the use
& misuse of
computers
in
education

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To Carole,
Leslie,
and Douglas
with love

Foreword

The possibility that computers will be used in schools seems to turn otherwise reasonable men and women into either implacable Luddites or doomsday zealots. To some the machine is the symbol of inhumanity, a blinking, rigid monster devoted to the dehumanization of the school. To others the computer is the route to new pedagogical sophistications, a device to free the child from the clutches of the biased, smothering teacher. The former think the latter are bloodless technicians. The latter find the former fearful reactionaries. Both Luddites and zealots are wrong, of course, and both are perversely right.

The computer is but another vehicle to employ in helping people learn, a cousin of books, films, blackboards, chalk, gerbils, abacuses. Like each of these devices, it can be well used or misused. It is a particularly sophisticated device, which makes it both promising and difficult. It requires careful preparation for use—as much or more as do some films—and it is as yet costly to operate. It requires teachers and administrators who can master its strengths and weaknesses, experts who are neither Luddites nor zealots. Their tribe is small indeed. The purpose of this book by my colleague Allan Ellis is to help it increase.

Rarely can one productively start in educational reform with *things*, whether they are books, films, or computers. One starts with a consideration of the *ends* of instruction, and employs things only as each of these emerges as the most efficient approach to meet, or to help meet, these ends. One uses a book or a computer only if a particular situation with a particular goal uniquely calls for one or the other. Effectiveness, economy of time, and the extent of financial outlay govern the choice.

The zealots' mistake has been to start with the thing. We've got this marvelous machine, now how can we use it? They have backed into the question of ends, sometimes virtually creating them to serve the machine's purpose. They have all too often ignored the commonsense realities of American schools, and have tried to market ridiculously expensive devices to meet trivial ends. In recent years the marketplace has cut many of the zealots down to size.

The Luddites gloat at the zealots' current discomfiture. However, as Ellis points out, there are few applications of computers that can serve to undercut their bias. The Luddites seem to control the field. As he says, "the promise of the computer in education is not a simple promise. . . [however] the computer can be our excuse and our mechanism to rethink and reformulate the very procedures we automate" and, later, "thinking about the computer's role in instruction does not mean thinking about computers. It means thinking about instruction." Such is thin gruel for hungry, doubting schoolmen, but it is an honest assessment of the state of computing art in education. The machine, Ellis asserts, is yet "incomplete." And the work to be done is not engineering or technological development. Until we substantially rethink and recast the programs of our schools, there will be little call for new devices. The task is, in the first instance, a philosophical and psychological one. Our current curriculum, born in the 1890s, is comfortably encumbered with an equally historical pedagogy, one which most teachers, students, and parents (in spite of the noisy complaint of a small minority) find quite satisfactory. There is no need for computers, as there is little call for the sophisticated new goals which computers alone could efficiently meet.

Therefore, this book about computers starts and ends with a call for new thoughts about instruction writ large. Only a revolution of educational ends and means could create an appropriate place for the misunderstood machine. That such a revolution is seriously overdue is appallingly obvious. That a reconstructed curriculum, which probably would be sited outside of schools as well as within them, would require computers is highly likely. Against the arrival of that day, a new group of educators, who are neither Luddites nor zealots, needs to be formed, and serious inquiry on the purposes of instruction and the place of computer technology in reaching them must be pressed.

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Preface

For the uninitiated educator this book provides an introduction to computers. For the educator who already uses computers this book encourages a second look at the opportunities that accompany such use. More specifically, the book identifies and examines some of the more critical central issues educators confront as they attempt to cope with the presence—and presumably the promise—of computers in their lives and in their work.

The book has two purposes. The first purpose is to pursue with the reader a line of reasoning which begins with the careful definition of computer, followed by a look into three implications of this definition which are of particular importance to people in education and are usually ignored by almost everyone who uses computers in schools. The discussion ends with a consideration of how computers enhance our ability to address complex educational problems. The second purpose is to provide information about computers and their role in education so that the reader will have sufficient background to follow the argument of the book, to become a knowledgeable reader of other books and articles in the field, and to become a skeptical viewer of attempts to automate education. These two purposes combine into an attempt to develop in the reader—be he naïve or sophisticated—a point of view about computing which will convince him to play a more critical and yet a more active role in the use of computers in education.

