although barriers to the integration of computers have lessened for most of these teachers over the years, significant barriers still remain (pp. vii, viii)."

D'Amico (1990) echos some of the same findings after considering his first year of running a computer-based instructional program in two elementary schools located in small communities. He phrases his findings in terms of "what I learned and what I would do differently next time."

> ...Next time I will remember that instructional impact is something that unfolds over time...,To expect large achievement gains, right away,...seemed to be asking a lot. A better gauge of the value of a CMI system is student achievement gains over time, consistent improvement year-after-year.
>
> As for teacher use of CMI, in the future I will look at that over time also, evaluating whether they move from a

mechanical instructional application to one more sophisticated and experimental. And I will analyze the degree to which they integrate CMI content with the content of their own lessons and curriculum.

I will measure comparative gains over several years; that is, look at each student's progress relative to previous performance. I will focus especially on the performance of high-need students and look at standardized tests in addition to curriculum-embedded ones. I will examine teacher training with a different emphasis, too, evaluating to what degree it helps teachers to move beyond awareness and comfort and challenges them to experiment. Then, over a period of years I will look at their progress in using CMI as an integrated part of their total approach to instruction. (p. 106)

Hypotheses About Non-Use, Limited Use and Inappropriate Use

Barriers seems to fall in several categories: (1) software quality; (2) time for teacher learning and planning; (3) hardware availability; and (4) adequate administrative support.

Sheingold and Hadley (1990) gave 608 computer using teachers a list of 35 barriers to the use of computers in teaching. The five highest barriers were:

"1. Teachers lack enough time to develop lessons that use computers. (Mean 4.22)
2. Problems scheduling enough computer time for different teachers' classes.(Mean 3.69)
3. Too few computers for number of children.(Mean 3.56)
4. Not enough place in the school schedule for more computer-based instruction.(Mean 3.53)
5. Inadequate financial support for computers from the school and/or district. (Mean 3.51) (p. 21)."

Note: 6 point scale: 1=not a major barrier
6=a major barrier

The time factor was a major finding in D'Amico's study (1990). Throughout his list of "lessons learned," he constantly refers to lack of teachers' time to prepare and to integrate

computer-based instruction and time to study students' learning over a longer span.

Scheduling problems usually refer to the facility where the computers are located, usually a "laboratory" in a separate room. In U.S. schools, that room is often the school library or a room reserved only for computer use. In either case, the facility must be reserved for students' use during the school day and often at the end of the day. Gavriel Salomon, in a recent article (1990), "The Computer Lab: A Bad Idea Now Sanctified," spells out the deficits of the separate room strategy. He discusses four erroneous assumptions about the computer laboratory that serve as barriers to optimum use:

1. "...the computer is an entity in and of itself, and thus deserves a special 'laboratory,' a special curriculum, and a special teacher to teach it."
2. "...computer use is to be learned as a topic onto itself."
3. "...the computer can just be added to otherwise unchanging instructional practices: The computer as an add-on." and
4. "...effective computer use depends solely on the quality of the software and courseware used." (p. 51)

This facility, and the assumptions that go with its use, certainly form major barriers to the optimum use of computers in schools and universities.

Plomp and Pelgrum (1990) asked computer coordinators to indicate software problems only. The two top reasons in the U.S. were "not enough software for instruction" (48%) and "software not adaptable enough" (22%). Of less importance in the U.S. but of more importance in the 7 other countries studied were "lack of information about software" and "poor quality of manuals (Appendix, p. 9)."

But these barriers apply mostly to those who are already using computers in Education. What about the vast majority that

do not use computers in the classroom? There appears to be another set of conditions that facilitate the implementation of innovations in general and computers specifically. The opposite of the facilitating conditions are hinderances that prevent implementation. They should be considered by those who attempt to introduce computers into educational settings. Ely (In press) describes these conditions as follows:

1. Dissatisfaction with the status quo. One of the first steps to initiate change in an education environment is a dissatisfaction with things as they are. It usually often begins in classrooms with problems that cannot be solved.
2. Knowledge and skills. The people who will ultimately implement any innovation must possess sufficient knowledge and skills to do the job.
3. Resources are available. Without the hardware and software, it is almost impossible to implement changes that require such support materials.
4. Time is available. Time is a distinct condition that must be made available for implementation to occur--"good" time, "company" time, paid time!
5. Commitment by those who are involved. Commitment communicates support and any individual who is about to try to use a new material or procedure wants to know that there is support from a higher level.
6. Leadership is evident. Even though individuals act alone, especially in classroom endeavors, they need the inspiration and continuing support of persons they respect.
7. Rewards or incentives exist for participants. For some it may mean satisfaction for a job well done; for others, it may mean more help, more (or better) resources and, in some cases, increased salaries and professional opportunities.
8. Participation is expected and encouraged. This means shared decision-making; communication among all parties involved;

representation where individual participation is difficult. Each person should feel that he or she has had an opportunity to comment on innovations that will directly affect his or her work.

These conditions provide guidelines for implementing computer-based instruction where it has been unused or under-used. The factors are applicable in almost any culture (Ely, in press). Once the implementation has begun, other barriers emerge and must be considered seriously.

Concluding Statement

The use of the computer in educational settings is solidly established in the United States of America. The extent and nature of that use is not fully known but, where it is known, studies of computer-using teachers indicate that the most frequent use is word processing and the least for integrated subject-matter instruction. Most students in most U.S. elementary and secondary schools have some access to computers, but usually on a very limited basis. The most frequently taught course using computers is the course about computers (computer "literacy"). Computers are probably adopted by many schools as symbols of modernization and change ("social" and "catalytic" rationales). There is a genuine desire to adopt computer use in many schools, but the conditions for implementation are not always present. There is no national plan or strategy for diffusing this innovation or for gaining its acceptance for instructional purposes in the schools and universities of the United States of America. Meanwhile, computer enthusiasts (such as those attending the ADCIS conference) are the primary carriers of information and serve as resource people to those who have much to learn before the "Nirvana" of computer use arrives.

REFERENCES

D'Amico, J.J. (1990). Three lessons I learned from a year of computer- based instruction, Journal of Computer-Based Instruction 17, 3, Summer, pp.103-109.

Ely, D.P. (In press). Conditions that facilitate the implementation of educational technology innovations, Journal for Research on Computers in Education.

Hawkridge, D., Jaworski, J. and McMahon, H.(1990) Computers in Third World Schools, London: The Macmillan Press Ltd.

McLaughlin, Pamela (1989). Computer-Based Education: The Best of ERIC 1989. Syracuse, NY: ERIC Clearinghouse on Information Resources.

Plomp, T. and Pelgrum, W.J. (1990). Introduction of computers in education: state of the art in eight countries, paper presented at EURIT 90, Herning, Denmark, April, 1990.

Salomon, G. (1990). The computer lab: a bad idea now sanctified, Educational Technology, October, pp. 50-52.

Sheingold, K. and Hadley, M. (1990). Accomplished Teachers: Integrating Computers into Classroom Practice, New York: Center for Technology in Education, Bank Street College of Education.

Turner, J.A. (1990) College, scholarly societies, and foundations create software-dissemination projects to share expertise, The Chronicle of Higher Education, October 17, 1990, pp. A17-A20.

Quality Education Data (1990) Catalog of Educational Mailing Lists and Marketing Services. Denver, CO: QED, pp. 24-25.