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PROGRAMMED INSTRUCTION AND TEACHING MACHINES IN SCHOOLS OF DEVELOPING COUNTRIES AND TECHNOLOGY IN EDUCATION--PAST, PRESENT, AND FUTURE.

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IN THE FIRST PART OF THE DOCUMENT, RESULTS OF GROUP DISCUSSIONS ON THE USE OF PROGRAMED INSTRUCTION (PI) AND TEACHING MACHINES IN DEVELOPING COUNTRIES ARE SUMMARIZED, EMPHASIZING (1) PROBLEMS OF DEVELOPING NATIONS, (2) QUESTIONS ON PI METHODS AND MATERIALS, AND (3) STRATEGIES FOR THE INTRODUCTION OF PI. THE SECOND PART OF THE DOCUMENT IS AN ESSAY DISCUSSING VARIOUS FORMS OF PI, INCLUDING INSTRUCTIONAL TELEVISION, LANGUAGE LABORATORIES, FILMS, AND TEACHING MACHINES. THIS IS A REPRINT FROM PROGRAMMIERTER UNTERRICHT UND LEHRMASCHINEN, FINAL REPORT OF THE 1963 INTERNATIONAL CONFERENCE OF PROGRAMED INSTRUCTION, BERLIN, PAEDAGOGISCHE ARBEITSTELLE, 1964. (MS)

"PROGRAMMED INSTRUCTION AND TEACHING MACHINES IN SCHOOLS OF DEVELOPING COUNTRIES"

and

"TECHNOLOGY IN EDUCATION: PAST, PRESENT AND FUTURE"

By

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Group 2: Programmed instruction and teaching machines in schools of developing countries

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SECTION I

Introduction

Group 2 sessions were directed toward identifying the educational problems of developing nations, with subsequent discussion of the role of programmed instruction in helping resolve these problems. Questions that need to be answered in introducing programmed instruction were listed and strategies recommended for getting work started in each country.

During the sessions, participants worked with children on programs and discussed the difficulties encountered by the children. Further demonstrations of the testing of programs were presented, and Dr. Kulkarni and Dr. Everett presented papers on proposed ways of introducing the programmed instruction concept in developing nations. In general, it was agreed that "programmed instruction" is significant as an empirical approach to instruction, As such, it requires a core of specialists to undertake research development, adaptation, and evaluation of programmed instruction materials and methods; it requires teacher training of a kind that will prepare teachers who take an empirical approach to education, and it requires a re-thinking of the economies of education and the administration of education in developing nations. First steps should include activities to interest the educational authorities, then activities to train specialists (behavioural scientists, etc.), and finally, materials should be carefully adapted or prepared and tested, concurrently with extensive teacher training activities.

Especially needed are demonstrations, pilot projects, and model school situations in developing nations where the use of such an empirical approach is demonstrated. Also needed are regional centers to provide demonstrations, expert advice, publications, training, and funds for experimentation.

Following are five sections on results of group discussions:

SECTION II - Problems facing developing nations.
SECTION III - Questions that need answering as programmed instruction materials and methods are introduced.
SECTION IV - Activities and strategies recommended as first steps in undertaking programmed instruction approaches.
SECTION V - Sample strategy or plan for introducing programmed instruction (prepared by Professor Farrag of Egypt).

SECTION II

Problems facing developing countries

1. The chronic shortage of adequately trained and competent teachers at all levels and in special subjects.

2. Lack of well formulated goals and educational objectives in some countries.

3. The growing demand for technical training and technological education.

4. How can we train teachers more effectively and how can we multiply the effectiveness of the individual teacher?

5. The need for developing new methods and techniques for teaching better and more efficiently.

6. The difficulties resulting from cultural differences and the need for texts and instructional materials suitable to meet the needs of the children.

7. The economic and the administrative problems of introducing new methods and materials in education (programmed instruction, television, language laboratories, etc.).

8. The need for an extensive plan for the application of new instructional techniques and for training personnel for the preparation and use of programmed instruction.

9. The problem of resistance to social change. How to encourage the teacher to use new techniques, and how to convince the parents to accept those techniques.

10. The problem of many languages, making necessary especially effective techniques for teaching reading of local language and for teaching common language of the country or the region.

SECTION III

<u>Questions to be asked as programmed instruction is introduced in developing nations</u>

To what extent can we expect programmed instruction to assist in alleviating the teacher shortage?

- To what extent will it be possible to automate part of the teaching process and use programmed instruction to relieve the human instructor of some of the more routine parts of his work?

- Can programmed instruction and teaching machines teach: problem solving, creativity, initiation, appreciation, creative criticism, application of facts to life situations and the like educational objectives that pose particular problems for the teacher?

