DOCUMENT RESUME

ED 350 760 EC 301 567

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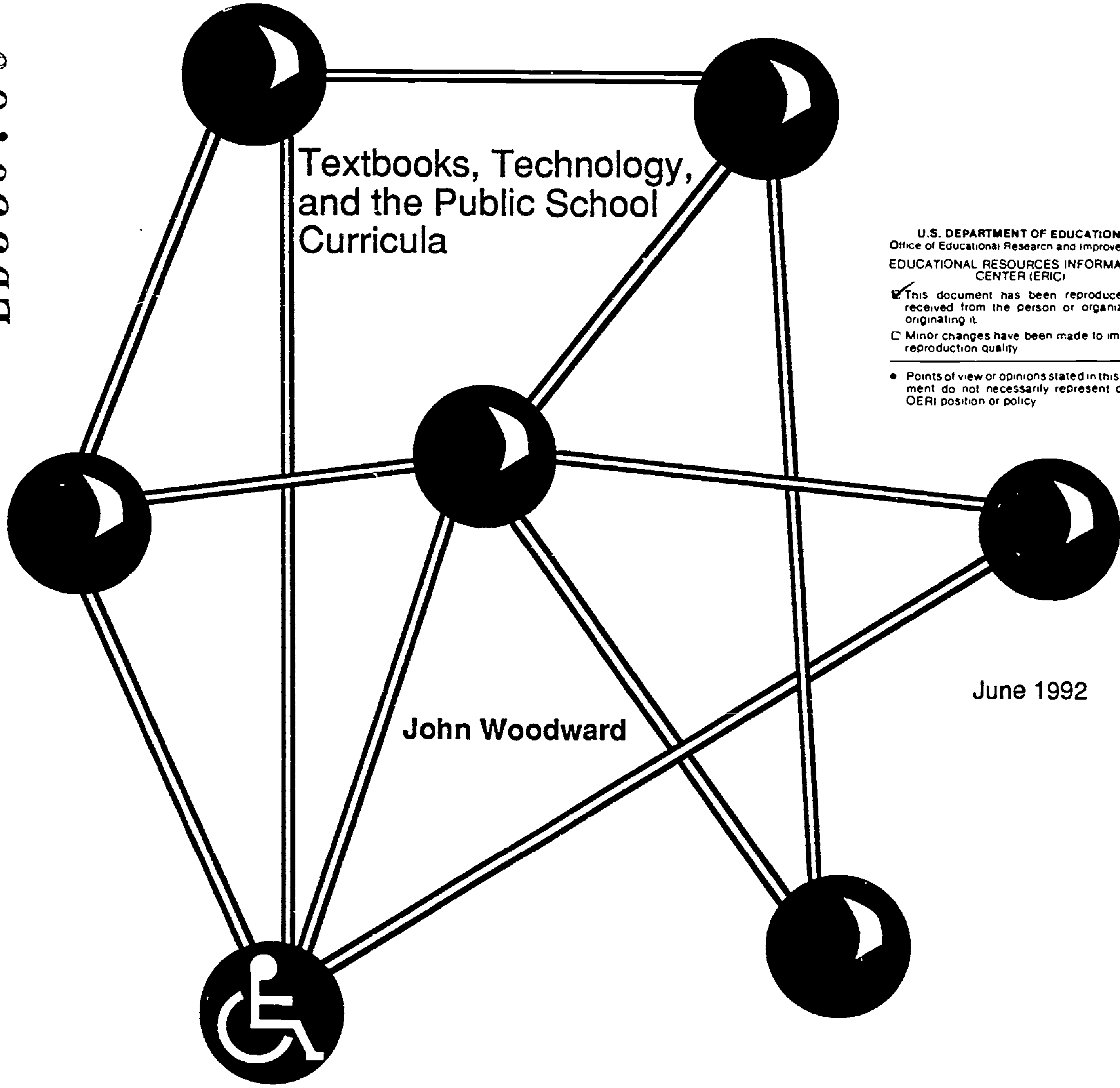
TITLE	Textbooks, Technology, and the Public School Curricula. Identifying Emerging Issues and Trends in Technology for Special Education.
INSTITUTION	COSMOS Corp., Washington, DC.
SPONS AGENCY	Special Education Programs (ED/OSERS), Washington, DC.
PUB DATE	Jun 92
CONTRACT	HS90008001
NOTE	24p.; For related documents, see EC 301 540, EC 301 568-574.
PUB TYPE	Viewpoints (Opinion/Position Papers, Essays, etc.) (120) -- Information Analyses (070)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Computer Assisted Instruction; Computer Uses in Education; *Disabilities; Educational Media; Educational Quality; Educational Technology; Educational Trends; Elementary Secondary Education; *Instructional Design; Instructional Materials; *Public Schools; *Technological Advancement; *Textbook Content; Textbooks; Trend Analysis

