Part 1
The Field: History and Overview

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Educational Technology
A Question of Meaning

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Members of the profession recognize that while educational technology is a dynamic emerging field, it is, sadly, still seeking definition. In the relatively short period of its evolution, the field of educational technology has taken on a surprisingly wide range of meanings. This has resulted in some confusion about purposes and boundaries of the field. The writing of this article was motivated by the notion that putting these meanings into a more structured perspective might assist both experienced and novice practitioners in developing a clearer view of educational technology.

The following sections present a sampling of meanings for educational technology and for some related terms. While these meanings have been grouped according to a few basic questions, only brief commentary is offered with the thought that the greater value lies in analysis by individual practitioners. As a target for further speculation, a personal view of what the author has come to think educational technology should mean is presented in the last section. References to the meanings used are provided at the end of the article for the benefit of anyone wishing to study the meanings in their original context.

If the study of these meanings has any more benefit than to help educational technologists explain to their respective spouses, children, relatives, and friends "what it is that we do for a living," then the time taken should be well spent.

WHAT IS TECHNOLOGY?

Technology, the root word of interest, is almost as confused in the public mind as educational or instructional technology is in that of the profession. The representative meanings that follow bridge several interpretations, including some from education.

1. "Technology is a rational discipline designed to assure the mastery of man over physical nature, through the application of scientifically determined laws" (Simon, 1963, p. 173).

2. "Technology, in its concrete, empirical meaning, refers fundamentally to systems of rationalized control over large groups of men, events, and machines by small groups of technically skilled men operating through an organized hierarchy" (McDermott, 1981, p. 142).

3. Paul Sætterl, a well-known historian of instructional technology, states, "The word technology (the Latin form is 'teknē,' to weave or construct) does not necessarily imply the use of machines, as many seem to think, but refers to 'any practical art using scientific knowledge.' The practical art is termed by the French sociologist Jacques Ellul, as 'technique.' He believes that 'it is the machine which is now entirely dependent upon technique, and the machine represents only a small part of technique. Not only is the machine the result of a certain technique, but also its instructional applications are made possible by technique. Consequently, the relation of behavioral science to instructional technology, parallels that of the physical sciences to engineering technology, or the biological sciences to medical technology." (Sætterl, 1968, pp. 5-6).

4. The renowned educational technologist, James Finn, defined technology by saying, "In addition to machinery, technology includes processes, systems, management and control mechanisms both human and non-human, and ... a way of looking at the problems so to their interest and difficulty, the feasibility of technical solutions, and the economic values—broadly considered—of those solutions" (Finn, 1960, p. 10).

5. In contrasting science and technology, Admiral Hyman Rickover, the father of the nuclear submarine and a self-proclaimed critic of education, stressed, as reported by Krozevich and Eye, "that science should not be confused with technology. Science dwells on 'discovering true facts and relationships of observable phenomena in nature, and with established theories that serve to organize masses of verified data concerning those facts and relationships.' In contrast, he declared, 'technology cannot claim the authority of science,' for technology deals with 'tools, techniques, procedures: the artifacts and processes fashioned by modern industrial man to increase his powers of mind and body.' He then added that the 'methods of science require rigorous exclusion of the human factor,' for 'the searcher for truth cannot pay attention to his own or other people's likes or dislikes, or to popular ideas of the fitness of things.' On the other hand, since 'technology is action' rather than the pure thought that is science, technology may be potentially dangerous, if it is allowed to disregard human considerations" (Krozevich & Eye, 1970, p. 17).
WHAT IS THE ROLE OF TECHNOLOGY IN EDUCATION?

If one agrees with the meanings of technology just presented, it is clear that technology by definition is a major component of all human activities. Therefore, it is not a question of "having technology or not having technology," but rather what role it is allowed to play in human activities. That question has been the subject of study for a number of prestigious groups and individuals, as follows.

1. Herbert Simon views technology as man's way of interfacing between the (natural) and outer (artificial) environments (Simon, 1969, p. 9).

2. The Carnegie Commission concluded that: "technology should be the servant and not the master of instruction. It should not be adopted merely because it exists, or because an institution fears that it will be left behind the parade of progress without it. We also believe that sophisticated technology is not to be equated with saturation. In some courses, the use of technology may be appropriate for a few hours in an entire term. In a few, technology may be constructively used for two-thirds of the hours allotted for a term of instruction; in a very few, it may take over the entire process" (Carnegie Commission on Higher Education, 1972, p. 11).

