traditional linguistic language. As a result the gulf between the humanities and sciences could be lessened and ultimately society could retire the compartmentalized view of knowledge and learning and instead see how well each "side" could benefit the other. Less abstractly, students can realize how well each subject in school compliments the others and how much each has in common, for there are very few subjects that could not be taught to at least a minimal degree with an "intelligent" computer program (Papert, 1980). Fourth, these programs should produce an increase in the degree of student participation (Raphael, 1976). "Intelligent" computer programs by their very nature require a great deal of active student involvement. No longer can a student merely daydream through a teacher's lecture. Each idea presented by a computer must be acted upon by the student. When a student has complete charge of the programming even more involvement is required. A mere nod of the head in acquiescence will not encourage a computer to continue. Undoubtably, this makes a student a better learner by sharpening the concentration and attention spans and by reinforcing the idea that learning is most productive when it is an active process.

Whether or not AI's potential to positively effect education will be realized can only be speculated. Though the issues involved are many it is clear that any talk of the future must be based on the assumption that computer technology has not reached its peak that growth will continue (Evans, 1980). Improvements are needed in the programs' abilities to respond to natural language and in understanding of the human thought and reasoning processes in order for the programs to be truly interactive and "intelligent."

Some Objections and Concerns

Opponents to widespread "intelligent" computer use in the classroom fear that computers will take over the teacher's job. This is highly unlikely for computers are a long way from possessing all the necessary traits required to abolish the teaching profession as it is today. Nonetheless, computers will be used increasingly to supplement human lectures, provide unlimited individual attention and infinite patience, and to keep lessons moving at a pace beneficial to all (Raphael, 1976). Even if computers were to gain the technological sophistication necessary to take the teacher's place such a drastic change would likely occur very slowly to many impending factors in educational institutions (Sugarman, 1978). Undoubtably, the classroom is an artificial and inefficient learning environment, but one that was forced out of necessity to develop because certain essential subjects such as mathematics and writing could not be assimilated in informal environments. Clearly, only truly "intelligent" computers capable of passing Turing's rigorous test would ever allow modification of the learning environment so that the knowledge schools now try to teach could be learned without human mediated instruction (Papert, 1980).

Another concern of the critics of AI's applications to education is the present lack of standards by which computers operate in the classroom. They feel that any teaching tool professing to be as powerful as computers are should not be implemented widely without some kind of protective restrictions. While Orwellian images of children 'running wild,' 'drugging themselves,' or 'making life impossible for their parents' are probably exaggerated, they do exemplify an area in great need of attention (Papert, 1980). A lasting solution can be possible only when education becomes a true science and the real nature of learning is understood (Evans, 1980). Simple solutions in the past, such as Skinner's teaching machine, have been insufficient and have probably done more to confuse than to resolve the problem. At present teachers, AI researchers, and administrators subscribe to their own personal theories of learning regardless of their actual appropriateness to the specific teaching situation. Only time can tell whether or not those with the power will have enough foresight and insight to address the confusion before it is too late.

One other major issue raised by AI's opponents is whether or not the ability of people to do simple calculations will be lost due to the computer's greater efficiency and accuracy with computational skills (Evans, 1980). This may not be actually detrimental because, though at this point it is impossible to tell, many people feel that truly natural and interactive mathematical powers are already inhibited by the formal discipline of learning trivial computational rules. "Intelligent" computers, they argue, will free students from the need to learn these unnecessary skills in mathematics and other subjects, so that they can tackle higher levels of learning and understanding. Consequently, it is possible that as computers become more "intelligent" student intelligence will also increase. These more "intelligent" students will then develop even better computers in a never ending upward spiral (Raphael, 1976). While this totally limitless growth in computing is neither predicted nor desired by many at present, it is surely possible.

Conclusion

Even though AI's opponents present some very real problems demanding attention, it appears they will do little to stop or even slow AI research into educational applications. Consequently "intelligent" computer use in the classroom will probably have an even greater effect on the intellectual development of children than any other teaching tool or technology, including the television, previously devised (Papert, 1980). Obviously, the issues discussed earlier concerning intelligence, thinking, and learning will need to be settled and many technological and social obstacles must be overcome. However, with the present disillusionment with the current school system and the promises that AI's application to education have offered, little appears to be stopping the eventual widespread use of artificial intelligence in education.