ABSTRACT

As part of a 3-year study to identify emerging issues and trends in technology for special education, this paper addresses the role of textbooks in today's education as well as the criticisms leveled at textbooks over the last 10 years. The paper also considers the rise of technology in schools and the presistent issue of improving the instructional design of educational systems. The pervasiveness of textbooks in contemporary education is documented, particularly as textbooks dominate the instruction of students with mild disabilities. The literature criticizing textbooks for such characteristics as shallow coverage, use of unfamiliar vocabulary, inaccuracies, and lack of appeal is reviewed and these criticisms found to be particularly pertinent for students with disabilities. Data indicating increasing use of computers in both regular and special education are reported, noting that special education students use the computer primarily for drill and practice activities. Little evidence that teachers are able to successfully integrate computer-assisted instruction with their traditional curriculum is reported. Uncertainty is noted about the extent to which new technological approaches are instructionally sound and suited to low-achieving students. (Contains 74 references.) (DB)

Textbooks, Technology, and the Public School Curricula



June 1992

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Prepared by COSMOS Corporation for:
U.S. Department of Education
Office of Special Education Programs
under Contract No. HS90008001

PREFACE

COSMOS Corporation is conducting a study of the issues and trends affecting the role technology will have in the 21st century for individuals with disabilities. This three-year study is funded by the U.S. Department of Education, Office of Special Education Programs (OSEP), under Contract No. HS90008001.

COSMOS Corporation was founded in 1980, and is located in Washington, D.C. Since its inception, the firm has conducted a wide range of applied social science projects for public and private organizations and foundations. COSMOS's specialties include: conduct of case studies; identification and validation of exemplary practices; evaluation of education, job training, and human services programs; provision of technical assistance to state and community agencies; and strategic planning for public agencies and public firms.

Project participants include expert panels, project fellows, an advisory board, a consortia of practitioners, and project staff. These experts in the fields of technology and special education have come together to examine the issues and trends in these two fields, and how they impact the use of technology for special education in the 21st century. Three expert panels have started examining these issues: one with a focus on technology outside the field of education, one on special education instruction, and one on evolving service delivery systems in special education. Over the three year period their research will be synthesized and become the basis for predictions about the future.

This document is one of the papers commissioned in the first year. The purpose of the paper is to present information on one or more issues as part of the expert panel discussions. It is being shared with people inside and outside of the project to stimulate discussion on the impact of technology in the early 21st century. Readers are welcome to comment on these findings and contact COSMOS Corporation for further information.

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TEXTBOOKS, TECHNOLOGY, AND THE PUBLIC SCHOOL CURRICULA

The effort to modernize education and enhance learning through technology over the last decade has confronted a very potent institution: the textbook. Textbooks have been a common feature of American education throughout this century. Large commercial conglomerates which now produce them have solidified their place in the classroom. Before technologists call for more computer based practices, it is important that they understand the nature of textbooks and their general quality.

This paper addresses the role of textbooks in today's education and the wave of criticism that has been leveled at them over the last ten years. While many argue that commercial texts are generally poor in quality, the leap to technology based instruction is fraught with its own difficulties. The second part of this paper discusses the rise in technology in schools and, in a limited way, its future. Almost regardless of newer, more sophisticated computers and computer programs, the instructional design of educational systems will remain a persistent issue over the next two decades.