The book consists of three parts. Part I proceeds from the premise that computers are consistently misused in schools because in the final analysis educators are unclear and confused about what computers are.

By clarifying the relationship between procedures and the machines that execute them, Part I establishes a firm and sturdy definition of computers. Part II looks into certain implications this definition holds for the proper use of computers in schools, showing how these implications have been missed in almost all the work done thus far. Finally, Part III presents a case study of the major steps involved in building a computer into an education machine by capitalizing upon the three implications of what computers are. Part III also documents the relevance and the usefulness of the point of view about computers established in earlier parts of the book.

Aside from some very technical works suitable for engineers and logicians, it is not possible to write a book just about computers. Books that use "computer" in their title usually boil down to being books about *people* who use computers. Sometimes these books tell what people have done, and other times they deal with what people are doing or propose to do. More than anything else this book is about the things people *ought* to do with computers, and by implication, therefore, about the things most people whom we call educational technologists have failed to recognize about their efforts.

To help the reader follow and assess its general arguments, this book cites many examples. Since, as with all examples, they are drawn from a larger set of possible instances and do not exhaust the full range, the reader should seek out other cases that fit the arguments. Moreover, many of the examples are time-bound even though the arguments they support are not so perishable. Thus some of the examples, such as the references in the Appendix to RCA computers which have since been purchased by and renamed UNIVAC, have already become out-of-date. Yet their strength as supports for the assertions of this book are not appreciably diminished.

Acknowledgments usually begin with the apology that it is impossible to list all the people who affected the author's professional life and, therefore, contributed to his capacity or his need to write a book. It is impossible as a practical matter, of course, since there are not enough pages. But it is impossible in the truer sense that none of us can be aware of all those who have shaped our interests or our thinking. Yet always there are a few people whose contributions to the specific act of writing a book are so direct, so important, and so far beyond any reasonable expectation that mentioning them slights no one.

Foremost among the people who contributed to the writing of this book is F. Andre Favat, who tried with a special patience, through many drafts, to teach me that thinking is never more precise than the language it uses. To whatever extent this book is written clearly and well, both the author and the reader have him to thank. Another person for whose kind and considerable assistance I am especially grateful is Marietta Haley, who typed, retyped, designed, drew, secured permissions, obtained

Contents

1: what is a computer?

"That's a great deal to make one word mean," Alice said, in a
thoughtful tone.

Lewis Carroll
Through the Looking Glass

CHAPTER ONE:
Common Conceptions about Computers

Remove every computer and every application of the computer from all the school districts in the country, and the schools will not shut down. Certainly there will be inconvenience, but this will be administrative inconvenience mostly, forcing some schoolmen to take on again the clerical chores associated with scheduling schools, keeping attendance, writing teachers' salary checks, printing grade reports, and such. Nor will the quality of the students' educational experience appreciably diminish. Some students—the few who take a high school course in computer programming—will have to wait a year or two until they get to college to learn about computers, but otherwise there will be little effect.

But this is not the impression we receive from the educational technologist. In conferences and symposia, presidential study commissions and congressional hearings, and books, articles, and project reports on the role of computers in education, the educational technologist encourages us to believe that the computer is indispensable to the life of the school. For example, the 1971 annual meeting of the Association for Educational Data Systems—the largest collection of people working on the use of computers in schools—opened with the assertion that "we can't do without the computer in education."[1]

The origin of this belief in the indispensability of the computer is not

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[1]Convention Reporter, *Highlights of the 1971 Annual Meeting of the Association for Educational Data Systems*, Lubbock, Tex., 1971.

difficult to find. People have heard or read that the computer holds great *promise* for education and that it will have as revolutionary an effect upon schooling as did the Gutenberg press. Should this promise be fulfilled then surely the computer would be vital to education. But since, as this book will show, the computer's promise has not yet been fulfilled, the educational technologist has no basis to assert that the computer is right now "no longer a gimmick or a frill [but] an integral part of the [educational] programs that are being mounted today.[2] Only when its promise is fulfilled can the computer be indispensable.