- How can teaching machines and programmed instruction be best employed in any given context? How can they be used in active cooperation with the human teacher? With television and radio instruction?

- What are the subjects that could be easily and effectively programmed? And to what educational levels?

- How can we overcome resistance?

- How can we introduce the programmed instruction technique to our educational systems?

- How can we guarantee success, acceptance, and cooperation?
- How can we train teachers for using the programs and the machines? How can we train them to develop programs?
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- Can we translate and adapt programs produced in one culture for use in another culture? What are the subjects that we can adapt?

- What is the cost of developing programs and providing schools with machines? How can we face and solve the problems of finance? Can machines be installed in mass?

- Can we produce simple, inexpensive devices that are capable of presenting effective programs? (programmed texts)

- What is the role of the international organizations concerned (e.g. UNESCO) in extending auto-instructional materials and methods to developing countries? Is it a proper domain for such organizations? How can the developed countries contribute?

- What other media can be used in developing countries and what are their relations to programming?

- Where do we go next? What are some of the possible individual efforts?

SECTION IV

<u>Activities and strategies recommended as first steps in undertaking programmed instruction approaches</u>

Recommended activities:

A. <u>Information and promotional activities</u> ("setting the stage")

1. Regional conferences on programmed instruction.
2. Brochures on programmed instruction to answer questions raised at this conference (to be prepared by international organizations).
3. Demonstration models and pilot projects (to be developed locally with international help).
4. Exhibits, perhaps travelling.
5. Radio - TV, press, journal articles within countries.
6. International organizations on programmed instruction.
7. Motion picture reports on programmed instruction activities.
8. Regional and international centers to act as: clearing houses, publication centers, offer expert advice, provide funds for demonstrations.

B. <u>Studies</u>

1. Effect of programmed instruction on school schedule and curriculum in developing countries.
2. Effect on role of teachers.
3. Effect on student achievement of educational objectives.
4. Subjects that need to be programmed and that can be programmed.
5. Cultural adaptability of programs now available.
6. Economic effect of new techniques on developmental plans of educational authorities for next decade.

C. Adaptation and production

1. Local unit needed for research and development of programmed instructional materials and related educational media.

D. Training

1. Professional training of specialists (behavioural scientists, etc.) through fellowships for foreign training and through local training and regional workshops.
2. Training of teachers in utilization at teacher training colleges, institutes, etc.
3. Training of subject-matter specialists abroad, in new curriculum approaches, e.g., physics, mathematics, chemistry.

E. Strategy

1. In most cases initial leadership help must come from international activities through conferences, workshops, fellowships, consultants, etc.
2. When activities begin locally teachers must be involved from the very beginning.
3. Professional education materials should be programmed to show teachers through use, the effectiveness of such materials.
4. Ministry officials and other key administrative officials must sanction work in this area.
5. The use of the term "teaching machine" may not be appropriate (probably "programming" or "automated self instruction" are more generalizable terms).
6. Stress the fact that programmed instruction improves the depth and scope of education.
7. Encourage regional and international organizations such as W.C.O.T.P., Arab League, UNESCO, and others, to undertake conference and dissemination activities.

SECTION V

Sample Strategy

A suggested plan for the application of programmed instruction technique in Egypt, V.A.R. Osman L. Farrag, Cairo / Egypt

One of the most striking and qualifying features of development in the Egypt of today is the increased interest in education and the demand for the expansion of educational facflities and the application of new theories and the utilization of new educational methods and techniques.

Several factors have contributed to this rapidly increasing interest in new techniques in general and in the development of the field of programmed instruction in particular.

There is the chronic shortage of adequately trained and competent teachers at all levels in our schools, colleges, and universities. There is the need to give special individual attention to handicapped children, to those apparently or actually retarded and to the gifted children as well. There is the ever growing need of industry and commerce to instruct recruits in complicated and

diverse techniques and disciplines. There is the demand for technical training and technological education and finally there is the coming of the machines themselves. From this point of view we believe we should introduce the programmed planning technique at least to those parts of the process at which the human teacher is not very efficient: conveying information, routine instruction, symbol manipulation, and the like and thereby free him to fill his proper role of creative educator, critic, catalyst, and in inspiration.

THE PLAN

A. Setting the stage (through a conference)

Programmed or automatic instruction will not be introduced uniformly on a wide front. Rather it will be more like a process of infiltration into key sectors. This necessitates a preliminary softening-up and overcoming the resistance to change.