Textbook Materials in Contemporary Education

The Pervasiveness of the Textbook for Instruction. America's use of the textbook is ancient by today's technology standards. Benjamin Harris's The New England Primer, published sometime between 1687 and 1690, established the "textbook" as the single most influential pedagogical, instructional, curricular force in American schools 300 years later (Farr and Tulley, 1985; Goodlad, 1970; Osborn, Jones, and Stein, 1985). Unlike the content of the textbooks used in today's classrooms, Harris's "textbook" extolled the virtues of "New England puritanism, savage theology, contempt of joy and tenderness, sturdy self-reliance, and noble emphasis on right living" (Jensen, 1931, p. 2).

Although the size and content of textbooks have changed radically since Harris wrote and published the first textbook more than 300 years ago, the role of textbooks in American classrooms has changed very little, if at all. For all practical purposes, it stands as an undisputed fact that American schools are textbook dominated (Chall, 1967; Duffy and McIntyre, 1980; Durkin, 1987; Farr and Tulley, 1985; Farr, Tulley, and Rayford, 1984; Goodlad, 1970; Rosecky, 1978; Singer, 1977). As Tyson-Bernstein (1988) stated, "textbooks have become the de facto curriculum of the public schools" (p. 11).

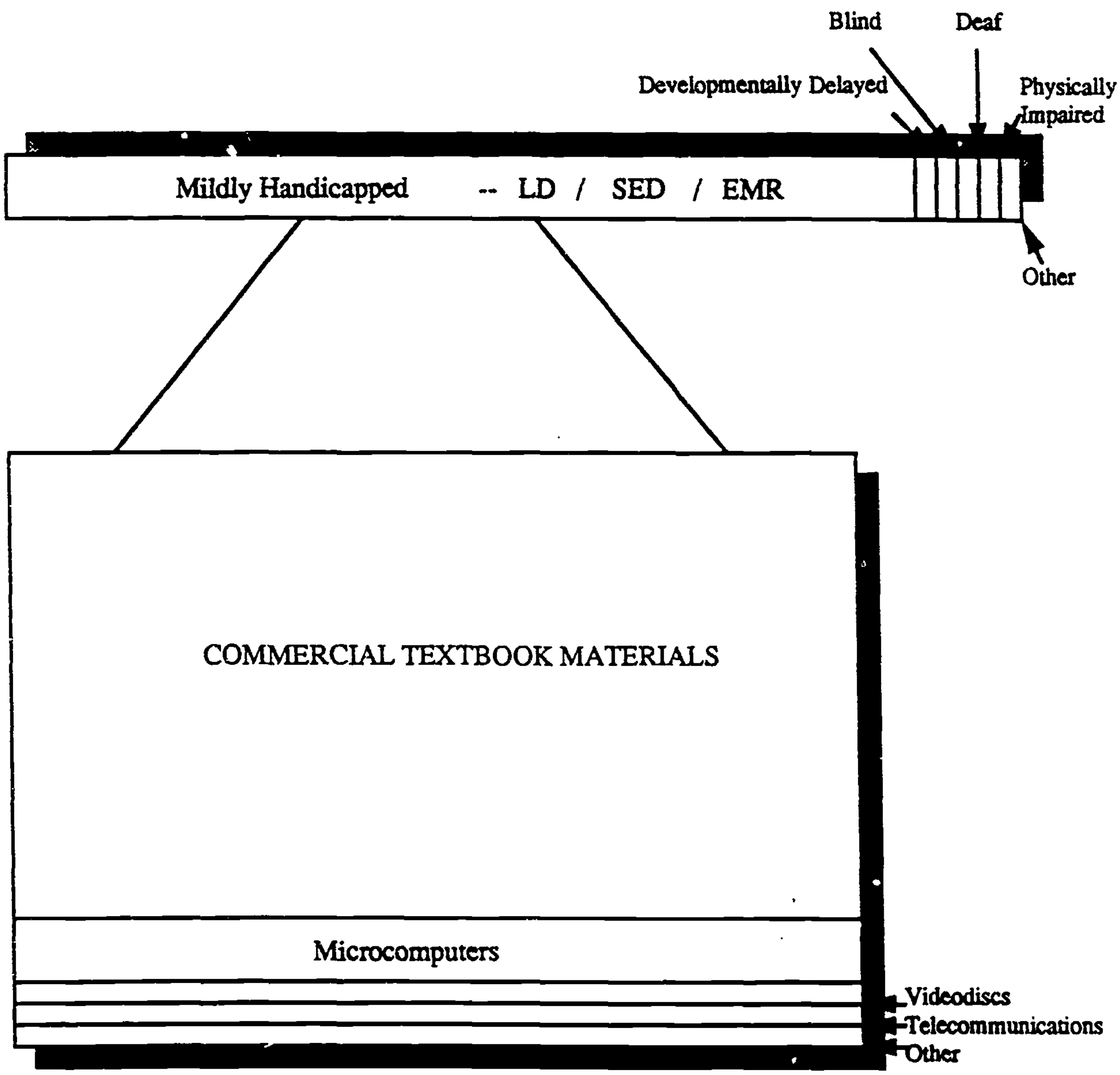
Naturally, the extent and nature of this textbook domination varies considerably depending upon a range of factors (e.g., type of textbook, level of instruction, textbook expenditures). For example, Goldstein (1978) estimated that elementary and secondary students spend 75 percent of classroom time and 90 percent of their homework time directly involved with textbook material (Cited in Farr et al., 1984). Studies by the Educational Products Information Exchange Institute (EPIE) revealed that 98 percent of all curriculum content in the intermediate grades was found in the curricular textbook materials. It is also accepted that 90-95 percent of students' instructional time involves interacting with textbooks (Farr and Tulley, 1985).

