DOCUMENT RESUME

ED 295 676 IR 013 427

AUTHOR Komoski, P. Kenneth
TITLE Educational Technology; The Closing-In or the Opening-Out of Curriculum and Instruction. An ERIC Information Analysis Product 1987, IR-77.
INSTITUTION ERIC Clearinghouse on Information Resources, Syracuse, N.Y.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO ISBN-0-937597-18-X
PUB DATE 87
CONTRACT 400-85-0001
NOTE 44p.
AVAILABLE FROM Information Resources Publications, 030 Huntington Hall, Syracuse University, Syracuse, NY 13244-2340 ($6.00 plus $1.50 shipping and handling).
PUB TYPE Information Analyses - ERIC Information Analysis Products (071)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Computer Assisted Instruction; *Curriculum Development; Databases; *Educational Change; *Educational Technology; Elementary Secondary Education; Family School Relationship; *Information Sources; Instructional Development; *Instructional Innovation; Productivity; Student Motivation
IDENTIFIERS *Educational Products Information Exchange; *Integrated Learning Systems

ABSTRACT

Faced with the growing concern over educational effectiveness, efficiency, and productivity, many schools are turning to educational technology, especially the computer-based curriculum products known as integrated instructional systems. However, it is vitally important for educators to examine and gain a clearer understanding of technology's relationship to the learner over the longer term if they are to avoid moving towards a solution to the educational productivity problem that is socially undesirable. Educators must not only concern themselves with the systematic integration of materials and technologies into the curriculum, but they must also consider the systemic integration of materials and technologies into a balanced curriculum that will enable teachers to design, select, and arrange for both formal and informal learning experiences adapted to the needs of individual learners. This "opened out" approach is of utmost importance as a means of engaging the learner's interest, effort, and day-to-day involvement in the curriculum, and educational practitioners need access to information that will help them become less dependent on the "closed-in," prepackaged, computer-based systems now available. The EPIE (Educational Products Information Exchange) Institute is currently engaged in the development of a series of interrelatable databases--the Integrated Instructional Information Resource (IIIR)--which is designed to provide such information to both educators and parents. (28 references) (EW)

EDUCATIONAL TECHNOLOGY; THE CLOSING-IN OR THE OPENING-OUT OF CURRICULUM AND INSTRUCTION

by

P. Kenneth Komoski

ERIC Clearinghouse on Information Resources

Syracuse University, Syracuse, New York
December 1987

P. Kenneth Komoski is the President and Executive Director of the EPIE (Educational Products Information Exchange) Institute, PO Box 839, Water Mill, New York 11976; telephone (516) 283-4922.

ISBN: 0-937597-18-X

This publication was prepared with funding from the Office of Educational Research and Improvement, U.S. Department of Education, under contract no. 400-85-0001. The opinions expressed in this report do not necessarily reflect the positions or policies of OERI or ED.

TABLE OF CONTENTS

FOREWORD

Like the series of boxes within boxes within boxes that we played with during childhood, so are the activities of the individual classroom based on a syllabus that is based on curriculum that reflects the expectations and values of a society. In planning for teaching, each layer should be considered.

It is relatively easy to look at the broad overview of curriculum and its relationship to the needs of society. It becomes increasingly difficult to operationalize the broader concerns when it comes to syllabus planning, and even more difficult at the classroom level. Yet it is at this level that curriculum designs are carried out and learners are exposed to ideas and resources that eventually determine the extent of learning.

For almost two decades, the Educational Products Information Exchange (EPIE) has attempted to provide essential information to educators who make decisions at all levels of the education spectrum. With a watchful and critical eye on the curriculum and societal needs, EPIE has meticulously investigated the utility of teaching and learning materials that are designated for classroom use. The heroic efforts of EPIE over the years have evolved to the current emphasis on matching educational products to specific curricular objectives, school by school. EPIE, along with other organizations such as WICAT and CCC, are attempting to provide a holistic approach to teaching and learning. Integrated curriculum systems seem to be pointing a direction to future comprehensive teaching and learning programs that use appropriate technologies, guided by teacher-leaders, to achieve curricular goals.

One observer of this scene has been Ken Komoski, whose name is inseparable from EPIE. Stemming from a basic concern that the learner should get a better "break" than most traditional classroom instruction can provide, Ken Komoski has been on the forefront of many major movements in educational reform. His fundamental interest is in the "software," the resources, the materials that are ultimately put into the hands of the teachers and learners. His current efforts with integrated curriculum resources focuses on the context in which these materials are used.

The ERIC Clearinghouse on Information Resources is pleased to offer this monograph as a thoughtful consideration of one of the "cutting edge" issues in educational technology.

Donald P. Ely
Director, ERIC/IR
Syracuse, New York
December, 1987

INTRODUCTION

To all you stalwart schoolmen
And the factories you run;
To all you frazzled teachers and
The frills you've learned to shun...

I celebrate your objectives, so
Behavioral, so complete.
I love the way your test results
Make knowledge look so neat...

Distar? Workbooks? M.B.O.?
I never had such tools.
I dared not hope technology
Could so control the schools...

You've scientized the whole shebang!
Efficiency? You employ it.
Just one thing still bothers me:
Why don't the kids enjoy it?

From: "What Franklin Bobbitt Might Say,
If He Could See Us Now,"
by Richard Larson.

The seemingly unavoidable conflict between efficient schooling and schooling that sustains the interest and enjoyment of "the kids" is as much with us today as it was during the early decades of the twentieth century when followers of Franklin Bobbitt and John Dewey worked to make very different visions of schooling a reality. Having neither resolved nor even fully comprehended the complex nature and context of the conflict, U.S. schooling is currently being expected to play a major role in helping our nation solve major economic and social problems. In order to respond successfully to these expectations, schooling in the United States is going to have to deliver on its much-stated-but-unfulfilled promise to educate each (and *every*) learner to his or her full potential. To accomplish this for all learners, efficient schooling can no longer mean schools that divest themselves of 30 to 50 percent of the students whose interest they fail to engage. Nor will it be accomplished for very many students unless schools learn how to create learning environments capable of sustaining the interest and enjoyment of learners over the full course of each learner's schooling.

The rather simple message of all that follows is this: although we may discuss the pressing educational problems alluded to above in the abstract, the solutions we employ to solve them are concretized every day in the form of the direct and mediated experiences that we as educators—in our wisdom

or witlessness—arrange for millions of learners. Like it or not, it is within these learning experiences that we embody our proposed solutions to the problems that plague us. These arranged experiences are the means with which we choose to achieve society's educational ends; but, while we must make sure that these means embody those ends, we must make equally certain that we do not use these means as though they were ends in themselves.

EDUCATION, TECHNOLOGY, AND PRODUCTIVITY

The increased use by schools of commercially developed and marketed computer-based curriculum products called "integrated systems" seems to be one more indication of the inevitable impact of technology on educational practice in a patently technological society. As the above reference to Franklin Bobbitt's early twentieth century efforts to make schools more efficient with techniques borrowed from industry attests, the impact of technology on educational practice is nothing new.

Nor is there anything new about the tension between those in education who are committed to making the process of curriculum and instruction systematic, rational, and efficient, and those who believe that the inevitable outcome of such efforts—no matter how well intentioned—is a palpable lack of enjoyment on the part of learners.

Indeed, the critics of such efforts can argue quite persuasively that at least some portion of today's widely evident student (and teacher) dissatisfaction with "the system" is a result of the work of those who, like Bobbitt, believe that to become more effective schools must become more efficient, and that the means of achieving more effective/efficient schools is modern technology. In Bobbitt's day, the use of modern technology in schools meant making use of the techniques of "job analysis" and "scientific management" (Callahan, 1964). In today's schools, it is increasingly being translated into the interrelated use of new electronic technologies for instruction and instructional management.

Currently, the most articulated examples of such translations are commercially-marketed "integrated instructional systems" or "integrated learning systems," products with an assuring, and to some, disturbing, comprehensively technological ring to them. It is to the use of such systems that many schools are turning as a means of improving instructional performance. And the increasing use of these systems in schools is being enthusiastically encouraged by those who view educational improvement as a necessary, if not an entirely sufficient, condition for curing what many see as the country's major malaise—"the productivity problem."

Productivity, educators are told in a report recently published by the National School Boards Association, must become the main concern of the next wave of school improvement, waves one and two having addressed equal opportunity and the raising of academic standards (Perelman, 1987). The report, which is entitled *Technology and Transformation of Schools*, speaks of "the vastly greater productivity of advanced learning technologies" that will enable students to learn today's basic K-12 school curriculum much more efficiently, i.e., by the time they are 15. The report seems to take for granted that as technology is used to increase a school system's efficiency (i.e., productivity), students will also experience an increased sense of their own personal productivity, both individually and when working cooperatively as part of a group.

This is an assumption that may not readily be granted by those who harbor concerns about the impact of technology on education, and about what

exactly is meant by productivity in the context of education. Does it simply mean having students learn more, and learn it faster, or does it have other dimensions? If so, will they, too, be considered and assessed?

Concerns about how to define and judge productivity and its improvement within schools are quite reasonable, and they deserve the considered attention of educational policy makers at the local, state, and national levels. Given today's much sought after goal of greater educational productivity, it is very likely that such (yet to be fully defined) measurements of productivity will be insensitive to whether students are experiencing a growing sense of their own productivity as they use technology to learn more and learn it faster. Although such a feeling may not easily be measured by a standardized test, nor validly monitored by current computer-aided management systems, the presence of such a feeling—ineffable as it may be—may be the truest measure and most valid standard against which to judge the educational impact of any learning technology. A student who feels personally productive is a student who is apt to be motivated to continue learning, and a motivated student will make any teacher or teaching technology look good.

Unfortunately, however, education's record of responsiveness to an individual learner's need to feel the intrinsic motivation that comes from productively (i.e., effectively, efficiently, and nontrivially) adding to one's knowledge and skills is rather dismal. The evidence is quite clear: much of what students do and experience on a day-to-day basis in school is of a make-work, trivial nature. Because as much as 90 to 95 percent of in-school learning involves the use of instructional materials produced by the education industry (EPIE, 1977), it follows that the responsiveness of that industry to a student's need to experience a sustained sense of personal productivity is no less dismal. There are many reasons for this unresponsiveness that tend to average out to an endemic thoughtlessness about the fact that the individual learner is education's ultimate consumer (Komoski, 1971). Taken together, these reasons signal a mindset that is succinctly summed up by an oft-used, though unwritten, textbook-publishing aphorism: "Remember, the kids don't buy the books."

