EDUCATIONAL TECHNOLOGY — HOW, WHEN, WHERE?[1]

by Roy Krynitz

How, When, and *Where* covers a broad spectrum in any subject. But when speaking in reference to educational technology, there can be only infinity. The first problem we encounter is: How can we define educational technology — and define it in a manner that is satisfactory and acceptable to all?

The obvious starting point for a suitable definition of educational technology is to analyze the meanings of the terms "education" and "technology." According to Webster, education is the action or process of education; the impartation or acquisition of knowledge, skill, or discipline of character; an act or process of training by a course of study or discipline; or the organized system of instruction as existing in a given state. Technology is defined as an industrial science; any practical art utilizing scientific knowledge; applied science contrasted with pure science.

Thus, educational technology is seen as having a dual nature; a knowledge or information component and a work-capability component. Many educators seem to view educational technology in terms of the use of the latest equipment or hardware that other technologies have supplied to the educational community. Educational technology is more than inventions and machinery; it is also a process in the way of thinking.

We know that educational technology can serve industry as well as education in many different ways. For example, store managers use films, slide projectors, and tape recorders to train their employees in the latest merchandising methods. Some industries require all employees to take a programmed first-aid and safety course, utilizing audio-visual principles of instruction. This allows constant updating and periodic reviews of the programs.

In some states, steps are being taken to incorporate the principles of educational technology in the Department of Motor Vehicles. All driver-license applicants will have to take programmed instruction in the latest traffic regulations and the principles of the operation and maintenance of motor vehicles. This training will be followed by a test, and a minimum grade must be obtained before a new license will be issued.

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We now ask ourselves: *How did all this begin?* and *How does it affect education?* Technology began to emerge into the field of education during World War II, when the Armed Forces recognized the value of using electronic equipment for intensified instruction in foreign languages.

In the early 1950's, educators and electronic specialists began experimenting with equipment and components which were originally designed for other uses. The pioneering efforts in this direction of instruction promised to strengthen our foreign language program, and we witnessed the introduction of the first language laboratories as the foreign language teachers recognized the value of this concept. The first operational language laboratory in the United States came into being at Louisiana State University in 1947. It has since proven useful in many other areas of instruction as well, but the others failed to recognize the significance of these developments and to move forward, utilizing the advantages offered by this method of instructional reinforcement.

Since NDEA was signed into law in 1958 and the first language laboratories were set into operation, the use and versatility of such installations have gradually become a reality. In the four years from 1958 to 1962, more than 10,000 language laboratories were introduced into the nation's classrooms.

To meet the needs of educational institutions, the U. S. Office of Education began authorizing purchases of certain items for this purpose under Title III and VI of the National Defense Education Act. In the beginning, this authorization was limited to foreign language study. Later, other areas of study were awarded grants for the purchases of instructional equipment using the same techniques.

Each day, more and more institutions are incorporating other subject matter, such as shorthand, music, math, art, drama, history, etc., into installations previously thought to be for language use only.

For the past decade, although perhaps unaware, we have been approaching this phase in our educational system. Now that it is upon us, we must analyze the situation very carefully and use the resources which are available to us to improve instructional techniques and provide richer learning experiences.

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With this media approach to learning, both printed and non-printed instructional material will increase to make learning more meaningful. However, no matter what approach we use to accomplish the results which we are seeking, it must be a cooperative effort on the part of all concerned. A concentrated effort will be necessary in our endeavor to meet the increasing demands and emphasis that will be placed upon learning materials, resources, services, and educators.

In October, 1968, Senator Yarborough of Texas introduced the Educational Technology Act, which is designed to provide for the improvement of education through the expanded use of educational technology. This affects education in many ways. For example, with the use of technical and mechanical devices, more students can be taught at the full rate of efficiency, while a large class usually suffers from lack of individual instruction and reinforcement of the materials presented in class. This is where learning resource centers, language laboratories, reading centers — or any other title given them — come into play. When a student enters a laboratory, it creates a one-to-one relationship between himself and the master program. No matter what the program may consist of or how impersonal it may seem, it still works.

Any classroom may be equipped with electronic and mechanical equipment designed and arranged to make learning more effective. The addition of educational technology to existing teaching methods is an asset to any school when operated properly by trained personnel.

Administrators in education have long overlooked the fact that teachers must be well trained in the operation, maintenance, programming, and methodology of this system for it to be effective. Educators also must have the proper equipment and materials to work with, or all efforts to make this addition to our resources will be in vain.

When did all of this begin? We could possibly go back to 1746 when Benjamin Franklin and some of his Philadelphia friends began serious studies of atmospheric electrical phenomena. Or perhaps, it all began in 1747, when Sir William Watson of England demonstrated that an electric current could be transmitted through a considerable length of wire using the earth for the completion of the circuit. But like our ever-changing field of technology today, this was only the first of many discoveries. In 1897, (Marconi) Machiese Guglielms, an Italian physicist, invented a practical system of radio telegraphy. Experimentation started in early 1894, and by December, 1901, his dreams became a reality as signals transmitted from Cornwell, England, were received at St. Johns, Newfoundland.