Thus, the selection of a textbook is tantamount to selecting the curriculum (Dixon, 1979; Farr, Tulley and Powell, 1987). Although teachers are permitted to depart from the content and sequence of basal curriculum programs, they seldom do (Stake and Easley, 1978; Stephens, 1982). The mathematics textbook, for example, is perceived by teachers as the authority on knowledge and the guide to learning (Romberg and Carpenter, 1986; Grouws and Good, 1989). General surveys reveal that teachers rely on textbooks for both curricular and instructional decisions (Research Update cited in Chambliss and Calfee, 1989). In general, the textbook appears to be subject-matter authority and pedagogical guide (Hurd, Robinson, McConnell, and Ross cited in Chambliss and Calfee, 1989).

Despite the push for technology over the last decade, instructional realities (i.e., technology vs. textbook materials) for students with disabilities in special education and general education

Figure 1

COMMERCIAL TEXTBOOK MATERIALS



environments are closer to what is depicted in Figure 1. As Figure 1 graphically portrays, the most predominant instructional material used in classrooms is traditional print curricula and these materials are used most with students with mild disabilities.

Issues of Textbook Quality. The predominance of textbooks as a curricular, instructional, and communicative tool for transmitting knowledge in the public schools has prompted researchers to call for scrutinizing the quality of textbooks. For example, Osborn, Jones, and Stein (1985) argue that, "because published textbook programs are so pervasive in American schools and because they often, in effect, constitute a curriculum, it seems important for educators to raise some questions about these programs" (p. 9). Osborn and her colleagues go on to assert that improving textbook programs used in American schools is an essential step toward improving American schooling" (p. 10).

Although the empirical basis for a causal relation linking the improvement of textbook programs to improved schooling has yet to be established, calling into question the quality, influence, and role--if not the integrity (Shannon, 1987; Tyson-Bernstein, 1988)--of textbooks appears to be a well-established American tradition as we head into the 21st century (Artley, 1980; Chall, 1987; Duffy, 1982; Durkin, 1978-79; Goodlad, 1970; Muther, 1984-85; Shannon, 1983; See also special issue of the Elementary School Journal, Hoffman and Roser, 1987). However, this tradition has yet to consider the potential impact of mainstream textbooks on students with disabilities who have diverse learning and curricula needs.

Nonetheless, the quality of textbooks certainly is questionable. In elementary level mathematics, a primary reason for a heavy emphasis on skills and decontextualized problem solving is the nature of the texts.

> The emphasis on skill development found among teachers is mirrored by the textbooks they use. In content analyses of fourth-grade textbooks, 65 percent to 80 percent of the exercises were on skill practice, while ten percent to 24 percent were on conceptual understanding, and six percent to 13 percent on problem solving... Story problems are

> presented in a repetitive format that tends to diminish their problem-solving character. Students are rarely, if ever, asked to formulate a problem for themselves, yet problem formulation may be the most important and most difficult aspect of the kind of higher order thinking that students need (Porter, 1989, p. 12).