3. There are a considerable number of writings that discuss technological inventions that affect education. The following examples make the point:

   a) "The alphabet provided the intellectual means for expressing, recording, and preserving the knowledge of mankind. The invention of paper and the refinement of writing instruments reinforced and made more practical the process of recording information with alphabetic symbols. The book [may be defined as] a "series of paper-based leaves of varying sizes which can be bound together, within a hard or soft cover, and organized for the purpose of presenting information in a sequential manner." In short, the book, like TV and the computer can be viewed from the mechanical aspects as separate from its substantive content. Movable type (Gutenberg) made it possible to have the written word within reach of the common man. The blackboard was one of the first joint communication devices that permitted teacher and student to view the same flexible referent at the same time. The school bus influenced the way pupils were organized for learning even in the most isolated areas" (Knezевич & Eeye, 1970, pp. 19-22).

   b) Engler views technology as being inextricably related to education. He states, "If we view the ecology of education as the web of relationships between and among learners, teachers, and the environment in which they operate, then it becomes apparent that these relationships are large defined by the prevailing technology of instruction" (Engler, 1972, p. 62).

   c) Professor Robert Heinich of Indiana University raises an interesting question about the relationship of teachers to educational technology, when he says: "Peter Drucker's largely misunderstood quote states that:
'Learning and teaching are going to be more deeply affected by the new availability of information than any other area of human life. There is a great need for a new approach, new methods, and new tools in teaching, man's oldest and most reactionary craft. There is a great need for a rapid increase in learning. There is above all, a great need for methods that will make the teacher effective, and multiply his or her efforts and competence. Teaching is in fact, the only traditional craft in which we have not yet fashioned the tools that make an ordinary person capable of superior performance.'

I say misunderstood, because most educators, after reading the Drucker quote, will not read their heads and automatically assume that he is asking for ways to increase the effectiveness of the 'classroom' teacher. Not at all. What he is asking for is a technology of instruction that can make an ordinary person capable of superior performance and a means, either printed or electronic, to distribute that instruction" (Hunsche, 1970, p. 56).

WHAT IS EDUCATIONAL TECHNOLOGY?

Now that something is known about the roots of educational technology and its role in education, one can ask the more difficult question, What is it? From the following attempts it is possible to see that meaning depends considerably on what part of the elephant is being touched and by whom.

1. The National Academy of Engineering's Instructional Technology Committee on Education defines educational technology as the "body of knowledge resulting from the application of the sciences of teaching and learning to the real world of the classroom, together with the tools and methodologies developed to assist in these applications" (Dieuzeide, 1971, p. 1).

2. Educational technology "is concerned with the overall methodology and set of techniques employed in the application of instructional principles" (Cleary et al., 1976).

3. Educational technology "is the body of tools that implements and aids people to improve the process of human learning... It is characterized by four features in particular: the definition of objectives to be achieved by the learner; the application of principles of learning to the analysis and structuring of the subject matter to be learned; the selection and use of appropriate media for presenting material; and the use of the appropriate methods of assessing student performance to evaluate the effectiveness of courses and materials" (Collier et al., 1971, p. 16).

4. Two conceptions of educational technology (ET) presented by Silverman are relative ET, which focuses on both procedures and devices, and constructive ET, which focuses on analyzing instructional problems, constructing and selecting evaluation instruments, and on production techniques and devices, all in terms of reaching desired outcomes (Silverman, 1968, p. 3).

5. Educational technology is a complex, integrated process involving people, procedures, ideas, devices and organization, for analyzing problems, and devising, implementing, evaluating and managing solutions to those problems, involved in all aspects of human learning" (AECT Task Force, 1977, p. 164).
WHAT IS INSTRUCTIONAL TECHNOLOGY?

A term often used interchangeably with educational technology, instructional technology (IT) presents refinements not found in meanings of educational technology.

1. The Commission on Instructional Technology defines IT in two ways: (1) as "the media born of the communications revolution which can be used for instructional purposes along side the teacher, textbook, and blackboard," and (2) as "a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication, and employing a combination of human and nonhuman resources to bring about more effective instruction" (Commission on Instructional Technology, 1970, p. 19).