Nor is the promise of the computer in education a simple one. Indeed the full power of this promise remains unclear, although the purpose of this book is to suggest that in education, as in other endeavors, the computer's promise rests in being both our excuse and our mechanism to rethink and reformulate the very procedures we automate. Thus it is we, and not the computer itself, who must fulfill the computer's promise. As we shall see, this is a very delicate matter. The computer's promise is complex, often disguised and misleading, and we must not interpret what it offers too literally.

Most educators have been too literal about computers and, as a result, they are overconfident that they know what computers are. Take, for instance, the meeting in November 1970 of the National Association of Users of Computer Applications to Learning, convened "to formulate a national policy statement by addressing the *critical issues* facing the use of computers in education." At the very bottom of their list of important concerns (they gave it a "priority weight" of zero) was the matter of developing "a better definition of computer technology in education." When asked by an outsider why this issue had been placed so low, the Chairman explained that the members had been involved with data processing for some years and that "we all know what computers do."

Ironically in their security about what computers do, such educational technologists miss the most important point of all about computers: anyone who knows what computers *do*, knows nothing about computers. Speaking about what computers *do* is a logically deviant enterprise. The whole point about the computer, as will be seen later, is that, unlike toasters or cigarette machines or snow blowers, it is not designed, in the ordinary sense of the word, to *do* things. Because the typical educator who uses computers has missed the distinction between computers and ordinary machines, he has been satisfied to look to ordinary places for his definition of computers. The result is a common sensical definition of computers which does not stand much scrutiny and which, as we shall see, leads to erroneous implications.

How this is so will be the concern of Chapter One. The subsequent pages of Part I will then attempt to build a strong, unshakable definition

[2]Ibid.

of computers. With this definition in hand, Part II will explore the principal implications for education of what computers are. Finally, Part III will show in detail what is involved in using a computer to address a complex educational problem, examining one such effort from its inception through to its completion four years later. Taken together the three parts of this book will endeavor to show, first directly and then through examples, that whatever chance there is for us in education to realize the promise of the computer depends almost entirely upon our coming to understand what computers are.

Common Belief

The situation in the final moments of Euripides' *Electra* is so involved and so utterly complicated that there is no hope of resolution. Suddenly a metal crane attached to the top of the scenery is lowered onto the stage. Suspended from the metal crane is a dummy, and everyone in the audience knows that this dummy represents a god and that by one godly act he will set everything right, freeing the heroine and her brother from their fate.

This literary device of *deus ex machina* is no longer considered good drama, of course, but for some modern men, faced with intellectual and scientific problems as intricate as any Greek tragedy, the idea is still in vogue. These men do not expect miracles any more from metal cranes and gods who ride upon them; these have been replaced by a more complicated machine which they call a computer. The intention, however, remains much the same: to somehow rescue *man* from his otherwise inextricable problems and puzzles.

In intellectual and scientific investigation, as in modern drama, this point of view is out of place. Yet it is not entirely unreasonable that most people see the computer as a twentieth century *deus ex machina* because, certainly, there are ways in which computers so exceed human capacities that they seem godlike.

Of all the things they are supposed to be, for example, everyone agrees that first of all computers are fast. Indeed, few men would be surprised to learn that in the time it takes an average person to read this sentence an ordinary computer performs one million six hundred thousand operations. They have become used to hearing that whenever NASA launches a rocket to the moon, computers figure from minute to minute where the missile is heading, correcting its flight, and standing by to look even deeper into the trip the missile has yet to make. It is unusual to no one that computers are used at places like the Cambridge Electron Accelerator to keep up with miniature atomic particles as they approach the speed of light. Even on election night—although politicians may worry about the effects upon the electorate—voters take it in stride when