Textbooks also reinforce a pattern of teaching a large number of topics for exposure only. Porter found that in content analyses of commonly used fourth-grade textbooks, 20 or fewer exercises were to present 70 percent to 80 percent of the topics covered in a book. In mandating math textbooks, then, a district is likely to reinforce the practice of teaching for exposure.

Problems are equally evident in science. For example, Armbruster and her colleagues note that science texts are inaccurate (Armbruster, 1984), packed with facts (Tyson-Bernstein, 1985), poorly organized, and uninteresting (Anderson, Armbruster, and Kantor, 1988). Recent critiques of secondary level science texts indicate that as the amount of scientific knowledge has grown over the years, texts have become "encyclopedic" in the attempt to accommodate the latest information (Tyson and Woodward, 1989; Wivagg, 1987). One result is the use of a topical style of discourse for connecting ideas. This organizational form, commonly found in factual writing (Niles, 1974), links units of knowledge through broad themes. Topics are presented sequentially, and explanations vary considerably in depth. Moreover, there are few explicit links between topics to make the relationship of one to another more comprehensible.

Related to the topical style of science texts is the amount of unfamiliar vocabulary, much of which is used in an ancillary manner. The new vocabulary introduced in texts climbs from roughly 300 words (approximately one word per page) in the sixth grade (Armbruster and Valencia, 1989), to over 3,000 terms and symbols in the tenth grade (Hurd, 1986). Quite often the vocabulary in a one week science unit is greater than that of a similar unit in a foreign language course (Eylon and Linn, 1988). Other evaluations of science texts indicate even higher rates for new vocabulary (e.g., Pauling, 1983; Yager, 1983).

Problems found in science texts also extend to social studies materials (Beck, McKeown, and Gromoll, 1989; Gagnon, 1987; Sewall, 1988).

A clear example of the poor quality of materials was evident in a recent study (Woodward, 1990). A version of a widely used earth science textbook formed the basis of explanations and discussions. In using the student text, the researchers constantly confronted explanations such as the one below. Newton's three laws of motion, a complex and extremely important set of principles, were described in this passage--and only this passage.

> Galileo found that an outside force was necessary to stop the motion of a body once it was moving. Later Isaac Newton summed up his understanding of motion in three laws. The first law states that a body continues at rest, or in motion, until acted upon by an outside force. The second states that the amount of motion in a moving body is equal to the mass multiplied by the acceleration of a body. The third law states that for every action there is an equal and opposite reaction. Newton's three laws are the bases for our understanding of the movement of all observable bodies. These laws do not fit the behavior of particles of subatomic size nor movement at the speed of light (Charles Merrill, 1981, p. 463).

The very next paragraph summarized Einstein's theory of relativity. In texts where there are many complex ideas or where scores of concepts are explained in a cursory manner, as in the passage above, naive or mildly handicapped students have a difficult time comprehending the material (Kintsch and Keenan, 1973; Kintsch, Kozminsky, Streby, McKoon, and Keenan, 1975; Voss, 1978). This fleeting coverage of terms and concepts comes at the expense of instruction that fosters a deeper conceptual understanding of scientific methods and theories (Linn, 1987; Tyson and Woodward, 1989). These observations reinforce the points made earlier by Porter (1989) regarding mathematics texts.

Finally, attempts to alter textbook materials in ways that would improve learning are promising, but time consuming. Lovitt and his colleagues (Lovitt and Horton, 1991) have conducted a significant line of inquiry on the effectiveness of adapting materials (i.e., verbally, visually or through computer-assisted instruction) for students with learning disabilities. Even though they have been relatively successful at increasing the academic performances of both average and above-average students, and students with mild disabilities, Lovitt and Horton (199) note that the biggest problem is that many secondary level teachers are not inclined to adapt the materials.

The cursory and sometimes careless manner in which textbooks are written is of enormous concern for educators as they look forward into the next two decades. Textbooks have maintained a considerable presence in the last 50 years of American education despite the waves of "new" technologies such as radio, film, and television (Cuban, 1986). This pattern would indicate that texts will continue to shape instruction in schools, at least for the near future.