2. David Engler, who has studied meanings of IT, tells us it is defined in two rather different ways. "First, and most commonly, it is defined as hardware—television, motion pictures, audiotapes and discs, textbooks, blackboards, and so on; essentially these are the implements and media of communication. Second, and more significantly, it is defined as a process by means of which we apply the research findings of the behavioral sciences to the problems of instruction. Defined either way, instructional technology is value free. Gutenberg technology, as an example, can produce the Bible, Mein Kampf, and Pornoy’s Complaint, with equal indifference" (Engler, 1972, p. 59).

3. Saetller thinks that the physical science concept of instructional technology "usually means the application of physical science and engineering technology, such as motion picture projectors, tape recorders, television, teaching machines (including the computer), for group (or individual) presentation of instructional materials" (p. 2). The behavioral science concept of instructional technology, on the other hand, suggests that "educational practice should be more dependent on the methods of science as developed by behavioral scientists in the broad areas of psychology, anthropology, sociology, and in the more specialized areas of learning, group processes, language and linguistics, communications, administration, cybernetics, perception, and psychometrics. Moreover, this concept includes the application of engineering research and development (including human factors engineering) and branches of economics and logistics related to the effective utilization of instructional personnel, buildings (learning spaces), and the new computerized machine systems such as data processing and information retrieval" (Saetller, 1968, pp. 4-5).

4. Instructional technology is made up of "the things of learning: the devices and the materials which are used in the processes of learning and teaching" (Armsey & Dahl, 1973, p. vii).

5. Instructional technology is "an effort with or without machines, available or utilized, to manipulate the environment of individuals in the hope of generating a change in behavior or other learning outcome" (Knerrich & Eye, 1970, p. 16).

6. An instructional technologist is a team member who "is a specialist in the learning process. His or her job is to help faculty members define the objectives of courses of instruction, to plot the learning strategies to be employed, and to evaluate results" (Carnegie Commission or Higher Education, 1972, p. 71).
7. A summary by the Commission on Instructional Technology states that the purpose of instructional technology is "to make instruction more productive and more individual, to give instruction a more scientific base, and to make instruction more powerful, learning more immediate, and access more equal" (Tiekoc, 1971, p. 72).

**WHAT ARE THE APPLICATIONS OF TECHNOLOGY?**

In discussing the levels of useful applications and their promise, the commentary runs from the pessimistic to the optimistic: "We pay our money and take our choices" (or is that chances?).

1. In describing the state of educational technology in 1972, Engler said that "the most accurate statement that one can make about our present (instructional) methods is that they are old technology. The basic media of instruction, such as textbooks, chalkboards, and teachers, have been used for many years. Today, teachers are better prepared, textbooks are better written and better designed, and chalkboards have changed color, but their functions and their relationships to learners have not changed essentially in over one hundred years. Moreover, the process by means of which instruction is carried on has not changed in any fundamental respect during this period. It remains teacher-centered, group-oriented, and textbook-based.... Its prototype was the Lancasterian model of large-group instruction which developed and spread in Britain and the United States in the seventeenth century; and while this model has undergone many modifications over the past century and a half, the general configuration of mass production education remains fundamental to this technology (derived from the impact of an industrial society on the role and methods of education)" (Engler, 1972, p. 61).

2. Clifford H. Block of the U.S. Agency for International Development, comments on the mammoth experiments with distance education technology by the British government: "By using television, radio, and the post, the production skill of the BBC, the instructional design skill of its superb educational technology group, and the center expertise of a first rate faculty, the British Open University has grown to more than 65,000 students, by all odds the largest university in Britain and one of the larger in the world. Its graduates have requisitioned themselves so well, and their intellectual standards are so high, that an Open University degree means a good deal even in status-conscious Britain" (Block, 1981, p. 73).

3. In discussing technology and change, Block further tells us, "It is tempting—very tempting—to speculate about the new world that we are coming into reality in the next few years: whole libraries available on a handful of videotapes; students of all ages learning at home through microcomputers linked by phone with vast educational data bases; instant access by satellite to an unlimited variety of televised information. But I, like many of the other contributors believe that we have learned that those fundamental changes will come to realization, in most cases, only in a gradual and often evolutionary way—rather than by some instantaneous sea change. Educational institutions, and those within them who learn, and teach, and administer, need time and experience to incorporate these new ways of learning into their individual, social and economic patterns of behavior" (Block, 1981, p. 72).
THE AUTHOR'S VIEW

The remainder of this article synthesizes the major definitions of the past into a current set which might be discussed by the profession at large. To do that, the author presents a proposed definition and provides an analysis for each definition.

Technology

Definition. The systemic and systematic application of behavior and physical sciences concepts and other knowledge to the solution of problems.