During the same period of time, Edison succeeded in making an incandescent lamp in which a loop of carbonized cotton thread glowed in a vacuum for more than 40 hours.

Let us assume, at least for a moment, that you are a traveler who has stopped at a local motel in a city where a group of educators are holding a conference. You hear a conversation among these persons using such terms as bias, brute force, dropout, crosstalk, channel, gain, head, mil, mixer, plug, saturation, separation, squeal, uniformity, wow, wrap, and writing speed. What is the first thing that would enter your mind about this discussion? Of course, it would depend on a number of factors, such as the region where you live, your education, and your occupation. But in all probability, you might think that the discussion was centered around such subjects as a civil rights movement, disciplinary problems, river navigation, the stock market, narcotics, taxes, a social affair, product promotion, marital problems, police work, military dress, girls, a butcher shop, or perhaps a secretary's shorthand. Confusing, yes, but these are everyday terms that we as educators must cope with in the rapidly growing field of educational technology.

Some may think educational technology started in the early 1900's, when on November 2, 1920, Station KDKA became the pioneer radio broadcasting station. It went on the air to broadcast news of the election of Warren Harding as President of the United States.

Meanwhile, as everyone was getting adjusted to and accepting this new media, behind the scenes more experiments were being carried out and advancements made. In 1938, Major Edwin Howard Armstrong built and operated the first FM radio station, KE XCC at Alpine, New Jersey.

No single person can be credited with the invention of television, and probably no other invention has played a more important role in the field of educational technology. The perfection of the modern television system as we know it today was the result of a number of isolated discoveries in the related fields of electricity, electro-magnetism, and electro-chemistry.

In 1884, Paul Niphou of Germany devised the first working television system. Additional gains in research were made in 1888 by W. Hallwachs using photoelectric cells in cameras and in 1907 by Boris Rosing of Russia. A. A. Campbell and Swinton of Great Britain suggested the use of cathode rays for the reconstitution of the image at the receiver.

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Most television research was halted by World War II, but not before Allen B. Dumont marketed the first modern home TV receiver in 1939.

Even as the war continued, some experiments on color television were still taking place. After the was, in 1946, work was resumed. Transmission was in the VHF band that had been opened during the war. The first coast-to-coast, black-and-white television broadcast over a nationwide system of microwave radio relay took place in 1951.

But, just as we were experiencing rapid changes in technology, color television was developed and patented even before the first coast-to-coast, black-and-white telecast was made.

In 1948, CBS announced it had developed a system for color television. NBC followed in 1949.

NBC, however, was awarded the patent by the FCC on the grounds that its system was based on an electronic tube and therefore was compatible with the black-and-white television system already in existance. NBC began color operations in 1954.

Educators, recognizing the value that this new media had to offer education, began seeking approval from the FCC for educational television channels. In 1951, the FCC allocated 242 television channels to be set aside strictly for educational use.

In 1962, the educational allocation was raised to 273 channels, but recent legislation requires that all future sets be equipped with both UHF and VHF channels, substantially increasing the number of channels available.

A new era dawned on May 25, 1953, when the first educational TV station went on the air in Houston, Texas. By the end of 1962, there were nearly 70 ETV stations in operation.

Funds for the construction of additional educational television facilities were made available by the federal government in 1962.

To say which invention was the most significant to educational technology is difficult, as they compliment each other. All play very important roles in the teaching methods employed today.

When will we realize the full potential of the vast facilities that are at our fingertips? This is very difficult to say, as the greatest challenge in education today is the necessity of anticipating and planning educational facilities that will adapt to the continuing change in the educational philosophies, methods, and equipment.

To meet the challenge of changing philosophies and methods in education, different systems have been designed to provide the educational community with the sophisticated equipment necessary to keep up with the important requirements of good pedagogy. This equipment adapts to meet present or future buildings and rooms. The same equipment used in a normal classroom may also be used in a library study carrel or in a seminar room.

If we are to be successful in our endeavor in the field of educational technology, strong emphasis must be placed on the research and development of programs and related materials. Without these, all the equipment that money can buy will not accomplish what we are striving for in the educational field.

Where will all of this lead? Apparently, far beyond our wildest imagination. Everyday we read about new trends and developments in the field of education.

Some visionary men worried about the threat of a machine-world long before technology brought such a thing into the realm of possibility. Since World War II, the first step was made with the introduction of space studies and with continued successful space exploration, practically anything is possible. We now stand in an era where some of science fiction's most doubtful predictions seem close to reality.

The knowledge explosion in our society has been so great, it is estimated that one-half of the knowledge of our graduating doctors, engineers, and other professional people will be obsolete within ten years after graduation. If we do not have enough teachers for conventional educational needs, where will we find teachers for the growing needs of continuing education? Obsolescence is a present and serious problem facing recent, as well as not-so-recent, graduates.

