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Theory and Research in Instructional Technology*

A general aim of this paper is to clarify the heritage of instructional technology and to put it in its proper context vis-à-vis the audiovisual movement. A specific aim is to show the relationship between diverse theories and the kinds of technologies of instruction which have evolved out of these conceptions. Finally, a redefinition of the prevailing concept of instructional media, one which holds the promise for a more fruitful media research endeavor, will be proposed.

origins

First, it is important to realize that the very process and even the terminology of instructional technology reaches back through many centuries and is not a recent innovation, as many seem to think. We can find its beginnings when tribal priests systematized bodies of knowledge and members of early cultures invented pictographs or sign writing to record, preserve, transmit, and reproduce information. In every age, there has been a technology of instruction or a set of procedures designed to serve a particular society. The more advanced the culture, the more complex the technology of instruction in reflecting ways of thinking, speaking, and feeling. Each significant shift in values, assumptions or goals of the society or culture has led to new or modified technologies of instruction. Instructional technology preceded science because primitive man was familiar with certain techniques of instruction before he understood the nature of science.

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The Sophists, drawn to Athens from all corners of ancient Greece during the fifth century B.C., are considered to be the forefathers of modern instructional technology. They even used the term *techne* or technology to refer to the process of the practical art of instruction. Whole bodies of cognitive rules were formulated, subject matter was systematically analyzed, specific instructional strategies were designed, and relevant instructional materials were planned and developed to meet the objectives of instruction. The Sophists' students always knew what was expected of them, how they might achieve their goals, and how well they were progressing. It is abundantly clear that the Sophists laid the groundwork for more advanced technologies of instruction and contributed a high order of consciousness about the problems and process of instructional design and development.

Throughout history, notable technologies of instruction can be found. For example, Abelard provided a new method of structuring and presenting materials and helped set the style for the age of Scholastic education. The systems developed by Comenius, Pestalozzi, Froebel, Herbart, and Montessori are other examples of technologies of instruction which evolved out of particular theoretical viewpoints and which exerted extensive influence upon instruction through the centuries as well as upon contemporary practice. For example, much of the current competency-based or mastery concepts of instruction stem directly from the ideas of Herbart in the early nineteenth century.

the concrete-abstract continuum

It is important to maintain a rarely-made distinction between what is known as visual or audiovisual instruction and instructional technology. Although the audiovisual movement is an important tributary, it is nevertheless a tributary flowing from the mainstream of instructional technology. The audiovisual movement developed in this century largely as the result of the invention of photography and became highly specialized in terms of certain devices or instruments which were considered "visual" in nature. Even before educators recognized it as a movement and coined an appropriate term, commercial interests had already christened it "visual education." Quite early in this century, audiovisualists began to develop their peculiar theoretical doctrine which presumed that visual experiences were far more powerful in effecting learning than

are any other types of experience. As a consequence, a concrete-abstract continuum of learning effectiveness — extending from the real situation or the object to a progressive series of abstractions through a photograph, a model, a film, etc. to a verbal description — came to be a cornerstone of audiovisual literature. One of the first comprehensive statements of this theory was made in 1910 by John Adams in his book, *Exposition and Illustration in Teaching*. He was followed by Joseph Weber in 1928, by Hoban, Hoban, and Zisman in 1937 in their work, *Visualizing the Curriculum*, and by Edgar Dale and others in the 1940's and more recent years.

Today this particular theoretical rationale still persists and serves as the primary theoretical basis for the use of what is now generally referred to as instructional media. While one cannot deny that instructional materials must help the learner to perform transactions with the real world, the conclusion does not follow that teaching displays should always necessarily be realistic. In fact, the studies of Travers, Piaget, and others throw considerable doubt on the validity of many of the statements of principles for the design and utilization of audiovisual materials found in typical textbooks on the subject. What is more, many who support the concrete-abstract notion do not always make it clear that, in denouncing verbalism, they are not necessarily claiming to have found a superior alternative to verbal communication.

The audiovisual movement has been essentially thing-centered. Quite early in the movement, certain commercial companies began to concentrate on the production of one or two devices. Many companies still do. Certain companies made blackboards, others produced slides, some produced motion pictures, other concentrated on maps and models, one centered on sets of slides and stereographs, others produced slidefilms and some specialized in recordings. Parallel with specialization by producers of devices was specialization in the administration and distribution of these devices. For example, the New York State Division of Visual Education collected and distributed lantern slides only. The St. Louis Educational Museum concentrated on exhibits. The University of California Department of Visual Education in University Extension at Berkeley distributed motion pictures only. As time went on, commercial interests competed with each other for the school's dollar and in so doing sold their wares under the overall label "visual education." All this fragmentation was confusing. To some,

visual education meant the motion picture while to others, visual education centered in the museum. Thus the competition was between things rather than ideas. Unfortunately, this historical heritage still affects the audiovisual movement today as evidenced in the increasing emphasis on the things and pieces of materials and instrumentation.

rationale and research

When the heritage of the mainstream of instructional technology is compared with that of the audiovisual movement, a number of significant contrasts appear. First, as we have seen, the Sophists even employed the term *technology* in the sense of weaving or constructing a design for effective instruction. Through the centuries, this same concept of *technique* has been applied to the process of instruction in its totality or what we today call a systems approach. None of these historic technologies of instruction was based on a device or thing or even on one dominating theoretical rationale. Instead, they were typically built on a whole set of assumptions involving theories or conceptions of human nature, motivation, perception, needs, interests, attitudes, feelings, and a host of other factors related to human behavior. Although these early technologies of instruction were not subjected to experimental analysis in ways that would edify researchers of our time, pioneer instructional technologists did classify human experience into categories which in turn structured and influenced the language, thinking, and designs of modern instructional research. What is more, they were familiar with the problems of analyzing and designing instructional approaches and materials and they devoted considerable attention to the evaluation of their procedure.