Such a softening-up, however, will only be possible through the following procedures:

1. Helping educators to realize the need for the development and utilization of new instructional techniques based on principles of psychology derived from laboratory studies of human learning.
2. Building a model to show programmed instruction and automated learning actually operating effectively with promising success.
3. Helping teachers to realize the fact machines are not to replace the human instructor but as his essential ally restoring his creativity and freeing the teacher from the burdensome time-consuming task of presenting material and restoring to him the process for which he is suited. It should be realized that the very conjunction of two words "teaching" and "machine" is however liable to arouse deep misgivings and emotive rather than rational responses, especially from parents, as well.
4. Establishment of automated teaching methods in industry and commerce to an extent sufficient to show that such methods are comparable with conventional instruction.
5. Industry in general should be prepared to take a long-term view and to make it possible for those who do the teaching to experiment with machines in sufficient numbers to find out what they can do and how they can be used in differing contexts. It is in industry and commerce that the effectiveness of programmed instruction and teaching machines will first be shown.
6. The utilization of communication media in conveying information about the new techniques (radio, TV, newspapers, periodicals, pamphlets, etc.).

The above steps should be taken by the Faculty of Education through conferences and radio, TV, films, teacher training programs, lectures, pamphlets.

B. Organization and administration

1. The Advisory Committee on programmed instruction (hereafter shall be called the Committee) shall be established within the Ministry of Education on establishing policies for the development and application of programmed instruction and teaching machines.
2. The Committee shall be organized with 20 members including the chairman and the vice chairman.
3. The chairman and vice chairman of the Committee shall be elected by the committee members.

4. The committee members shall be appointed by the Minister of Education among the qualified persons including
   - the Undersecretary of State for planning (the Ministry of Education)
   - the Undersecretary of State for follow-up and evaluation
   - the Dean of Education of Ain Shams University
   - 5 university professors
   - 5 supervisors
   - 5 specialists in subject matter
   - 2 members who have sufficient knowledge and experience in industry and business

As consultants and advisors to the Committee there should be 2 experts recommended among persons who have sufficient knowledge and experience in programmed instruction (from abroad).

Functions of the Committee and sub-committees

1. Testing potentials considering and exploring the application of programmed instruction techniques.
2. Planning for stimulating informed discussions about automated instruction: this will probably be done in the first instance by making it possible for specialists from abroad to visit the country.
3. Developing the content and methods of programmed instruction.
4. Providing for pre- and in-service training for mastering programming and using programs.
5. Developing courses of programmed instruction in the college of education.
6. Providing for the use of machines in teachers colleges not only to familiarize students with the concepts and the techniques of programmed learning but to help teach conventional lesson preparation.
7. Translation and adaptation of some programs in subjects like mathematics, vocational training, statistics, and foreign languages. Translation will not succeed if the programs contain even the slightest hints of ignorance of the mores of the society.
8. The study of the problem of what new special types of machines will be required. It is advisable to start with the very simple and very inexpensive linear devices.
9. When machines and suitable programs are available, they should be tried on a very narrow scale in some of the laboratory schools to which students will go for certain phases of their instruction. The use of new techniques should not be spread before extensive research and experimentation. Before any program is finally issued for operational use, it must have been subjected to a number of real life tests during which factual mistakes, inadequacies in anticipation, programming weaknesses have been eliminated.
10. Approving and appointing committees and experts for conducting needed research.
11. Call for a conference to be held in one of the Arab countries to spread the knowledge of the new technique and its practical implication in the Arab world. Planning for such conference should be done through the Division of the Cultural and Educational Affairs of the "Arab League."
12. Setting adaptation and program production units. Probably a way of convincing prospective teachers is to prepare programmed instruction courses from which they can learn some of their teacher training courses. Those programs can also be used in in-service teaching programs.
13. Coordinating activities of organizations concerned: P.T.E., N.E.A., Supreme Council on advancement of Science and Literature, universities, teachers colleges.

TECHNOLOGY IN EDUCATION: PAST, PRESENT, AND FUTURE

Seth Spaulding

Technology is defined by Webster as "any practical art utilizing scientific knowledge....; applied science contrasted with pure science." Technology in education, then does not mean machines in education, although man-machine systems in education are a part of educational technology. Teaching machines, television, language laboratories, motion pictures, film strips. and yes, even books are a part of educational technology, but it is the proper use of these and other devices to achieve educational objectives that will make a difference. In essence, new machines in education will make little difference in themselves; the educational methods they make possible may make a great difference.