Those who do buy the books, and who see to it that the products of the education industry are used in classrooms, tend to be so encumbered with deeply entrenched policies, practices, and priorities, that a concern for whether or not a learner feels productive when she or he uses those products seldom surfaces as a major concern. Those long-established policies, practices, and priorities tend to focus on what is referred to increasingly as the "delivery" of curriculum and instruction, rather than on the effect on students of what is "delivered."

Such a focus reveals a view of students as passive recipients of educational mass media, not as active participants in that inherently personal experience of internal growth known as learning. This anomalous view of learners as passive receivers of an educational delivery system has become so embedded in the language that even a recent report (National Task Force, 1986) to the U.S. Secretary of Education by a prestigious National Task Force on Educational Technology refers to technology's "capability to manage and *deliver learning*" [italics added]. Clearly, members of that task force, and other

educators who use the word, don't all believe that learning is something that gets *delivered*. Nevertheless, the fact is that textbooks and the other learning materials that *are* delivered to teachers and students influence the way many educators have come to think (albeit, unconsciously) about the teaching/learning process.

How Well (and What) Are the Advanced Technologies "Delivering"?

One reason advocates of the "advanced learning technologies" are so confident of technology's ability to "deliver improved learning" is a significant body of evaluation studies reporting on the efficacy of computer-based instructional systems. For instance, the above-mentioned National Task Force report refers to an analysis by Kulik in 1983 of 169 such studies, a significant number of which have shown computer-based instruction out-performing conventional classroom teaching in elementary schools, high schools, and colleges (National Task Force, 1986, p. 10). The Task Force also cites an overview of the research on the effectiveness of computer-based education by Bracey which concludes that "in the area of affective/motivational outcomes of computer-assisted instruction, the news is almost all good. At the college, high school, and elementary levels, students have good things to say about learning from computers" (1982, p. 54). While the findings of such studies are clearly positive, their results need to be qualified: the results of almost all such studies are based on a comparison of computer-based instruction with what must surely be considered the "straw man" of conventional classroom learning. In other words, one of the major justifications for turning to the use of "advanced learning technologies"—indeed for calling them advanced—is widespread agreement about the ineffectiveness of conventional (i.e., "unadvanced") instruction. Otherwise, why is there all the fuss about improving instruction?

What seems to be going unrecognized here is that all reports of the comparative success of *any* new means of instruction over conventional classroom teaching are at least as much a confirmation of the ineffectiveness of the latter as they are proof of the superior effectiveness of the former. Only after they see this fact clearly—and are unsatisfied with what they have seen—will the advocates of the advanced technologies be likely to make the effort needed to move those technologies toward realizing anything approaching their acknowledged *potential* to help all students become more productive learners. In other words, there is a "real and present danger" that schools—and society—may settle for a lot less than the new technologies have to offer. The new technologies, and those who use them, must be pushed toward realizing their full potential, just as a good teacher pushes under-achievers.

Many school administrators seem to have a willingness, even an eagerness, simply to use the new technologies to do better what they are not now doing well. This may well be because they are less eager to face up to the probability that, when fully realized, the new learning technologies may force a recognition that schools shouldn't be doing a lot of what they now do, no matter how much better they might be able to do it through the new technologies.

Unfortunately, current interest in the effectiveness of the new technologies is prompted more by concerns about their very newness, their cost, and the confusion caused by their rapid proliferation, than by a concern over whether they are fulfilling their full educational potential by helping learners to fulfill theirs. Consequently, the effectiveness of the advanced technologies tends to be judged on the basis of immediate comparisons of short-term effects on the performance of large groups of students on standardized tests. Seldom, if ever, is there a focus on longer-term effects on the knowledge, skills, attitudes, capabilities, and continuing interest of learners to work productively—both individually and as part of a productive group—within, and beyond, their school experience.

Be that as it may, it should be duly noted that *any* interest by school consumers *in any measure of effectiveness* of the new learning technologies represents an attitude seldom, if ever, evinced toward the "old" educational technologies, especially the textbook. Yet today, that two-century old instructional technology affects more learners—and commands a greater portion of school budgets—than all other educational technologies combined. However, as noted above, because most studies of the effectiveness of the newer technologies have compared their performance to the performance of textbook-based instruction, assessing the new has inadvertently been assessing the old as well. Considered singly, the outcome of each such study will have been influenced by the quality of the specific products of the new and old technologies used. Almost all such studies share three characteristics in common that are quite revealing.

The three shared characteristics are: (1) the level of curriculum content commonly addressed; (2) the style of instruction employed; and (3) the means used to assess effectiveness. In almost all cases—for both the new and the old technology—the curriculum content addressed has been very much at the basic skills level; instruction has been in the style of graded, didactic lessons; and assessment usually has been limited to the measurement of students' performance on a standardized test of the basic skills taught in the lessons.

This being so, it may also be said that one reason the new computer-aided instructional technology has so often proven more effective than conventional textbook-aided instruction has to do with what, to date, seems to be the one widely apparent *in-practice* rather than *in-promise* difference between these new and old technologies. This difference stems from the unique, interactive capability of the computer. Granting that the current use of the computer's formidable interactive capability is a mere shadow of its promised potential for providing interactive instruction, the presence of even this "shadow" use seems to be a major factor in the instructional effectiveness of the advanced technologies. The operative effect here seems to be that in contrast to textbook instruction, the computer's interactivity increases both the quantity and quality of a learner's time on task—an acknowledged factor in the improvement of learning.

In the comparative evaluation studies in which textbook-based instruction has produced as good or better results than its computer-based competitor, it is not unreasonable to hypothesize that a conscientious teacher has been

actively providing students with a superior level of instruction that includes active—if not individually interactive—feedback.

In general, however, the instructional effectiveness of the advanced learning technologies has been demonstrated often enough that every developer and marketer of a computer-implemented integrated system is easily able to provide school administrators and school boards with evidence of the type described above. Because the evidence is invariably in the form of test results demonstrating that a group of students using the product in question outperformed a comparable control group of students taught via conventional instruction, and because the advanced technology so often consists of a graded series of textbook-like conventional lessons—less the teacher—a school's response to such evidence might be to ask, "Is this what we really want from an advanced learning technology?"

This teacherless-textbook stage of today's advanced learning technologies is not unlike the early "horseless-carriage" stage of automobile development, when the advanced technology still looked like the conventional horse drawn vehicle of the day less the horse. Pursuing the analogy a bit further: the initial efforts of the designers of today's advanced learning technologies, like the initial efforts of the designers of early automobiles, have focused on producing a vehicle that is as reliable and more efficient and effective than conventional instruction. But, just as the more advanced aspects of the new automotive technology were not realizable until the marketplace saw that its basic requirements were being met, so today the educational marketplace evidently has its own need to see that the new instructional technology is as reliable, and more efficient and effective than, conventional classroom instruction.

However, as with much analogous reasoning, differences emerge. In this case, the most significant one may prove to be that computers are not going to replace textbooks to the extent that automobiles replaced horse-drawn vehicles. With textbooks and computers, the more likely scenario promises to be a transformation and adaptation of that nineteenth century technology to an environment that is very different from the mass-production, mass-instruction environment that initially fostered its development. This transformation will very likely incorporate the textbook as one part of yet-to-be developed computer integrated learning systems, in which the hardcover textbook, as such, may be made obsolete because of the economic advantages of direct electronic distribution of textbook-like instructional modules to schools, where they may be reviewed, tried out, adopted, and then locally site-licensed and laser-printed by the school for student use.

For the present, it must be said that, on the whole, the effectiveness of the newest instructional technologies is to be rated as good when compared with today's textbook-based instruction. However, these technologies cannot be rated as excellent when judged on the basis of how well they (and textbooks as well) ought to be able to perform in the future. What this means—as is clearly implied in the above-mentioned National School Boards Association Report (Perelman, 1987)—is that the current operating definition of increased educational productivity is *the use of new technologies to enable schools to do faster and better just what they have been doing—but not doing very*

well—with textbooks. While some (including this writer) may not be satisfied with either that definition or the position it implies regarding the nature of educational productivity, neither the definition nor the position is unreasonable. They both reflect a realistic acceptance of the still formidable gap that exists between the potential and the current condition of today's advanced learning technologies. However, they also reflect a conceptual/historical gap in our understanding of technology and its relationship to education. It is this gap in our understanding of technology that has made education so susceptible to the use of one advanced hardware-based technology after another in schools without being able to improve the quality of student learning, motivation, and personal productivity upon which the ultimate success of our educational enterprise depends.

What We Need to Understand about Technology and Education

The problem that confronts all who are concerned with improving educational productivity—no matter how variously they may define it—is the seemingly endless one of bridging that large gap between where we are as a society and where we could be were we able to fulfill the educational potential of all our members. At the present time, there are those who see "improved productivity," a concept derived from the technology of production, as a potential solution to this formidable socioeconomic problem. In a similar manner, technology itself is now being turned to for a solution to the productivity problem in our schools.

There is a serious question being begged here. How well do we understand technology, not just in itself, but also in its relation to the core educational processes of teaching and learning? We need to recognize that our current, and perhaps incomplete, view of technological solutions and concepts can lock us into ways of thinking about education, productivity, and technology that may head us toward a solution to the educational productivity problem that may prove—in the long term—to be socially undesirable. In short, it may prove vitally important for us to examine and to gain a clearer and deeper understanding of technology, especially in its relationship to teaching, and to that most fundamentally productive of all human acts, learning. What follows is offered as a first step in that direction.

A noted Jesuit scholar, Walter Ong (1963), has commented that in Ancient Greece technology meant originally "an ordering of subject matter in a logical fashion so that it might be taught." The subject matter referred to included all "human arts"— the useful, the aesthetic, and the intellectual or liberal (freeing) arts. Based on this original meaning, Ong argues, technology pertains to "the ordering of the possessions of the human mind." This writer has used this statement by Ong as an argument for the computer as the most fundamentally technological artifact yet developed, and clearly the most educationally important technology ever devised.

Ong's helpful identification of this fundamental connectedness of technology to the organization of human knowledge, and to the orderly transmission of that knowledge from one mind to another through the process of teaching, provides a unique insight into the nature of technology and

its "radical relatedness" to education (Komoski, 1973). However, it is the commentary of the intellectual historian, Scott Buchanan (1963), that opens a window to a particularly relevant insight as to why the task of improving productivity in education may differ markedly from improving productivity in industrial production—even though the latter may depend profoundly on the former.