Article after article appears in local newspapers, national publications, and professional journals citing new developments in the educational field.

For years, in theory, open-door admission has been public policy in many states. Several of these states have even provided bylaws stating that all high-school graduates must be admitted to state colleges. But, in practice, this has usually opened up nothing more than a revolving door, since one-third or more of the entering freshmen are cast out after the first term.

However, this fall, the City University of New York opened its doors to all high-school graduates. They are determined to make it work. It is the biggest such effort ever in U. S. history.

Many of these students will not enter the system's four-year campuses. Many will follow the pattern made famous by the California educational system and attend a two-year community college.

What does this trend mean to us as educators? There will need to be a catch-up phase for one-third of the students who are deficient in elementary and secondary preparation.

Improvised classrooms set up in gymnasiums, basements, churches, or other types of temporary structures are not the answer. In order that these students may catch up in minimum time, there will have to be a one-to-one ratio. The only satisfactory financial arrangement is the utilization of educational technology.

The increase in teachers and classrooms over the years has not kept pace with the increase in students. Efforts to alleviate teacher and classroom shortages have not been successful. It has been estimated that this fall more than 100,000 students will be turned away from colleges and universities because of the lack of space and teachers.

Now we are faced with a radical departure from the traditional admission policy, such as New York has undertaken.

Under the present system, in most colleges and universities every student taking 15 credits is expected to spend 15 or more hours each week in a classroom with a teacher. What if independent study materials could be prepared for 5 of these 15 or more hours? This would make it possible to decrease classroom shortages by reducing the need for classrooms by at least one-third. However, this would not reduce the need for teachers by the same proportion, because they would be needed to create the independent study materials. Materials that would adequately substitute for classroom time would contain audio-visual sequences which could be presented to the student at any time and almost any place through a dial-access information-retrieval system.

From the realistic standpoint, if we purchase $10,000 of media equipment this year, next year we will have the same equipment. With the exception of minor repair costs brought about from the use of this equipment, no other outlay of money would be necessary. On the other hand, if we were to hire an instructor to do this same teaching job, we would need to employ a person for the approximate an-

nual salary of $10,000, plus fringe benefits and annual raises. Under normal circumstances, the annual raise in salary would be as such as the repair cost of the equipment. From a financial viewpoint, you can see that this suggestion is very practical.

Various systems may be employed to bring this educational tool into the hands of the student. It may be called dial-access, or it may be strictly an individual process of checking out necessary materials and going to a study carrel where equipment is installed. However, in order to accomplish our goal, much time must be spent analyzing course content, learning about the synthesis of course materials, and then actually preparing the appropriate course materials. Some other differences are: a) Most lectures are recorded and made available to the student. In this case, a dial-access system would be extremely convenient, particularly where two or more campuses are involved. b) Students are scheduled to meet formally with their instructors in a classroom only one hour per subject each week for group discussions and occasional brief lecture. c) Outside of the scheduled meetings, the student's study time in the various subject areas are in study laboratories at his convenience between certain hours as set up by the administrative policies of the school. d) Students are given each week, in writing, the general and specific learning objectives for each subject. e) The students are directed by audio-tape or by mimeographed material to the necessary learning experiences (texts, experiments, films, slides, audio-tapes, etc.) in order to achieve the stated objectives for the week. f) Almost all the student's study time takes place on the campus. g) Through the use of self-tests, supplementary learning experiences, and faculty tutorial help, each student is required to achieve a certain percentile depending upon the departmental specifications of the week's learning objectives. h) Faculty are required to be available in their offices, which are adjacent to the study laboratories, for a designated number of hours per week for student questions, student testing, and for impromptu small group discussions. i) At least one faculty member or graduate assistant in each subject area has to be available during specified hours per day, seven days a week, when laboratories are open, or other times as determined by student and curriculum demands.

We, as technologists in the educational field, must make our voices heard by the administrators and the teachers who are not aware of the value and effectiveness of independent study as a key to individual motivational learning. It has been found that to fully encourage students to pursue knowledge on their own or in the intimacy of small groups, they must be provided with a facility that contains the physical means of access to information. This appeals to the

reluctant learner as well as the avid one. To fully stimulate and motivate, not only the limited student but the gifted student as well, we must substantially increase not only the academic content of materials, but its carriers, i.e., the means by which materials reach the student.

Maximum encouragement to individual learning is coming from new educational concepts, technological media, and learning materials which have been integrated with the existing carriers of knowledge. The separation of book and audio-visual service as two independent sources of knowledge no longer exists. They now blend, and are proving that the inherent self-instruction ability in youngsters and young adults has long been an untapped human resource.

In conclusion, I say that the greatest challenge in education today is the necessity of anticipating and planning the educational facilities that will adapt to the continuing change in the educational philosophies, methods, and equipment.

ABOUT THE AUTHOR:

Dr. Krynitz is Language Lab Director, New Mexico State University.