Analysis. Important terms in the definition are to be understood as follows:

1. "Systemic application" is included because of a concurrence with the system's notion that all things have an impact upon and are affected by other things in their environment. The effect of this interaction needs to be considered in constructing any system, if it is to be effective, efficient, and relevant to its purpose.

2. "Systematic application" is included because it is easy to pass over or leave uncontrolled many significant variables in a complex system such as learning.

3. "Application" is the translation and implementation of scientific and other knowledge into a system of strategies and techniques designed to solve a problem. Thus, strategies (designs for action) and techniques (practical or established means for accomplishing something) become the primary units of technology. In other words, the strategies selected for solving a problem are equated with action designs, while the tactics for making the strategy work are equivalent to techniques.

In support of the author's definition, the following points should be considered:

1. Technology is value free; its use or misuse depends on the values of those who employ it.

2. The application of technological solutions to one problem may create other problems which may be more serious than the original problem.

3. Applications of technology should be selected and/or continued only after determination that desirable consequences outweigh undesirable consequences.

4. Fear and hesitancy about using advanced technologies is largely a fear of unknown consequences. To be supportive of appropriate technologies, individuals need to progress through the stages of awareness, interest, trial, and appraisal before either acceptance or adoption will take place (Rogers & Shoemaker, 1971, p. 100).

Instructional Technology

Definition. The systemic and systematic application of strategies and techniques derived from behavior and physical sciences concepts and other knowledge to the solution of instructional problems.
Analysis. Concerns about the definition of instructional technology include:

1. Instructional technology may be divided into more narrow technologies. For example, there are message design, message delivery, and evaluation of message effectiveness as subsets of instructional technology. To communicate effectively, one must clearly state the referent technology on which the broadening or narrowing is based.

2. Instructional technology can be viewed as a subset of a larger technology, that is, educational technology. To illustrate, educational technology might be a combination of instructional, learning, developmental, and managerial technologies. In turn, educational technology could be combined with others to form an even larger or higher order technology.

3. Many of the strategies and techniques of one technology may also be relevant for other technologies.

4. The profession must internalize the idea that the selection of technology depends on both purpose and values. Some strategies and techniques are superior to others and should be chosen on that basis.

Educational Technology

Definition. The toughest construct to define is "educational technology." Consider the following: The combination of instructional, learning, developmental, and managerial technologies as applied to the solution of educational problems.

Analysis. Several points to consider in this definition are:

1. The referent for both instructional and educational technology remains the root concept "technology." There is need to provide other referent, that of "education." John Dewey (1936) defined education as "the enterprise of supplying the conditions which ensure growth, or adequacy of life, irrespective of age" (p. 61).

2. Others differentiate between education and training: "Where the acquisition of skills, habits, attitudes, or beliefs is intended ... the process ... is called training. In contrast ... to increase the student's ability and inclination to employ critical, independent, and creative judgement (is called education)." (Smith, 1965, p. 27).

3. Good defines instruction (under teaching) as "the act of providing activities, materials and guidance that facilitates learning, in either formal or informal situations" (Good, 1959, p. 552).

WHENCE FROM THENCE?

To plug these meanings for education and instruction into educational and instructional technology can leave one impressed and humble at the idea of being in the business of developing supporting technologies for what is probably mankind's most significant invention.

Regardless of how well this collection of interpretations of educational technology clarifies or confuses matters, it is safe to assume that some time will pass before precise meanings are accepted across the field. It is also safe to assume that educators will continue to chip away at the problems of definition. No doubt many of the efforts will be at the level of a UNESCO study that concluded that whether a project was labelled ET or IT was dependent on the project's
size and duration, with ET projects being large-scale and involving long periods of time, whereas IT projects would be those of small size requiring less time for completion (Dieuzeide, 1971). For those searching for substantive answers, this does not help.

Fortunately, there are increasing numbers of thinkers who have joined the definitional fray, and a continued refinement of the meanings of educational technology can be expected.

On studying the meanings presented here, including the author’s interpretation, one can see both differences and similarities. A closer look often gives the impression that definition depends on the project being focused on or on the point being made at the moment. Thus, no doubt, some of the many meanings can easily be subsumed by others. However, among these are meanings that are clearly at variance with one another. These could well point the direction toward major issues seeking resolution.

At any rate, the range of specializations suggests considerable ferment within the profession, and change theorists state that ifmeneis is a time of opportunity for those with prepared minds.

REFERENCES