It is both unfortunate and ironic that the important difference between industrial and educational productivity is rooted in centuries-old knowledge about the nature of technology that goes largely ignored in the present overwhelmingly technological society. It is, therefore, doubly important to reassert and to reflect on that knowledge as we examine its radical implications for understanding the requisite conditions for developing more productive learners—hence more productive schools.

To begin with, Buchanan (1963) points out that in addition to recognizing technology as the human capacity to analyze, order, and transmit all human arts, the Greeks implicitly recognized that all arts were not of the same nature. But, says Buchanan, it was not until the Middle Ages that thinkers fully explored and articulated the important distinction implicit in the Greeks' description of the arts (i.e., technology). The result was the organization of all human arts into two distinct groups. In the first group are the arts practiced on matter and on the many things and forces found in nature. These arts, such as sculpture, agriculture, hydrology, painting, carpentry, cooking, etc., are arts in which "*the form in the artist's mind... could be impressed on the matter... which could be fashioned and formed.*" Buchanan demonstrates the degree to which our past as well as our present understanding and uses of *all* technologies have been—and continue to be—influenced by this view of "*technology as a system of exploitation.*"

In the second group are those arts "*practiced on human beings, who also have artistic capacities.*" In humans there are "*natural processes which if left to themselves might accomplish their ends, but if aided by the professional would accomplish their ends more easily and more fully. Medicine and teaching were the frequently discussed examples of such arts. They were called cooperative arts because they were understood to be cooperating with rational natures.*" The physician who gains the cooperation and confidence of patients, and the teacher who gains the willing cooperation of students, are much more apt to end up with healthy patients and competent learners than those doctors and educators who fail to gain such cooperation.

Based on this distinction, we shall examine two types of technologies: Type 1 technologies that are *exploitative* in nature—and of nature—and Type 2 technologies that are *cooperative* with the aesthetic and rational capabilities of human nature. Also, based on this distinction, it seems more than reasonable—even devastatingly accurate—to recognize that the view of technology that has dominated almost *all* aspects of western society, at least since the beginning of the Industrial Revolution, has been a view heavily influenced by experiences with Type 1 (exploitative) rather than Type 2 (cooperative) technologies. In other words, it has been the *exploitative technologies*, with their undeniable and demonstrable efficiency and effectiveness, that have shaped our thinking about, and our practice of, all

technologies—including those such as medicine and teaching that, presumably, function more effectively when practiced as *cooperative technologies*. Lewis Mumford (1967), one of this century's most noted students of technology, made a somewhat similar distinction when he talked of "authoritarian technology" and "democratic technology." However, Mumford's distinction has more to do with the size and purpose of the technological enterprise than the nature of the medium on which the technology is used, i.e., inert matter, natural forces, people, etc. He sees certain technologies as lending themselves to centralized authoritarian control, while others seem to foster decentralized, more democratic use. Reflecting on the nature of the constantly expanding size of the public education enterprise during the last century and a half, we see an institution in which centralized control has been an important value, especially in urban districts. Paralleling that need for centralized control with an endemic inability to recognize the nature of education as art/technology, it is easy to understand how schools have become more authoritarian and exploitative than democratic and cooperative.

The results of the misapplication of the exploitative technologies to educational practice and administration are not difficult to discern. Too many commentators and critics have decried the school-as-factory model of education (Apple, 1979) to need to dwell on it here. However, it is important to understand that: (1) although the exploitation of nature and its resources may cause unforeseen problems for both nature and humans, exploitation as such is not always a bad thing, as is proven every day by the careful husbanding of land and animals; and (2) while both the factory and the factory-like school (Kliebard, 1971) have been justifiably criticized for their treatment of those whose lives are affected by them, on balance, factories and schools have done more to improve the quality of human life than to debase it. Nonetheless, an increasing number of technology-exacerbated problems have arisen in schools since the Industrial Revolution that provide us with ample evidence of the extent to which educators and their supporters have allowed inappropriate and poorly understood technological concepts, practices, and products to play a debilitating role in the lives of hundreds of millions of learners and teachers for almost two centuries.

BALANCING THE SYSTEMATIC WITH THE SYSTEMIC IN CURRICULUM AND INSTRUCTION

When the textbook industry emerged in the 1840s as a symbiotic support for the new system of public education, it provided the major elements in a rigidly-structured, production-like system of instruction in schools, which reflected the growth of technology throughout an expanding, exploitative system of industrial production. By the beginning of the nineteenth century, the Industrial Revolution had inspired educational practices such as Joseph Lancaster's "monitorial system" of instruction. In that primitive integrated instructional system, which used wall charts and copying slates, older students monitored the progress of younger students as they recited and rote-learned their way through a series of graded lessons in what today would be considered the most basic of skills. The system used no teachers as such. By the 1820s, Lancaster's systematic method of instruction had spread rapidly, as had the factory's systematic method of production, from England to the growing urban centers of North America.

The heart of this systematic approach to instruction was the graded series of linear lessons. These graded lessons were eventually organized into book form, and the books systematically organized into graded, linear series which, in turn, reflected the grade-by-grade, linear organization of the growing system of public schooling. These graded textbook series became the "integrated system" of the mid-nineteenth century—the teacher-text-chalk-talk system. It is this system, though decried by many as outmoded, inefficient, and unproductive, that still dominates instructional practice in many, perhaps even most, U.S. schools as the twentieth century nears its final decade. This undeniable dominance is not based so much on the textbook's instructional effectiveness as on its administrative convenience for school boards, school administrators, and classroom teachers. School boards feel a need to make sure that schools are providing systematic instruction. Administrators need to be able to assure their boards that this is the case. And teachers need a day-to-day program to follow as they teach. Ever since the beginning of public schooling, the textbook has helped to fill each of these needs.

The frustration that many feel with the more than a century-old teacher-text-chalk-talk system stems from the fact that, although in most schools this textbook-based system has often been embellished, it has never been successfully replaced by alternative, integrated systems utilizing what generations of critics have claimed to be superior means, media, and methods. When such potential alternatives began to appear early in the current century, they came to be viewed by both their developers and users alike as useful supplements, rather than valid alternatives, to the established textbook-centered system. Such supplemental materials, in the order of their appearance, were workbooks (beginning in the 1920s); teachers' guides (sometime during the 1930s); film and other audiovisual materials (in the 1930s and 1940s); television (beginning in the late 1950s); teaching machines and programmed texts and workbooks, as well as language laboratories and

dial access computer-assisted instruction (during the 1960s); management systems (starting during the 1970s); and microcomputers (in the 1980s).

While some schools have done well at effectively melding these means, media, and methods into well-designed instructional programs, in far too many schools such things are, at best, curriculum add-ons that publishers have cosmetically correlated to textbooks, often using color-coding and similar surface connectors to substitute for substantive curriculum integration.

While it is true that such correlations have been done systematically, it will be argued that almost all such efforts have been *systemically* flawed. The distinction being made here between systematic and systemic is an important one for educators to adopt if they are to move beyond the present practice of systematically addressing one or two parts of the curriculum and instruction process, while failing to deal with all parts of the process as dynamically interrelated elements of a systemic whole. For example, a school may spend a good deal of time and money systematically selecting and correlating supplementary materials with a textbook without asking such questions as: "Is this particular textbook the one that best fits our school's curriculum?"; "Do the supplementary materials we've selected effectively extend the limits of textbook learning?"; or even, "Might not students enjoy and learn more from the curriculum if learning were not so thoroughly textbook-based?" More importantly, publishers may develop a product very systemically, and systematically ascertain that it's an item that schools will buy. Schools may select that item just as systematically, but seldom do publisher or school take the trouble to ask: "Is this material capable of engaging learners and sustaining their interest in learning more, i.e., does the material cooperate with every learner's natural, aesthetic, and rational proclivity to want to know more about things that seem interesting?"

Appropriate answers to questions such as these can only be arrived at when those asking them are capable of maintaining a broad systemic focus in which the need to cooperate with the individual learner is a critical and continuing concern. It is one thing to have a curriculum document that represents a systematic curriculum effort; it is quite a different matter to sustain an effective, dynamic program of learning from day-to-day which is based on a well-integrated curriculum that gains and maintains the cooperation of learners throughout their schooling. Tall order though this may be, it is what must be done in thousands of school districts if we are to build a foundation for long-term, healthy productivity, and not some narrowly conceived technological quick fix that is ultimately exploitative of learners and teachers.

Unfortunately, a lack of systemic integration is not restricted to the materials level of the curriculum and instruction process. The same lack of systemic coherence can also be found at the conceptual and management levels of the curriculum as well. This is a serious problem, one that deserves a great deal more attention than it is receiving at present. This lack of progress with the systemic—not merely systematic—nature of the curriculum enterprise is particularly disheartening when a valid conceptual framework and a rationale for the development of systemically coherent curricula has been available to us for almost 40 years.

This rationale, initially articulated as a set of helpful principles by Ralph W. Tyler in his *Basic Principles of Curriculum and Instruction* (1949), has been endlessly adapted and expanded upon by others over the decades. But the tendency in many of these efforts has been to emphasize solely Tyler's advice about systematically answering each of the four questions used as a framework for his well known "rationale":

1. What educational purposes should a school seek to attain?

2. What educational experiences can be provided that are likely to attain these purposes?

3. How can these educational experiences be effectively organized? and

4. How can we determine whether these educational purposes are being attained?

While many educators pay their intellectual respects to the *systemic* interrelatedness of these four questions, the actual, operational response to them in schools is apt to be the systematic answering of not more than one or two of the four questions within a given year. Too often the work must be done within severe limitations of time, money, and teacher availability that preclude a fuller, systemic approach to the curriculum and instruction process.

Nonetheless, such truncated efforts frequently produce impressively systematic lists of instructional objectives, a systematic process of textbook selection activities, a systematic cataloging and correlating of supplementary materials, and the systematic testing of learners. However, unless all such efforts are well-integrated parts of a dynamic, adaptive curriculum development strategy, they will not be capable of producing what is really needed to get—and/or to keep—learners, teachers, and the entire school community cooperatively engaged in achieving the school's purposes. In the meantime, teachers and administrators go on "keeping school," and expediency continuously erodes the probability that the curriculum and instruction process will achieve those purposes.