A second troubling aspect of commercial textbooks is their failure to attend to the substantive research on curriculum design, story grammar, text structure, and so forth over the last 20 years. This naturally has direct implications for educational software, not only what has been produced to date, but is likely to be developed. The increased access to technology as well as the quality of software will be explored in the next section.

Technology Use in Schools

Over ten years ago educational technologists predicted dramatic gains in the uses of computers in schools.

> We are at the onset of a major revolution in education, a revolution unparalleled since the invention of the printing press. The computer will be the instrument of this revolution. While we are at the very beginning--the computer as a learning device in current classes is, compared with all other learning modes, almost nonexistent--the pace will pick up rapidly over the next 15 years. By the year 2000, the major way of learning at all levels, and in almost all subject areas will be through the interactive use of computers. (Bork, 1980, p. 53).

Although the current pace of computer use has not "picked up" as rapidly as Bork predicted, the use of the computer as a learning device has certainly increased in the past ten years. For example, in 1983, schools had relatively few computers when compared to total school enrollment (Becker, 1983). However, in the "Computers in Education" survey conducted two years ago by the International Association for the Evaluation of Educational Achievement (IEA), Becker (1990) reported that the "typical" school now has about 45 computers, which represents a significant increase from the 21 computers per school documented in the 1985 survey (Becker, 1985).

In addition, it appears that twice as many teachers in the 1989 survey reported using computers for instruction than did their counterparts in 1985. Furthermore, Becker (1990) reports that schools have finally reached a critical mass of computers. Specifically, he notes that the proportion of schools with 15 or more computers has increased from 24 percent in 1985 to 57 percent in 1989, and he argues that "whole class instruction" is now feasible if students work in pairs.

The results of the IEA's 1989 survey of Computers in Education appears to be supported by the growing increase in use of computers in special education. A recent survey of special education supervisors throughout the country by the Information Center for Special Education Media and Materials (1989) corroborates this point. For example, in a 1987 survey, 27 percent of the respondents noted that computers were not used at all, while 28 percent said that computers were used less than an hour a week. In a survey two years later, 21 percent of those surveyed noted that computer use was one hour a week and 36 percent reported computer usage as one-two hours a week. In addition, 21 percent of the respondents said the computer was used three-four hours a week, which is in contrast to only 14 percent of two years ago. In addition to a survey of computer use, 45 percent of the respondents rated their progress in making technology resources available to special education students as "good" or "very good."