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BOOK REVIEWS

The Computer in the School: Tutor, Tool, Tutee. Robert P. Taylor (ed.) Teachers College Press, 1980

Information Technology: Innovations and Applications. Bernard S. Sheehan (ed.) Jossey-Bass Inc., 1982

Meeting Learners' Needs Through Telecommunications: A Directory and Guide to Programs. Raymond J. Lewis American Association for Higher Education, 1983

The Coming Information Age. Wilson P. Dizard, Jr., Longman, 1982.

By Paul Hurly

The bountiful harvest of recent books concerned with the role of new media in education and society leaves educators and educational administrators with few excuses for being ill-informed. The following is a sample of some of the best of the new crop.

Robert P. Taylor gathered five of the most innovative educators using computers in the United States — Alfred Bork, Thomas Dwyer, Arthur Luehrmann, Seymour Papert and Patrick Suppes — to discuss their philosophies and approaches in **The Computer in the School: Tutor, Tool, Tutee.** Taylor conceived a trimodal framework for analyzing the educational role of computers which these five pioneers describe.

As a **tutor** the computer tests student knowledge, provides remedial material, and manages the learning process. As a **tool** the computer is programmed to perform such functions as simulations or word processing. The **tutee** mode, which receives the greatest focus in the book, is when the student tutors the computer via a computer language. Beautifully conceived, Taylor's text provides an uplifting glimpse of the potential future direction of schooling and formal learning in North America.

A much broader range of educational technologies are scrutinized by the authors gathered by Sheehan in **Information Technology: Innovations and Applications.** By itself this book does not provide sufficiently detailed descriptions of the new technologies to assist those readers who are less well informed about computers and new media terminology. The strength of this book is its attention to the broader context in which decisions are made regarding the use of educational media and information technology.

Manfred Kochen and Carl Adams discuss the challenge of planning for the implementation of information technologies and responding educational to their impact on society. They also identify some benefits of information technologies for planners. Richard Evans provides an update of his 1968 study on resistances to innovation in higher education and suggests several pragmatic steps for overcoming the blockages. Despite the learned opinions of Sheehan and his colleagues, however, educational technologists may sense that information technologies will have a far greater impact on the typing pool than in the classroom domain of the professor.

In **Meeting Learners' Needs Through Telecommunications,** Raymond Lewis has provided impressive evidence that innovative media-based educational programs are alive, well and thriving. Using mail and telephone surveys Lewis compiled summaries of 70 educational programs at the college and university level which use CATV, interactive CATV, teleconferencing, videoconferencing, computers and computerconferencing, television and videotape media to serve the needs of a wide range of learners. Prose and point form summaries for each project cover a range of standard topics such as educational mission, problems encountered, delivery system, finances, administrative structure and observations about distance learning. This is an excellent directory for planners and administrators seeking models for implementing innovative telecommunication-based learning strategies for their institutions.

Planning for the successful implementation of information technologies, argues Wilson Dizard, Jr., requires strong central leadership and the participation of all, or as many as possible of the sub-groups in society. Otherwise, he states, we risk making decisions which will benefit elites and will ultimately undermine democratic freedoms.

In **The Coming Information Age** Dizard provides a summary of the development of computer, satellite and telephone communications in the United States, and the facts to demonstrate the economic preeminence of the telecommunications sector in the 1980's. His discussion of the follies of Washington bureaucratic communication planning and corporate gamesmanship underscores similar points made by John Wicklein in his largely ignored but insightful, **Electronic Nightmare.** Dizard's observations on the dangers awaiting society if corporate machinations, and government disarray, regarding telecommunications policies persists, will give Canadians considerable cause for anxiety. The recent track record of Francis Fox's DOC mandarins, and the CRTC, typify the frenetic approach to planning Dizard advises we must foresake. In this advice there is also a strong message for educational planners.