The result is that, increasingly, textbooks define a school's curriculum content, teachers' guides spell out instructional practice, and tests delineate the curriculum's goals and objectives. And, with increasing frequency, packaged integrated systems of advanced learning technologies are being correlated to those textbooks and tests—which serve to reinforce those text-test driven curricula—in the hope of improving educational and national productivity. The paramount goal becomes to use those textbooks and systems to do well on those tests. As a result these various *means* of aiding a school to achieve and to assess its educational purposes have become *ends* in themselves. Teachers strive "to cover *the text*," while administrators make it painfully clear that "students must do well on *the test*." Educators who have taken schools down this road of substituting means for ends seem satisfied, even enthusiastic, and seemingly unaware of the implications of their actions.

What's wrong with such systematic coverage of texts and preparation for tests? What's wrong with this system? Doesn't it help us to know what teachers and students are supposed to be doing, what we're getting and not getting, and what the trade-offs are?

These are some of the questions that educators will be answering by the decisions they make and by the actions they take about curriculum and instruction in the years ahead and at least through the end of the century, as increasing numbers of prepackaged, integrated systems become available to schools. By these decisions, we shall move toward either an increasingly "closed-in" or a more "opened-out" approach to curriculum and instruction in schools. Unfortunately, the fact is that *it is a lot easier to think in narrow, systematic ways than in broader, systemic ones* about the curriculum and instruction process. By focusing systematically on one or more curriculum elements (e.g., the test) it is easy to lose sight of the systemic dynamics that inextricably bind them together in an interrelated whole. By committing to a systematically packaged, *closed-in* curriculum program that promises results on a pre-determined measure, it is easy to ignore the need to develop an *opened-out* systemically-evolving curriculum designed to educate students for an unknown future, rather than to train them to do well on today's known tests.

The closed-in approach to curriculum makes for a more administratively convenient system. Witness the century-and-a-half hegemony of the graded-textbook series and the support of textbook-like instruction by the use of prepackaged computer-implemented systematic instruction. What is particularly unfortunate is that, over the decades, schools have responded systematically to the four question-based principles of Tyler's curriculum rationale while clearly missing its embedded systemic message. For, although Tyler does not use the word systemic, he does speak about the necessary interrelations of the four basic principles (Tyler, 1949).

By emphasizing the need for curriculum workers to address the necessary interrelations of all four principles, Tyler is implicitly identifying a fifth basic principle of the curriculum rationale. This fifth principle can be readily expressed in Tyler's question-asking style as:

How can a school maintain a systemic balance among the activities called for by the first four questions?

In other words, the implied *fifth basic principle* of curriculum and instruction calls for maintaining an adaptive systemic equilibrium among the four basic elements of a school's curriculum. Such curriculum equilibrium is not easily maintained. It will never be easy because the maintenance task means constantly attending to the dynamic tensions and trade-offs that are always operating among each of the first four basic curriculum principles and among those responsible for the various parts of the curriculum.

But when the first four principles are attended to systemically—rather than simply systematically—this fifth principle will become so deeply embedded and integrated within the work of the curriculum that there would seem to be little need to single it out for special attention. However, the trun-

cated state of the curriculum and instruction process in many schools today makes it essential to feature this fifth *principle of systemic equilibrium* as the centerpiece of much-needed curricular reform throughout elementary and secondary education.

Closing-in, or Opening-out Curriculum through Technological Choice

As already noted, generations of school administrators have tended to delegate to the publishers of textbooks many decisions about both major and minor curriculum concerns that would otherwise have to be resolved within schools themselves. This goes back to a long-used administrative mechanism of standardizing instruction by means of adopting uniform textbooks for each curriculum area in order to achieve a sense of curriculum coherence and control:

> The great variety of textbooks on the same subject [is] acknowledged by all to be one of the greatest evils which afflicts our schools... Whenever superintendents find this difficulty existing, they should not fail to point out its injurious consequences and to urge a remedy by the adoption of uniform textbooks as speedily as possible. (Superintendent of Common Schools, 1847, p.181)

The widespread continuance of this nineteenth century practice throughout the twentieth century means that in many schools today textbooks are either the driving force within the curriculum or have, in fact, become the curriculum. When either is the case, administrators may, in fact, achieve a good deal of managerial comfort, but they give up having a curriculum that can continuously revitalize the life of a school. Curriculum as an adaptive, equilibrium-seeking force that keeps the school in touch with the present while moving it into the future, is no longer an option; it is an imperative. Yet in schools today this imperative is traded-off for the comforting feeling that "we know *exactly* where we are, *exactly* where we are going, *exactly* how we are going to get there, and *exactly* how we are going to be able to prove to ourselves and others that we have, indeed, arrived." Even though each year we tend to end up back where we started.

Isn't this a reasonable trade-off? After all, isn't schooling an intentional process? Shouldn't every school be able to show that it knows where it is, where it intends to go, how it will get there, and how it will demonstrate that it has arrived? The answer to each of these questions is, of course, yes. In each case, the yes must be qualified with a "yes but..." that says, "when we are working with a *cooperative* technology (e.g., education), we can never know things with the same exactness that is common to those technologies that do not depend on human cooperation for their successful application." The fact is that with educational (i.e., cooperative) technology, a school is dealing with large numbers of individual learners and teachers on whose cooperative efforts and energy the success of the curriculum depends.

What this means for the process of curriculum and instruction is that the task of sustaining the dynamic, systemic equilibrium essential to the successful development and implementation of a school curriculum cannot be

the exact, systematic, and predictable enterprise that its intentional nature might suggest. In other words, both curriculum and instruction need to be systematically attended to, but if they become too systematic, the cooperative dynamics on which systemic vitality depends will atrophy. As a result, the school's curriculum fails. It is no longer an effective, adaptive force in the lives of teachers, students, and parents, all of whom will express their dissatisfaction with the no-longer vital system in different ways.

Granted, the sickly system may be gussied-up to produce short-term gains in test scores. The hundreds of thousands of test-preparation workbooks schools purchase each year attest to this reality. All concerned know that the system is not well; that somehow it needs to be resuscitated in ways other than by rigging up a closed-in system of narrow curriculum objectives that can be systematically taught, learned, and tested with exactness and predictable success. But where to begin and how?

When, and if, such revitalization begins to happen, it will have to start at the techno-educational root of the teaching-learning enterprise, i.e., technology as the ordering of the possessions of the human mind so that they may be taught. If that revitalization is sustained, its continued sustenance will require a broad-scale, in-perception and in-practice, shift away from the use in education of concepts and practices misappropriated from the exploitative technologies. In other words, it will have to move toward the perception and the practice of education as the most important of the cooperative "arts."

There is, of course, little likelihood that such a two-level paradigm shift is likely to occur in the foreseeable future. A more likely scenario, it seems, will be education's living through yet another well-intentioned, misguided, and ultimately ill-fated attempt to improve educational practice through misappropriated technology. This would be followed by the inevitable pendulum-swing reaction: "Educational technology never delivers on its promise, it just costs a lot of money!" What, if anything, can be done to avoid such a scenario?

Avoiding that scenario will not be easy. It may appear to be impossible. Nevertheless, every effort must be made to avoid it because the cost of failing to do so is far too great. The forces to be overcome are formidable and entrenched, both in the organizational structure of our schools and in habits of mind and action that guide those schools. To begin working toward a more systemic, balanced, and cooperative approach to curriculum and instruction will mean that people, budgets, and programs that habitually do not function as a systemic whole, will have to break long-established professional and institutional habits, some of which have become enshrined in district, state, and federal policies.

The difficulty of changing these habits and the policies that legitimatize them is both subtle and deep. On the surface, everything looks reasonable: a curriculum committee is appointed that produces a written curriculum; another committee is assigned to the textbook selection process; the selection of other instructional materials becomes the responsibility of small teacher groups, individual teachers, or a media specialist or librarian; still another committee or a professional consultant may be involved in deciding about the district's testing program. All very reasonable. And, in all likelihood,

very systematic. But, invariably, this very reasonableness results in each of the activities taking on a life of its own, and a turf of its own, with a budget of its own, with each turf and budget having its protectors and promoters. The all-too-common result is an analyzed and partitioned curriculum where there ought to be a seamless, systemic synthesis.

One reason for the difficulty of working systemically is the reticence of educators to acknowledge openly that the above scenario describes, or comes very close to describing, the way things operate in their school district or in their state education agency. However, many local and state-level administrators, district curriculum consultants, media and technology directors, and teachers serving on curriculum selection committees have privately shared countless "war stories" confirming the validity of the separate, though systematic, treatment of what they readily acknowledge to be systemically interrelated elements of the curriculum and instruction process. The administrators, specialists, and teachers just referred to are from districts that are conscientious about the curriculum and instruction process; however, their counterparts in other districts are simply insensitive to the issue, given the realities. Twenty years of speaking and working with many educators from the latter type of school district convinces me that, in such schools, one of three additional scenarios obtain: (1) at present there is no up-to-date written curriculum guiding the overall instructional program; (2) if there is a written curriculum, it is "being driven," is "modeled on," or has been "extracted from" the textbooks or the tests that are being used; and (3) the textbooks teachers are using *are* the curriculum.

There are, to be sure, a small minority of school districts in which administration, staff, and parents (even students) are continuously creating and recreating a responsive, systemically vital program of curriculum and instruction. It is heartening to see a district functioning well in this all important area of its life. But, unfortunately, this minority of districts does not yet represent the critical mass needed to serve as ready models for the vast majority.

Curriculum Alignment: Symptom of Systematization or Systemic Solution?

The current interest on the part of local school districts and state education agencies in "curriculum alignment" can be viewed as both a measure and a symptom of the current widespread curriculum disarray in most schools. As characterized earlier, the nature of this disarray takes the form of a truncated view of what a school curriculum is and what it ought to be. As a result, there are a number of ways in which school districts approach curriculum alignment. Each of these approaches reveals something important about the sorts of curriculum truncation going on in schools. The four approaches discussed below, while typical, are not exhaustive.

First, it is quite common for districts to view curriculum alignment as simply the systematic aligning of textbooks with a mandated test, particularly in the many districts in which textbooks and tests have replaced the curriculum development process. Second, it is almost as common to find

schools wanting to find a test that aligns with the textbooks they are using, or ones they are about to adopt for use. In such cases, curriculum alignment is perceived as a process through which a single element of the curriculum—usually a testing program—becomes the element to which all other elements are expected to conform. If the central aligning element is a textbook, then the instructional program becomes geared to covering the textbook. If the aligning element is a test, then the instructional program becomes geared to preparing learners for "the test," even to the extensive use of commercially published test-preparation workbooks during the six to eight weeks of the school year that precede the administration of the test.