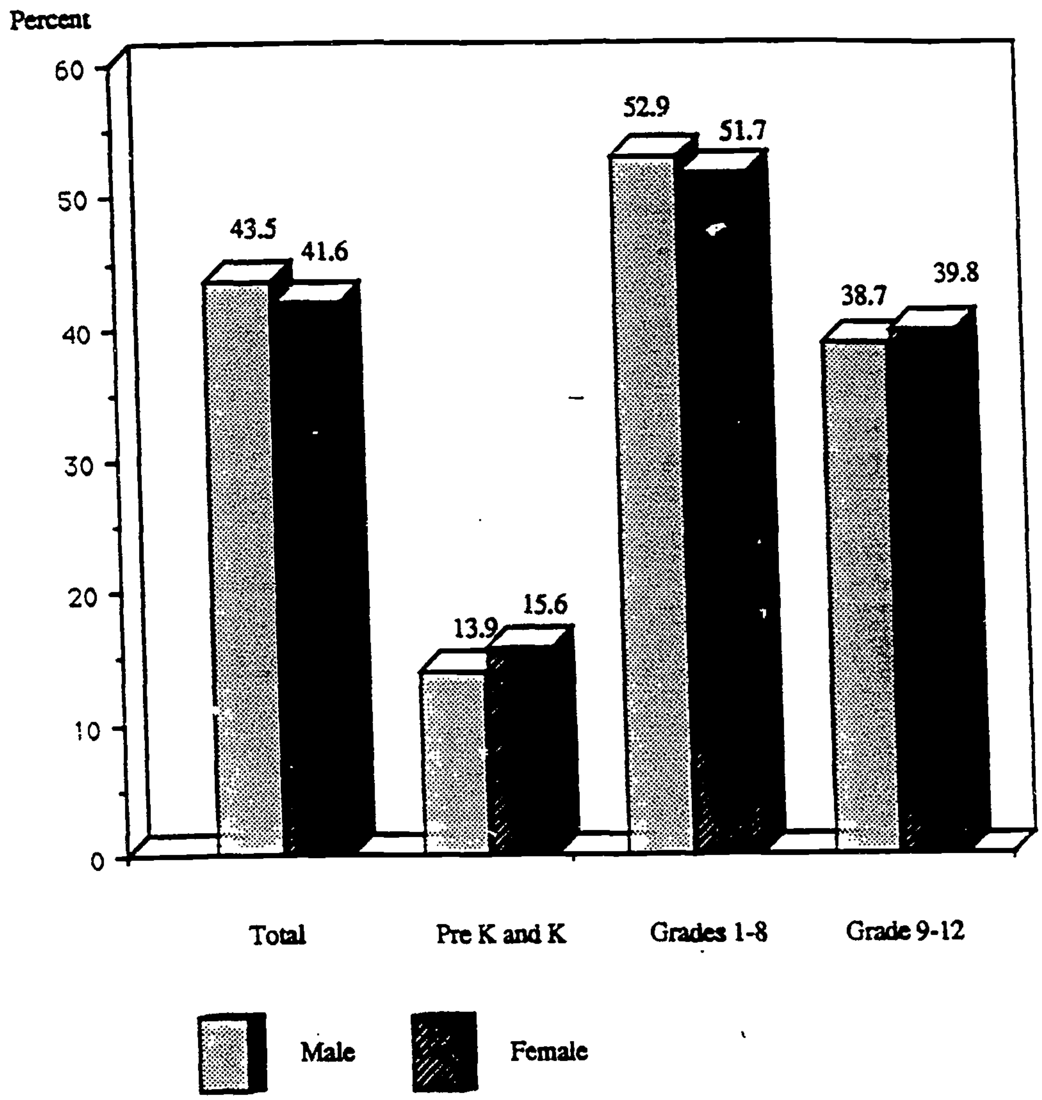
Recent surveys of microcomputer use also indicate that special education students spend as much time on computers as average ability students (Becker and Sterling, 1987). Even more recent surveys show that there is a rough parity of use by male and female students (see Figure 2).

However, they engaged in very different activities on the computer than their peers. On the average, secondary students used drill and practice computer programs only 13 percent of the time. In contrast, special education students spent most of their time on drill and practice, mainly in the areas of math and language arts programs (Becker and Sterling, 1987; Okolo, Rieth, Polsgrove, Bahr, and Yerkes, 1985; Semmel and Lieber, 1986). Where computers were not used for drill and practice, the main intent of computer use with special education students was to improve motivation, self-confidence, and self-discipline. On the other hand, when working with other students, teachers' main goals (at the secondary level at least) were programming, computer literacy, and word processing (Becker, 1987).

Several key points need to be emphasized about use of technology with special education students. The first point is seemingly obvious: technology use in all schools fundamentally involves microcomputers. Rarely do educators utilize alternate technologies such as videodisc instruction or more elaborate uses such as telecommunications or information retrieval from commercial databases. Second, while the number of computers in schools has increased dramatically, the sophistication of these computers is questionable (e.g., the vast majority are of the Apple II vintage) and access typically remains limited, possibly undercutting their value as tools for instructional delivery. This is true for both special education students and other students. Third, mildly handicapped students, like other students in the bottom one third of the school, tended to use microcomputers for drill and practice. This point extends to experimental research, where exceedingly few studies involving computer simulations have been conducted with mildly handicapped students (e.g., Hollingsworth and

Figure 2

STUDENT USE OF COMPUTERS IN SCHOOL



Woodward, 1991; Margalit et al., 1987; Woodward, Carnine, and Gersten, 1988).

One final observation can be gleaned from an early study of microcomputer use in secondary special education (Rieth, Bahr, Okolo,Polsgrove, and Eckert, 1988). The researchers found that despite the availability of microcomputers, only 60 percent of the teachers chose to use them for instruction and they were in use only 25 percent of thetime. Also, even though secondary special education teachers extensively supervise their students during computer use, very limited, substantive academic interaction occurred. While students tended to be engaged at high rates, it is far from clear that students are successful at their work on the computer or that they understood the content of the computer assisted instruction. Generally, there was little evidence that teachers are able to successfully integrate CAI with their traditional curriculum.