The discontinuity of the audiovisual movement with the mainstream of instructional technology can probably best be illustrated by the historical development of programmed instruction. For example, Maria Montessori began developing a technique and devices of programmed instruction based on a theory of human behavior as early as 1907, at least a decade before Sidney Pressy (often considered the pioneer of programmed instruction) began his experiments, and at about the time the so-called visual education movement was beginning to take form. Yet, for four decades or more, there was absolutely no theoretical or research connection between these

two developments! In fact, there is some question as to whether a theoretical or research connection exists today. Similar observations can be made concerning the wide historical gaps that exist between the development of test and measurement technology, learning theory, theories of human communication, technologies of innovation and diffusion to mention only a few bodies of knowledge and research which are systematically applied within the context of instructional technology.

Apart from their conceptual and functional discrepancies, it is true that the audiovisual movement and instructional technology are related and that they have converged at least in the area of media research. This has been a long research tradition which has been dominated by the all-consuming question, "What has been the effect of media?" Thus, research has been confined largely to studies of the comparative effectiveness of conventional instructional procedures and selected types of media in attaining the same instructional objectives.

One of the first large-scale instructional film research projects was sponsored by the United States Social Hygiene Board and undertaken in 1919 by the psychological laboratory of Johns Hopkins University under the direction of Karl Lashley and John B. Watson, the father of behavioristic psychology. The purpose of the study was to determine the instructional effect of certain motion pictures used for the control of venereal diseases. Results showed that a single film could not be expected to bring about basic changes in behavior or attitudes. However, the Lashley-Watson study is a classic because it anticipated many of the conceptualizations rediscovered or formulated since. For example, the observation that learning from films varies with the audience characteristics and individual selective perception has only recently come to be appreciated.

Just a few years later, in 1922, the University of Chicago under the sponsorship of the Commonwealth Fund began a series of studies of the use of films, still pictures, charts, maps, slides, and stereographs, as instructional media. These studies, directed by the educational psychologist, Frank N. Freeman, were conducted in eight school systems, involving over 5,000 students for a period of three years. The final report, called *Visual Education* and published in 1924, concluded that pictures could not be substituted for language, but that the re-

lative effectiveness of verbal instruction as contrasted with the various forms of concrete experience — depends on two major conditions — the nature of the instruction to be given and the character of the pupils' previous acquaintance with the objects which are dealt with in instruction. These pioneer studies also showed that the usefulness of motion pictures would be enhanced if they were so organized as to confine themselves to their peculiar province, namely that of moving objects. They are outside of their province when they show still objects or when they enter the field of abstract verbal discussion. They cannot compete, in these respects, with still pictures or with the teacher. Thus, it was recommended that subject matter which is not primarily the representation of motion or action should not be included in instructional films and that it is probably desirable to have motion picture films produced in small units or what we call today single-concept films.

The University of Chicago-Commonwealth studies clearly laid the groundwork for much of contemporary media research. Many media variables exposed in these studies still remain largely unexplored. Unfortunately, media research which followed these studies usually conformed to a rather rigid and limited correlational paradigm which has largely persisted to the present time. Even as early as 1930, Joseph Weber decried the endless comparative studies of media and recommended that future media research should concern itself with such problems as the optimum length and content of instructional films and the interrelationships between animation and other psychological factors. Weber's recommendations went unheeded and the next two decades produced mainly additional media comparison studies which resulted, in most cases, in the same monotonous conclusion of "no statistical significant differences." Hovland, Lumsdaine and Sheffield's *Experiments on Mass Communications* (1949) and James Gibson's work during World War II offered some refreshing variations from this pattern of media research, but the research literature continued to report the same "no significant difference" findings.

One can hardly escape the conclusion that constant "no statistical difference" findings appear puzzling even when we are confronted with many poor research designs, a paucity of theory, and research on trivial matters. As a consequence, it is apparent that we have fallen into the habit of regarding devices or instruments — such as films, radio, television,

teaching machines not only as media but also as messages, a misinterpretation brilliantly perpetuated by Marshall McLuhan.

It is clear that a redefinition of instructional media is needed so that a more fruitful era of instructional media research might begin. A new concept of media might embrace three broad categories: linguistic, iconic, and kinesic. *Linguistic media*, in their simplest form would consist of words, that is, language. They would also include such digital languages as numbers or mathematical symbols. *Iconic media* would include the symbolic representation of patterns and things or may include the actual object or thing itself. *Kinesic media* would comprise body movement in a general sense including posture, gesture, facial expression, voice inflection or any other non-verbal manifestations of which an organism is capable, as well as any communication clues which may be present in any context.

A redefinition of media such as that suggested above clearly calls for a new approach to research. Obviously, the rather complex details or implications cannot be explained in this brief paper, but are dealt with in a manuscript now in press. It can only be suggested here that the implications of theory and research from such sources as psycholinguistics, perception studies of nonverbal communication, and kinesics can provide the conceptual basis for a new media research tradition. This approach, of course, would involve an overthrow of the prevailing concept of media and call for new research paradigms for, as we know from Kuhn's *The Structure of Scientific Revolutions*, a time comes when anomalies accumulate and new paradigms are necessary.

Finally, it should be obvious that this conception of instructional technology goes beyond any particular device and is more than the sum of its parts. Sometimes it does involve the use of devices and machines; frequently it does not nor need not. It essentially includes methods of instruction, organization of content, group processes, the design of effective learning environments; the effective use of media forms; the processes of problem solving; or even the possible use of chemicals to enhance learning. It should also be clear that a viable interpretation of instructional technology must incorporate a holistic view of man in nature and an understanding of the instructional technologist's function as an agent in the evolution of humanity.

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