A third approach to curriculum alignment used by a school system is one in which both the means and the ends of a curriculum may be decided by purchasing one of today's proliferating computer-based integrated learning systems. When such a system is decided upon by a school district, few curriculum decisions have to be made other than the decision to purchase and to use the system. Most, if not all, curriculum and instruction decision making has been done by the developers of the prepackaged program, and, hence, delegated to them by the district that purchases the package. The system's developer has decided issues pertaining to curriculum purpose and content, instructional strategy and tactics, teacher and student roles, the amount and nature of teacher and student control of the system, and how student learning is to be assessed.

In a fourth—less common—approach, there are districts that begin the curriculum alignment process with a carefully considered, locally developed curriculum statement, which usually takes the form of written sets of objectives at each grade level for each subject area. Then the rest of the process usually focuses on the task of examining and selecting textbooks and supplementary materials that align closely with the district's written curriculum, not always an easy task. In the course of this process, trade-offs are inevitably weighed and compromises yet have to be made. Although all too often there is little attention paid to the design of learning experiences that are valid alternatives to instruction based on the almost exclusive use of commercially marketed materials, this approach to curriculum alignment is clearly more systemically oriented than the other three.

In the first two approaches schools are taking commonly used *means* of fulfilling the instructional and assessment requirements of the school curriculum (i.e., textbooks and tests) and have elevated them to the status of *ends*. In the third case, much, if not all, of the curriculum and instruction process—both its means and its ends—has been turned over to a commercial vendor. Only in the fourth approach do we have an example of a conscientious effort being made to articulate ends before considering the means to achieve those ends.

In each of the first three instances, the process of curriculum and instruction has been truncated—to a greater or lesser degree—by the technological choices made by the professional educators to whom parents and other members of local communities have delegated decisions about how the community's young persons shall be educated. Traditionally, few parents or community members have questioned the degree to which those to whom

they have delegated decisions about the what's, which's, and how's of curriculum and instruction have, in turn, delegated their decisions to others. To date, those parents and others who have done such questioning have usually done so on moral or religious grounds.

If schools increasingly turn to using the teacherless textbook of a computer-implemented integrated system as a major vehicle for delivering learning, it will be interesting to see whether parents begin to question who is in charge of these new educational horseless carriages as they transport students down the learning highway, perhaps more swiftly than ever before. Will parents care about how their children feel about the journey and about themselves as learners, or will they simply assume that whatever decisions schools make in these matters will be the right ones? And what are the chances of these decisions being right? The truncated approach to curriculum and instruction currently used in most schools should give thoughtful parents pause.

First of all, the very idea of an aligned curriculum ought to be viewed as the practical result of a school's wanting to apply all four of Tyler's basic principles by making sure that a curriculum's goals, learning experiences, instruction and materials, and assessment (testing) of what has been learned, are all effectively interrelated. Invariably, when this writer has described the idea of curriculum alignment to noneducators, the reactions have been: (1) "Well, that's just common sense, isn't it?" or (2) "You mean schools haven't been doing that all these years? No wonder they're in trouble!"

Consider once again an automotive analogy, the obvious one of wheel alignment. In this analogy we see that most schools empower only one of the four "wheels" (i.e., the "textbook wheel," or the "test wheel") on which a well designed curriculum depends. The result is that, like most automobiles, most schools are going down the educational highway with a curriculum with a "one wheel drive." But unlike a car with one drive wheel, the test- or text-driven curriculum lacks a mechanism comparable to a car's differential with which to balance the car's power and smooth forward movement.

The result is that most schools' current curriculum "vehicles" tend to move curriculum in circles or veer from one side of the educational highway to the other, i.e., from minimum competencies to high standards, from traditional taxonomic content organization to process learning. The role of textbooks and tests in the cyclical, or pendulum-swinging nature of school curricula, is clearly apparent. As long as a school's program is allowed to be driven by only one element of the curriculum instead of being moved forward by the well-balanced, well-coordinated power of all four basic elements of the curriculum, schools will continue to repeat the present pattern.

The four-element, goal-driven curriculum, like the four-wheel driven automobile, is the safer technology, especially when changing conditions are apt to make for rough weather ahead. But the four-element driven, systemically-balanced, adaptive curriculum is a possibility only if schools undertake to reclaim the control of the curriculum that they have been delegating to textbook publishers and test makers. Doing this will mean taking the time and the care to go back to the basics, i.e., the basic principles set forth two generations ago in Tyler's seminal approach to the curriculum and instruction task.

The current interest of schools and state education agencies in curriculum alignment is a necessary, but hardly sufficient, step in the right direction. It should be taken more as an indicator of a well-established and chronic curriculum disease that schools must consciously work to cure, than as a quick fix which, along with the miracle drug of the advanced learning technologies, can rapidly result in instructional improvement. The answer to the educational health of our schools is the same as the answer to our personal mental and physical health: attend to the systemic needs of the whole organism. For education, this will mean a program designed to exercise those curriculum decision-making muscles of school people that have become flabby from disuse and abuse. The question is whether enough schools will rise to the challenge by exercising both their muscle and their options.

Correcting Systemic Curriculum Imbalance

A major means of meeting this challenge must be a sustained effort on the part of schools to rebalance their curricula by paying much greater attention to the first and the second of Tyler's four basic principles: (1) the need to carefully think through the educational purposes of the school; and (2) the need to design, select, and arrange learning experiences that treat each learner as an intrinsically valuable educational end, not as an exploitable means.

Unfortunately in many schools the first of these important activities is allowed to devolve into what often becomes the busy-work of writing—or adapting/adopting someone else's—instructional objectives. Just as unfortunately, the second of these activities is given even shorter shrift by using a selected textbook as the dominant learning experience for students, thereby further truncating the thinking through of experiences that will enable students to achieve the intended, more open-ended (than the textbook's) purposes of the school.

Creating such learning experiences means cooperatively tapping the enormous potential energy for learning that exists within the one out of every five members of the U.S. population who by law must attend school every day. Most current school improvement efforts seem focused on things other than the crucially important issue of how to create learning experiences that put students in touch with the intrinsic reward that comes with (1) productivity from mastering difficult but do-able tasks, and (2) getting in touch with the inherent strength, beauty, and power that resides in knowing something well.

Engaged Student Energy as a Cohesive Systemic Force

If the country's more than 15,000 school systems were to focus on the task of building such learning experiences into their curricula, they would see themselves as purposeful systems of human energy brought into being to facilitate learning. By examining the implications of this systemic view of schools and classrooms, it would become clear that not only is the human energy within such systems overwhelmingly student energy, but that at every moment within the life of such a system it is the disposition of that student

energy that defines how effectively a school system is fulfilling its societal purpose and responsibilities. Those who run school systems would become increasingly sensitive to the disposition of student energy toward the learning experiences being provided by a school's curriculum. This sensitivity can be heightened by recognizing that, in any purposeful human energy system, there are three potential energy dispositions: (1) a productive disposition, (2) a depressive disposition, and (3) a destructive disposition.

In a school system's classrooms, these dispositions are manifested along a positive to negative continuum. At the positive end of the continuum, learners are enthusiastically engaged in learning experiences provided by the curriculum. Moving toward the negative direction on the continuum, some learners are being bored by those experiences, while others may be resorting to the use of depressants, such as alcohol and other drugs. At the furthest negative end of the continuum, the curriculum's learning experiences are totally rejected and replaced by fighting, theft, vandalism, or leaving the system.

Every time an individual student responds to the school system in one of these ways, the character of that school is being defined. And every time a student chooses to behave in one of these ways, he or she is choosing to order or to disorder the possessions of his or her mind in a particular direction. Viewed in this way, we can see that students are shaping their own character as well as the character of their school every day.

The job of the school, therefore, is to provide each student with stimulating, *cooperative* technological learning experiences that honor the learner's *artistic capacities [and] natural processes which, if left to themselves, might accomplish their ends, but if aided by a professional, would accomplish their ends more easily and more fully.*

Perhaps the most famous statement about the importance of engaging the learner's interest, effort, and day-to-day involvement in a school's curriculum is John Dewey's 1913 monograph on interest and effort in education. The point of Dewey's monograph was that when learners become interested in a particular lesson or curriculum activity, they make more effort and learn more. Reflecting recently on the significance of this monograph for curriculum in the twentieth century, Tyler (1987) points out that Dewey's message ran counter to the prevailing "pedagogical dogma," about which Tyler says: "A guiding principle in the selection of curriculum and learning experiences was that the material should be distasteful to the students—not interesting, but quite the opposite. The idea was to build a curriculum on subject matter activities that were difficult and of no particular interest to learners so that they might gain discipline needed later in life" (Tyler,1987). Not surprisingly, Dewey's monograph, which appeared at the height of the popularity of Franklin Bobbitt's efforts to make schools models of industrial efficiency, had more influence on the development of new "progressive schools" than on the typical schools of the period whose administrators were much more concerned with Bobbitt's efficiency and scientific management.

Bobbitt invited school administrators faced with the challenging task of managing rapidly growing school systems to model themselves and their schools on proven examples of managerial and technical success of the sort

being achieved by the exploitative arts of "scientifically managed" businesses and industries. These administrators were approved and rewarded by society for following that model (Callahan, 1964).

Dewey's audience, on the other hand, was made up of teachers and others dissatisfied with the then current systematically graded instructional practice and excited by hearing about research-based, learner-focused practices at the laboratory school described by Dewey. His audience was less apt to come from the growing ranks of administrators faced with the task of organizing and managing the world's fastest growing system of schooling.

The dual legacy of these very different efforts by Bobbitt and Dewey in the early decades of this century, and the ways in which the inevitable tension between them has been played out in the lives of school administrators, teachers, students, and parents throughout this century, deserves more attention than has been given by those interested in school improvement. The tension between those who believe learning must engage the learner by making learning more interesting, and those who believe schools can become more efficient and learners more productive by "delivering learning," has been significant. As the century nears its last decade, this tension shows little sign of being reduced or resolved. In fact, a major message of the present work is that nowhere will this tension be more manifest than in how schools define and use integrated systems of instruction in the years ahead. The question is whether such systems (i.e., means) are going to become "the system" and define our educational ends, or whether such systems are going to be constructed and used as adaptive means that can help schools to achieve evolving educational ends that are as responsive to the needs and interests of individual learners as they are to the common needs of society.