Issues of quality. From the inception of widely distributed educational software in the late 1970s and early 1980s, researchers revived earlier questions from the mainframe era regarding the instructional effectiveness of CAI. The research, particularly the meta-analyses (e.g., Bangert-Drowns, Kulik, and Kulik, 1985; Kulik, and Kulik, 1986; Kulik, Kulik, and Bangert-Drowns, 1985), are complicated and findings are often equivocal. Syntheses of research indicate some guarded enthusiasm for its effectiveness, at least as an intervention on par with tutoring or adaptive education (Niemiec and Walberg, 1987). Kulik and Kulik (1987) also support the effectiveness of CAI, but indicate in their synthesis that it has not been uniformly successful at all levels of instruction and that less success has been demonstrated with computer enriched environments (e.g., programming, as a calculating or simulation device).

On the other hand, Semmel and Lieber (1986), in their review of computer based instruction for special education, believe the early claims about the superiority of computer assisted instruction as an alternative to traditional instruction were exaggerated. They view the best role of technology, at least over its early period, as a complement to traditional instruction.

This debate over the effectiveness of computer based instruction, however, is framed as an instructional delivery issue, with little, if any, attention paid to the influence of the media itself or the effects of technology from a systems perspective. This is largely due to the view that technology is merely a vehicle for delivering instruction (Clark, 1983). Emerging views of technology use in instructional settings question this assumption.

Kozma (1991), for example, argues that recently developed hypertext and interactive videodisc systems dramatically move beyond the earlier forms of CAI (a.k.a. electronic textbooks) into exploratory environments which allow for a constructive interplay between the learner and the technology. What is learned from such interactions cannot necessarily be captured by traditional criterion measures of achievement. Salomon, Perkins, and Globerson (1991) also extol the "intellectual partnerships" which may arise from this kind of technology use. Technology can reside as a tool for the enhanced division of labor (e.g., word processing) or, more importantly, it can augment intelligence by engaging students in problem solving, exploration, and hypothesis testing in a way that is difficult or impossible through conventional forms of instruction.

From a systems perspective, cognitive activity can be distributed among individuals and technologies (Pea, 1990; Perkins, 1990). Limited research (Johnson, Johnson, and Stanne, 1986; Nastasi, Clements, and Battista, 1990) in cooperative learning arrangements (e.g., where students work with others to solve simulation or Logo problems) has shown positive social and intellectual effects favoring such configurations. This use of technology satisfies several critical issues at once: the limited number of computers in most schools; the need for students to work collectively; and for some students, particularly mildly handicapped students, the need to publicly express ideas and reasoning in a classroom setting.

While these emerging views hold promise, if not revive a pall in the enthusiasm for the use of technology in education, their extensions to low achieving students is uncertain. Only a handful of researchers (e.g., Hasselbring, Goin, and Wissick, 1989) have begun to examine the effects of the newer technologies on mildly handicapped students. Critics (e.g., Heller, 1990) have argued that hypermedia, for example, relies on incidental and discovery learning, which is largely unsupported in the educational research literature. Students also tend to suffer from disorientation and cognitive overload when using these kinds of tools (Conklin, 1987).

Concluding Remarks

While the number of computers in schools has risen dramatically over the last decade, implementations of these tools has been far from ideal. This is due, in part, to the institutional force of the textbook, which has had an enduring place in the classroom throughout this century. Attempts to dramatically replace it go against the grain of everyday practice.

One "virtue" of textbooks, despite their generally low quality, is the way in which they are aligned to important measures of learning, particularly norm referenced tests which are administered once or twice a year. As an instructional delivery tool, technology has been unable to demonstrate this alignment.

Finally, as schools pass through the teething process of technology acquisition to broader and more far reaching applications (e.g., interactive video environments, virtual reality, hypertext), the extent to which these approaches are instructionally sound or suited to low achieving students will be an important question.

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The papers commissioned by the project are available upon request include:

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"Workforce 2000 and the Mildly Handicapped" by John Woodward;

"Virtual Reality and Its Potential Use in Special Education" by John Woodward; and

"Annotated Bibliography: Training, Education Policy, Systems Change, and Instruction" by Lewis Polsgrove.

Copies of these reports are available upon request.