The decisions that relate to how well our system of curriculum and instruction will meet these needs are going to be made in thousands of independent school districts containing some 100,000 school buildings across the country. They will be made by hundreds of thousands of school board members, school administrators, teachers, and parents. The success of those decisions will ultimately be known by the reactions of millions of learners who will engage either productively or unproductively with such systems. It will be in those decisions and those reactions that this century-long tension will be palpably played out.

To be sure, there will be many who will never feel the tension because they will be so certain that their decisions are, willy-nilly, going to make their schools and the economy more productive. For others, the tension will be masked by assurances that the instructional system they are considering is one with a proven track record of having out-performed conventional classroom instruction, and one that the "kids will enjoy" because of the interactive nature of the software used.

But for some, the tension will be real and pressing. These will be people with concerns, however vaguely or vigorously felt, about the effects of such systems on individual learners. Many of these people will, of course, be parents. But many will come from the ranks of our schools' best teachers, who intuitively know—and practice—education as a cooperative art/technology.

When such concerns are raised, it will be important that they be welcomed as honest questions about whether the experience of learners will be based on an exploitative and authoritarian, or a cooperative, democratic, decentralized view of educational technology. Advocates of cooperative technology will be challenged to bring forcible, articulate, alternative views of curriculum and instruction to bear on local decision making.

A Need to Examine Embedded Curriculum Decisions

What this means is that educators must examine with great care the curriculum and instructional decisions embedded within each integrated system under consideration (whether commercially purchased or locally developed, whether text-based or computer based) to determine if the decisions made by the designers of the system are compatible with the way in which those who will be responsible for implementing them view the teaching and learning process. That such decisions have been made need not pose a problem, unless, of course, they are found to be incompatible with—or clearly counter to—the decisions that those potential users would have made had they designed the system themselves. The point is that the curriculum and instructional decisions embedded in any integrated system—whether textbook or computer based—should be uncovered and examined before a commitment is made to use the system.

Whenever one is critical of using a prepackaged instructional system, a question that often follows is whether schools themselves can design their own systems. The answer to this question is that while there is no reason, in theory, why schools cannot create such systems on their own, there are many practical reasons why the average school is not going to develop an instructional system from the ground up. Given this reality, the next question is: would schools be able to create locally extended versions of a commercially purchased product if given proper assistance by systems developers? The answer is probably yes. But the answer prompts another question about the nature and quality of the assistance to be provided.

For example, many of the integrated systems currently being marketed to schools are replete with an "authoring system" that schools are told they may use to expand the system they have purchased. Such authoring systems, however, are seldom more than tightly restrictive generators of patterned instructional exercises that force a teacher to follow a set instructional paradigm with few, if any, optional strategies available. If such options do exist, taking advantage of them usually calls for more time or technical knowledge than most teachers possess. Even when teachers do have the knowledge and they are given the time to apply it, their effort is restricted to a single system's approach to a subject matter or curriculum area. The uniform textbook syndrome is still at work. A cooperative technology might have a teacher spend time and energy on the creation of a segment of mediated instruction that would be an example of that teacher's particular instructional strengths in responding to a particular need of learners not being met by the school's available instructional resources.

Approached in this way, teachers' mediated instructional efforts would be used to produce needed alternatives to conventional materials that are failing to respond to learners' needs for different types of learning experiences. In addition, such an approach to teacher-generated materials would give those teachers who are interested in and capable of assisting their schools in making the transition from exploitative to cooperative educational technologies a chance to do so without being exploited themselves by being forced to work within a closed-in instructional paradigm of a particular prepackaged integrated system.

Depending on how much of the students' total learning experiences are being provided by a prepackaged computer-based or textbook-based instructional system, teachers who are given the time may wish to concentrate their energies on the design of totally different types of learning experiences, such as community-based, peer-based, or individually-based systems. The hope is that during the last half decade there has been enough movement away from the administrator-teacher-textbook relationship reported by Shannon (1983) that administrators will encourage teachers to go beyond the constraints of prepackaged instruction, whether textbook or computer based. Shannon reported that although teachers claimed to dislike the idea of textbook-based teaching, they accepted the practice because "that's what the administration wants." However, administrators were reported as being equally convinced that the reason textbook-based teaching was so prevalent was because "it's what the teachers want."

Integrated Instructional Information: An Aid to Systemic Realignment

A generation ago, Ralph Nader gave voice to the intuitively-recognized truth that "information is power." Today, every modern businessman, lawyer, doctor, and professional consultant worth his or her fee not only knows but uses that truth to enhance and empower his or her professional effectiveness and productivity every day. The so-called Information Age is an age of empowerment for those who can apply and have applied information to help themselves and those around them. Today's widely used computer-based "productivity tools" are not hand tools made of metal and wood. They are "head tools" made of organizing principles, designed to help order the possessions of the minds of those who know how to use them effectively.

As we approach the beginning of the twenty-first century, where those who will have access to information and the tools and the knowledge to use it effectively will function as powerful professionals, educators remain information-poor. Neither teachers nor the administrators who organize and guide their work have information or information-management tools equal to the job society is expecting them to do. The important tasks of designing and sustaining useful, motivating, and intellectually valid learning experiences involve being and keeping informed about an increasingly complex array of continually expanding instructional options. For while most textbooks remain uniformly alike, and while the industry that produces them continues to implode, the computer software industry (EPIE, 1988) generates ever more educational software companies (currently over 800),

that, in turn, continue to produce ever more educational software (some 200 new options per month, with a current total of over 10,000 programs across all curriculum areas). Not far behind is a mounting wave of instructional video producers and programs that will add still more options for educators to consider.

A major implication of these shifts in types and numbers of instructional options available to schools is the problem of sorting out, identifying, correlating, and effectively using the most relevant of these options to fill a particular instructional need in a school's curriculum. A major aspect of this problem is that it can only be effectively solved if a school's curriculum and instructional decision makers have easy access to accurate, trustworthy information about the curriculum relevance of these options and are able to make informed judgments about their instructional quality. However, in order to develop a systemically-balanced, learner-responsive curriculum, schools also need ready access to information that will help them to think through the organization of curriculum content and processes that go beyond the current closed-in curriculum that is characteristic of both conventional textbook-based and current computer-based integrated systems.

In saying this, it is important to note that the closed-in nature of current prepackaged, computer-based systems is not in and of itself undesirable—nor, in fact, avoidable. What *is* undesirable and avoidable is the readiness of schools to allow the necessarily limited scope of and depth of such systems to define the scope and depth of the school's curriculum, which one hopes will always be reaching beyond the limits of available prepackaged systems. Such systems, as will be attested by all but the most zealous of the developers, were never meant to become *the* curriculum of a school. This is evidenced by the way in which many of these systems are marketed and used, i.e., to serve the needs of specific student populations.

The dozen or so computer-based integrated systems currently on the market tend to be "closed-in" in three ways. The most obvious closed-in aspect of some of these systems is due to the use of the proprietary hardware and networking technologies. The use of proprietary hardware makes it either impossible or quite difficult to use another manufacturer's equipment. This type of closed-in-ness has usually been a feature of systems that have been on the market for 10 years or more (i.e., before the advent of microcomputers) when pioneer companies like Computer Curriculum Corporation, WICAT, and Control Data Corporation (PLATO) were marketing networked computer-assisted instruction (CAI) systems that ran on either a terminal connected to a mainframe computer or a minicomputer. Since that time, few new proprietary hardware-based systems have entered the marketplace. This has put pressure on the pioneer systems to make provisions for using hardware other than their own. But not all have done this or do it as readily as, for instance, Educational Systems Corporation's programs, which can accommodate three major educational computer hardware operating systems.

The second way in which most of today's systems are closed-in is that most of them are based on a proprietary set of instructional software (and in some cases, proprietary print materials) that make no provision for, or prohibit the use of, other software on the system.

The third type of closed-in-ness is related to the level of curriculum goals and or objectives most current systems have been designed to achieve. For the most part, these systems are focused on very basic skills and are frequently marketed to schools with a focus on teaching at-risk learners who are not responding to regular classroom instruction. This focus has made marketing such systems easier than it might otherwise have been because it has narrowly focused the use of the systems to those students that many teachers have difficulty reaching, and on whose education federal monies may be spent by local schools. While this focus has made it easier to sell and to buy such systems, it has also been a factor in keeping many of the systems focused on lower-level learning goals. This has tended to restrict development of the fuller potential of such systems to help teachers and learners to move beyond textbook-like versions of computerized instruction and create learning experiences that take full advantage of the capabilities of today's computers and instructional design technology.

Because almost all of today's systems companies are heavily dependent on the availability of venture capital to fund further development, such events as the recent Wall Street crash are having, and will continue to have, ramifications for the future of integrated systems. Thus, while there is some movement in the direction of more opened-out systems, especially by some of the newer systems developers, this movement is much slower than what will be required to redirect the impact of today's computer-based integrated systems toward a more opened-out approach to teaching and learning.

But, as opened-out as such systems may eventually become, they will still be contributing to the predominance of materials-based teaching and learning. Consequently, in order to fully open-out the curriculum, those responsible for instruction in schools also need access to information that can help them become less dependent on instructional materials for providing students with learning experiences. This means schools need information about how teacher-generated (perhaps learner-generated) strategies can help learners to master aspects of the curriculum through experiences that go beyond those available in most instructional materials.

Finally, schools will need information about available means for assessing how effectively the instructional options they have selected and the learning experiences they have designed have enabled students to master their school's curriculum. Schools are going to need access to information that provides them with the power to select among and integrate their options into effective locally-controlled curriculum and instructional systems that can be systematically designed, yet systemically open to a changing educational environment.

Such locally constructed and locally controlled systems of learning would, of course, have to make use of current instructional technologies, both conventional and advanced. By working with those technologies in ways that keep them in a balanced relationship to other elements of a systemically designed curriculum, those technologies could be used in a variety of nonexploitative, learner-responsive ways.

THE INTEGRATED INSTRUCTIONAL INFORMATION RESOURCE (IIIR)

What form might such information empowerment for educators take? Totally open, broadly accessible, electronically-searchable, and interrelatable databases containing information on all types of curriculum-correlated information on every category of instructional material, varieties of teaching strategies—both materials-based and nonmaterials-based—as well as information on all types of tests and related assessment strategies. During the last five years, the primary research and development activity of the Educational Products Information Exchange (EPIE) Institute has been the design and implementation of such interrelatable databases, which, taken together, form the Integrated Instructional Information Resource (IIIR) (EPIE, 1987). To accomplish this, EPIE has been working with school districts and state and university level agencies to study and develop the sorts of information mentioned above, and to make such information an easily-accessible and integrating force in local curriculum and instructional planning and practice.

This integrated set of databases—one for each area of the curriculum, plus intercurricular concepts, skills, and processes—is now beginning to be used by schools to redesign local curricula, and to examine the quality of alignment that exists across major elements of an extant curriculum. This formidable undertaking began with the development of databases in the areas of elementary school mathematics and science, and the development of databases in reading and language arts and in social studies was begun in 1987. The overall development of the Resource and its component databases is viewed as a long-term evolving cooperative effort involving school districts, intermediate service units, state education agencies, and appropriate curriculum departments and study centers at universities. The Resource will be functioning for levels K-12 in the four major curriculum areas mentioned above by the end of 1989, and additional areas of the school curriculum will be developed in subsequent years.

At the present time, the Resource is being used primarily to assist schools in curriculum planning, curriculum development, and curriculum alignment in mathematics and science. Because the Resource is designed to help schools attend to the four basic curriculum elements in Tyler's rationale as interrelated parts of a complete instructional program, it can be a major means of helping schools to maintain these elements in systemic equilibrium, i.e., the fifth, and integrating, principle of a systemically-focused process of curriculum and instruction.

The Resource addresses the first of Tyler's basic principles by providing a comprehensive, evolving universe of curriculum descriptors to support a school's work in designing or revising its curriculum purposes, goals, and objectives. These descriptors may be used as an aid in:

- building locally developed curricula. By using this adaptable set of descriptors on a special curriculum design spreadsheet, curriculum committees can explore curriculum "what ifs" and continually order and

reorder a school's curriculum, subject area by subject area, grade by grade;

- analyzing, correlating, and comparing the subject matter content, and the cognitive processes embedded in textbooks, other learning materials, and tests to the content and processes called for in a school's curriculum;

- documenting and tracking the evolution of curriculum thinking and practice over time within a district, a state, or across states; and

- using state and nationally-recommended curriculum standards to inform local curriculum development. For example, the Resource's descriptors have been used to code state curriculum guides and such national-level standards as those of the National Council of Teachers of Mathematics. This means that schools can use the Resource as a means of informing their curriculum work with these state and national efforts to improve curriculum planning.

The Resource has also been designed to provide information related to the second and third principles of Tyler's rationale, i.e., learning experiences and their organization. The two types of information are:

- information on mediated learning experiences ranging from textbooks and the proliferating array of other instructional materials (computer-based, video-based, and print-based), to the increasing numbers of integrated systems, some of which combine computer-aided instruction and management with print and other media;

- information about nonmaterials-based learning experiences and about the ways teachers can organize use of materials to go beyond their obvious uses. This function includes such teacher-generated strategies, student studies of nature, local government, their own behavior, as well as having students carry out useful projects with their school and local community. Many such experiences may be found in the current work of the cooperative learning movement. (Rhodes & McCabe, 1985)

The information about textbooks and other instructional materials is created by using the universe of curriculum descriptors as the basis of an analysis system, which explicates the contents and various learning activities that students will experience as they use specific instructional materials. By coding the results of these analyses into the Resource's databases, it becomes possible for schools to access reliable information about the relationships between all types of instructional materials and an individual school's curriculum. And, eventually, to arrange these materials so that they serve the needs of individual learners.

Such information may be used both to select new materials and to make more effective use of the large number of instructional materials a school

already owns. Such materials are frequently not used effectively because teachers lack information about where and how specific materials or a group of materials might relate to the school's curriculum—or to the needs of individual learners—at a specific point in the instructional process.

The second type of information, i.e., information on nonmaterials-based learning experiences, is especially important. In most schools today, the predominant learning experiences are through the textbooks and other instructional materials that teachers in many cases are required to use. School curricula seldom define or require that teachers use nonmaterials-based learning experiences. This means that most teachers must initiate and depend entirely on themselves to create such experiences for learners. In order to help teachers identify appropriate nonmaterials-based experiences, the Resource contains a database into which exemplary teacher-generated, nonmaterials-based learning experiences, especially cooperative learning experiences, may be stored and accessed in relation to a teacher's or a school's curriculum goals. The emphasis in this component of the Resource is on experiences that are better taught through real-life experiences than via a textbook or other media.

It is clear to the Resource's developers that many teachers are deeply committed to creating such alternative experiences for their students, even though their school's curriculum may not specifically call for them. Some of these experiences may be extensions of learning that begins with particular materials, but then goes well beyond what the developer of those materials had in mind. By identifying and coding the work of such teachers into the appropriate database within the Resource, other teachers may use the Resource to find teaching strategies that go beyond materials to create a more balanced set of learning experiences for their students. Some of these nonmaterials-based strategies can be found in professional journals, in the project files of teacher centers, and in the work of special projects such as those related to the growing cooperative learning movement.

The Resource also contains information related to the fourth of Tyler's basic principles, i.e., the need to assess how well a school's curriculum goals are being mastered by learners. By using the Resource's curriculum descriptors to analyze and code test objectives and/or items into the Resource's database on tests, information about relevant norm-referenced and criterion-referenced tests may be accessed, correlated, and aligned with a school's curriculum goals, its materials, and its nonmaterials-based teacher strategies. It is also possible to create a link between the Resource and any of the many available banks of criterion-referenced test items.

The developers of the Resource believe that such *curriculum-referenced* tests might eventually be constructed and calibrated so as to enable teachers and schools to create their own customized, computer-constructed tests capable of addressing various levels of curriculum difficulty. Ideally, such tests would be correlated with nationally-normed tests in order to give comfort to those concerned about such matters. More importantly, they would enable a school district to thoroughly integrate the assessment component of its curriculum (the fourth basic principle) into its curriculum and instruction program in ways that would provide administrators, teachers, parents, and

students with relevant and appropriate assessment information when needed.

A major purpose of the Resource is to enable schools to expedite the time-consuming, systematic analysis and correlation that are essential to curriculum planning, materials and test selection, and curriculum alignment. As a result, it makes it possible for a school's curriculum planners and teachers to devote more time to thinking through the systemic concerns involved in using the results of those analyses and correlations in applying the crucially important fifth principle of curriculum and instruction. The importance of doing this—and the importance of the Resource's helping to create the time that needs to be spent on doing it—cannot be emphasized enough. Without the time to do what needs to be done, the curriculum efforts of most schools will continue to be limited to systematic concerns. Even in the most conscientious schools, so much time is taken up dealing with producing systematic information that there is little time and energy left to address the ultimately more important systemic concerns.

Helping to Do What Needs to Be Done

What is called for is a process of systemically-focused curriculum and instructional development that begins and proceeds very differently from the practices prevalent in most schools today. First of all, in this more systemic process there would be little acceptance of textbooks or tests as definers of a school's objectives. If these curriculum means are permitted to continue to influence educational ends as much as they currently do in our schools, curriculum and instruction will continue to be in deep trouble. This will not occur because of deviousness or incompetence on the part of textbook publishers and integrated systems developers, but because of a lack of effort by schools to make the curriculum and instruction decisions that they—by default, and without adequate examination—have been delegating to publishers and developers.

By buying into a set of prepackaged purposes contained in textbooks, computer-based systems, or tests, and then concentrating on covering the content of those texts and systems, or on preparing students to do well on a test, schools swiftly slip into the great technological temptation: turning means into ends. One way to avoid that temptation is to make sure that everyone involved in a school's life—administrators, teachers, parents, and students—is committed to the process of creating experiences that help learners achieve the school's educational ends without allowing any of today's prepackaged curriculum means to become so dominant that they are permitted to define a school's educational ends.

For instance, if one of a school's purposes is to enable learners to become competent gatherers, filterers, and processors of a wide variety of information for decision making about important issues in their lives, students will need experiences that go beyond textbooks and textbook-like learning. Likewise, if the work students do at school is going to prepare them for the cooperative, project-focused type of work that is increasingly being done in short-lived, special-purpose, "ad-hocracies" in today's business and professional world, they will need to be working in similar productive groups in

school. Interestingly, it is computer technology that is facilitating so much of the group problem solving that is going on in today's business and research enterprises:

> Corporations need [computer] tools that facilitate teamwork because the complexities of the business environment pose challenges that are beyond the grasp of even brilliant individuals. Only by pooling resources and combining different views of reality can businesses meet complex challenges with variety and flexibility. (Seybold, 1987, p. 35)

In most schools, however, student time on computers is still largely devoted to textbook/workbook-like learning experiences. In order for this pattern to change teachers need to become familiar and comfortable with alternative approaches. And they need to have ready access to information about a variety of specific, strategic options, and how to employ them.

A major goal of the Resource's developers is to have it become an effective means of training teachers to select curriculum-appropriate learning experiences for students based on a well-balanced mix of commercial materials and programs, and teacher and student generated individual and group learning strategies. Teachers who are frustrated by the limitations under which they are currently operating may find themselves looking to the Resource for ways to support needed changes in their present instructional practices. Whenever teachers are ready to use the Resource in this way, it can and will be adapted to meet their evolving needs for either inservice or preservice training. In anticipation of this, a network of cooperating teacher-training institutions is being developed to support the Resource's use as an instructional-problem-solving tool for classroom teachers.

The Resource's Role in Building Home-School Curriculum Connections

In addition to adapting the Resource to serve the evolving needs of teachers, research at the EPIE Institute is exploring ways in which parents may be able to use it to become more informed about their child's curriculum and about ways they can support and expand a child's learning at home. In this regard, the Resource can be particularly helpful in relation to the widely-recognized but poorly-realized educational potential of the home computer and VCR.

As important as it is for schools to be well informed about the proliferation of new computer/video curriculum options, it is just as important for schools to recognize and to support parental interest in home use of the new learning technologies. The need for schools to cooperate with parents by providing them access to information about these learning technologies is underscored by two facts regularly ignored by most schools: (1) computers in the homes of school-aged children outnumber computers in the schools of these children by a 12:1 ratio (EPIE, 1986); and (2) children whose parents have acquired software for at-home use that is related to their child's school curriculum learn significantly more from home computer use than do the children of parents who may spend more on software but who do not acquire curriculum-related programs for their child's use at home (Hess, 1984).

In light of such evidence, along with the self-evident importance of school-home cooperation, there is good reason for schools to make both information about materials and the materials themselves available for students' home use. Only a handful of schools across the country are currently helping parents find out about appropriate software. Even fewer schools are making software available for home use.

This must change. Schools must realize that technology is readily available that will enable them to provide not only curriculum committees and teachers, but parents as well, with information and materials with which to build an educational technology that is consciously cooperative with the needs, interests, and abilities of learners both in school and at home. For this to occur, educational practitioners and policy makers will have to reconceptualize and redirect educational technology toward the goal of providing all who are involved with teaching and learning with easy decentralized access to "the possessions of the minds" of *all* who have created learning experiences that may assist teachers and parents to implement curricula that engage the cooperating energies of learners. These creators of learning experiences may be established publishers of instructional materials or some of the more than 800 new developers of educational computer/video software; they may be individual teachers or groups of teachers brought together by their school districts or by mutual attraction; and they may be learners and their parents.

TOWARD A FUTURE OF OPENED-OUT CURRICULUM, INSTRUCTION, AND LEARNING

Today's readily available communications technology can not only provide schools, homes, libraries, and other community centers with electronically accessible information about relevant learning experiences, but this technology can also provide both teachers and learners with direct electronic access to the learning materials themselves. Now, all media—computer software, video, radio, print, etc.—may be digitized or transmitted and stored electronically for future school and home use.

During recent years, this feasibility has prompted new research and development on the idea of an "educational utility" for providing learners with electronic access to all types of mediated learning. The idea of such a utility was first explored, and its feasibility successfully tested, almost a generation ago (Georgia Institute of Technology, 1971). The current evolution of the idea and its renewed implementation is described by Gooler (1986) as a technologically-open, decentralized electronic distribution system for all types of educational materials, both commercial and teacher-made. Were such an open system (i.e., open to the use of all types of hardware and software) closer to the sort of system of optional product choices that characterizes much of the rest of life in our society, the still-dominant, closed-in systems of curriculum and instruction might evolve more rapidly in the direction of the opened-out, adaptive systems needed to enable schools to be responsive to life in a society in which change is the only constant.

However, in education as elsewhere, an ever-increasing deluge of technology-generated options is a mixed blessing. And it will remain a mixed blessing until teachers, parents, and learners are empowered with information that helps them to choose and to use available options as components of systemically sound learning plans. The readily available alternative to such a systemic interrelating of options is trivialization of those options by treating them as unrelated bits of knowledge. A cafeteria approach to learning without a menu comprising a common core of well thought through curriculum-relevant experiences is not going to work either in school or at home. Yet, parents are acquiring an almost random selection of computer and video software for children's home use, which, along with the computer, is soon relegated to a closet. Many schools are following a similar scenario.

One way of not having to deal with the many options being generated by education companies is already offered to schools in the form of prepackaged integrated systems. As has already been said, such systems require little, if any, decision making on the part of schools, teachers, parents, and students beyond the basic decision to purchase one or more of them. Whether the developers of such systems will themselves open them up in ways that will enable users to include options beyond those provided by the developer remains to be seen. If this practice does not become common (only one, or possibly two, of the currently available systems seem to offer this capability to users) the long-established and still-prevalent closed-in textbook-like system of instruction will probably prevail for still more generations.

To avoid this, schools must be willing to take the initiative and begin designing curricula that provide teachers and students with (1) a variety of options and strategies by means of which the school's curriculum goals might be effectively achieved, and (2) information about those options and strategies that would enable teachers, parents, and learners to choose the most appropriate among those options on the basis of both objective evidence and an intuitive feel for which among the competing options is the one to use at a particular time. Were schools to do this, the chance of teachers and learners being locked into closed-in curricula would be greatly reduced. Even the seemingly inviolate form of the hardcover textbook might be transformed into a flexible series of instructional lessons that could be electronically produced, distributed, and used alongside other instructional strategies at appropriate points in the curriculum. The tasks that need to be undertaken in order to achieve this sort of opening-out of curriculum and instruction are formidable to say the least. Even though the technology for creating and providing options is readily available, the amount of teacher and administrative retraining and refocusing that would need to be accomplished is considerable. Where the time and the resources to do this might come from is a major question, particularly when those to be retrained must continue to "keep school" every day.

Nevertheless, the choice to be made is before us. Technologies exist that allow educational policy makers, school boards, and school administrators to exercise and implement their professional choices. These choices will affect the learning and the lives of hundreds of millions of Americans for generations to come; for, as the history of the last two centuries has made abundantly clear, once a system of instruction becomes common practice, it tends to remain common practice for some time. Education and technology—and their combined effect on what it will mean to be a productive individual and a responsible member of society—are at an important point of confluence. Educational practice may well be at a watershed: curriculum, instruction, and learning may either begin to move more swiftly along the narrow course they have been following since the early nineteenth century, or head down a new, wider course that will enable schools to open out toward the twenty-first century with confidence.

There are major forces keeping schools moving along their well-grooved course: institutional inertia and the mistaken idea that the best way to assure the learning of a common core of curriculum that can link us together socially, and also make us economically more productive, is to continue to use uniform means of instruction in the form of textbooks or the textbook-like versions of the new advanced technologies.

The opened-out course of curriculum, instruction, and learning that has been advocated in these pages would still enable students to learn a common core of curriculum, plus much more of what each learner might be personally interested in learning. In addition, this new course would also enable learners to master that common core of curriculum through a variety of instructional means that would enable schools to be more responsive to the

needs of individual learners, both in school and at home. The result will be better learning not just of those things that everyone needs to learn, but the learning of things that go beyond that common core. Educational policy makers and school practitioners willing to take the risk of setting schools on this new course will soon find that the benefits far outweigh the risks.

BIBLIOGRAPHY

Apple, Michael W. (1979). *Ideology and curriculum*. London: Routledge & Kegan Paul.

Boorstin, Daniel J. (1978). *The republic of technology. Reflections on our future community*. New York: Harper & Row.

Bracey, G. W. (1982, November-December). Computers in education: What the research shows. *Electronic Learning* 2(3), 51-55.

Buchanan, Scott. (1963). Technology as a system of exploitation. In Carl F. Stover (ed.), *The technological order: Proceedings of the Encyclopaedia Britannica conference* (pp. 151-159). Detroit, MI: Wayne State University Press.

Callahan, Raymond E. (1964). *Education and the cult of efficiency. A study of the social forces that have shaped the administration of public schools.* Chicago, IL: Phoenix Books, The University of Chicago Press.

Dewey, John. (edition not dated). *The child and the curriculum* [and] *The school and society*. Chicago, IL: Phoenix Books, The University of Chicago Press.

EPIE Institute. EPIE Report #76. (1977). *A national study of the nature and the quality of instructional materials most used by teachers and learners.* Water Mill, NY: Author.

EPIE Institute. (1987). *Curriculum alignment services for educators: A capability of the Integrated Instructional Information Resource.* Water Mill, NY: Author.

EPIE Institute. (1988, in press). *The educational software selector-1988.* Water Mill, NY: Author.

EPIE Institute. (1984, November). The home-school computer connection. *MICROgram* 4(2), 1985. Water Mill, NY: Author.

Georgia Institute of Technology. School of Information Science. (1971, March). *Self-instruction systems: An alternate socio-technological approach to national education and training. A research report and prospectus.* Atlanta, GA: Author. ERIC Document Reproduction Service No. ED 081 194

Gooler, Dennis D. (1986). *The education utility: The power to revitalize education and society*. Englewood Cliffs, NJ: Educational Technology Publications.

Hess, R. D. & McGarvey, L. (in press). School-relevant effects of essential uses of microcomputers in kindergarten classrooms and homes. *Educational Computing Research.*

Kliebard, Herbert M. (1971). Bureaucracy and curriculum theory. In *Freedom bureaucracy, and schooling.* Washington, DC: Association for Supervision and Curriculum Development.

Komoski, P. Kenneth. (1973). Realizing the radical relatedness of technology and education. In *Introduction to educational technology* (pp. 113-117). Englewood Cliffs, NJ: Educational Technology Publications. Originally published: (1972, January). *Educational Technology* 12(1), 5-9.

Komoski, P. Kenneth. (1971, September). Fifty million learners can't be wrong, but who's listening? *Audiovisual Instruction* 16(7), 13-15.

Kulik, James A. (1985, April). *Consistencies in findings on computer-based education.* Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL. ERIC Document Reproduction Service No. ED 263 880

Mumford, Lewis. (1967). *The myth of the machine: Technics and human development.* New York: Harcourt, Brace, & World.

The National Task Force on Educational Technology. (1986). *Transforming American education: Reducing the risk to the nation. A report to the Secretary of Education.* Washington, DC: United States Department of Education. ERIC Document Reproduction Service No. ED 269 012

Ong, Walter. (1963). A report of the discussion in *The technological order: The proceedings of the Encyclopaedia Britannica Conference,* (Carl F. Stover, ed.). In Preece, Warren E. *Ideas of technology* (pp. 82-101). Detroit, MI: Wayne State University Press.

Perelman, Lewis J. (1987). *Technology and transformation of schools.* Alexandria, VA: National School Boards Association.

Preece, Warren E. (1963). Ideas of technology. In Carl F. Stover (ed.), *The technological order: The proceedings of the Encyclopaedia Britannica Conference* (pp. 82-101). Detroit, MI: Wayne State University Press.

Rhodes, Jacqueline & McCabe, Margaret. (1985). *Simple cooperation in the classroom.* Willets, CA: ITA Publications.

Seybold, Patricia. (1987, December 2). Collective force: Tools for group productivity. *Computerworld* 21(48a), 35-38.

Shannon, Patrick. (1982, May). Some subjective reasons for teachers' reliance on commercial reading materials. *The Reading Teacher* 35(8), 884-889.

The Superintendent of Common Schools. (1847). *Statutes of the State of New York relating to common schools.* Albany, NY: C. Van Benthuysen.

Tyler, Ralph W. (1949). *Basic principles of curriculum and instruction.* Chicago, IL: The University of Chicago Press.

Tyler, Ralph W. (1987). The five most significant curriculum events in the twentieth century. *Educational Leadership* 44(4), 36-38.