Traditionally, formal education has meant a syllabus, a textbook, a teacher, students and a classroom. Even the textbook is a technological innovation of the past hundred years. Until the last century, children learned from tutors and the basic information needed for continuing to the professions was imparted by word of mouth and by miscellaneous classical readings. One of the first efforts to put on paper a teaching method or a course of study in the United States was that of McGuffy, who produced the McGuffy reader and which sold untold millions of copies (and is still used in some schools). Here was a successful attempt to take a machine (the printing press) and devise a sensible new educational use for the machine.

But except for the introduction of the textbook, education has changed very little in the past century. We continue to make estimates of future educational needs in terms of numbers of classrooms and numbers of teachers required to accommodate the numbers of students we expect to enroll. The teacher is trained, he graduates, enters the classroom and for the succeeding forty years no one knows what happens in that classroom, and no one seems to care, so long as the students are kept disciplined. We talk of education as something noble, as something that requires close teacher-student interaction, as something that is more than the learning of facts and figures. And yet, we burden the teacher with too many students, too many classes to teach, too many other duties than teaching, until he has little time for individual attention to students. We judge student achievement by the scores made on periodic tests of information acquired. We too often assume that better education will come from doing more of what we are already doing poorly.

How can educational technology help us do more of what we should be doing? We have some of the answers, and we need many more, but all of the answers require total rethinking of the way we go about education, the way we train teachers, the way we manage the student's time, the way we develop educational materials and use the machines of education, the way we plan the content of education, and the way we spend the educational dollar.

Media and Methods

Programmed instruction, I suppose, is the latest technological development in a long line of events during the past twenty years. But is programmed instruction really new, or a refinement of educational methodology that has far reaching implications for the programming of all experiences in education?

Probably the potentially most significant educational technology development of the thirties was the emergence of the sound motion picture. Yes, the sound motion picture is only three decades old. And its use in education has far from matured. Sixteen millimeter sound films are basically used as supplemenetary materials and all too often they are used to entertain the students for a school period for which the teacher has not prepared. Although many films claim to be "correlated" with a course of study, few are prepared with a precise behavioral objective in mind. If an educational film sells several hundred prints in the United States, it is considered a great success, and yet we have more than a million and a half teachers and over 125 thousand 16 mm film projectors in the country!

The basic limitation of films in education is that the filmed material has not been programmed properly into the course of study. Only now, twenty years after the advent of the technique, are we beginning to think of eight millimeter, cartridge load, single concept films for education. Try to visualize two to ten minute segments of films, in self-load, self-thread cartridges, on the shelf in every classroom so that students or the teacher can display a demonstration of a scientific principle, explanation of a theorum, or an event in history, anytime during the class or course, simply by selecting the proper cartridge and pushing it into a rear screen projector. Such could be the potential of filmed material, properly programmed, in the future.

Even pre-dating the sound motion picture is the slide film strip projector. These were on the market as early as 1918 in more or less the same basic design as used today, constructed to project 35 mm film frames. By 1931, the first synchronized sound recordings were made to accompany the slide film. (Saettler, 1961).

Today in the United States, it is estimated that there are more than 175,000 slide or film strip projectors in the schools of the United States. (Goodfrey, 1961). There are film strips on nearly every subject and, as with educational motion pictures, there are many catalogs which purport to correlate these film strips with courses of study. And yet only during the fast few years has there been any attempt to develop film strips as part of an instructional system so that the teacher would have at hand precisely the sequence of visual events necessary to teach a precise behavioral objective at a precise point in the student's development. As with sound motion pictures, film strips are too often so-called supplementary materials which add a bit of variety to the classroom instruction, but which often contribute very little to any specific behavioral outcomes.

Television is one of the latest of a long list of technological advances which have made possible new methods in education. There are over fifty thousand television receivers installed in school systems in the United States and superintendents of schools indicate there is a need for another fifty thousand to attain educational objectives that they have in mind. There are over seventy educational television stations and hundreds of closed circuit television systems in use in schools and educational institutions. A survey conducted two years ago showed that there were over five hundred complete courses recorded in videotape or kinescope, and television courses given live but not recorded must number hundreds more.

Television offers great potential for distributing learning experiences to large numbers of students at relatively low per-student cost. But is television being used well? Two regional television libraries and a national TV library, established to exchange recorded televised courses between stations and school systems, have set up evaluation committees to select telecourses produced locally which may have regional or national value. Of the hundreds of telecourses available locally, very few have been judged of the quality sufficient to merit regional or national distribution.

Why is this? Simply because relatively few educators have carefully studied the potential of educational television with the idea of programming educational experiences that are uniquely suited to the 23-inch screen which

the students watch. Except for certain experimental programs, the use of television in education has been restricted to placing a teacher in front of a camera and telling the teacher to teach. What the student in the classroom sees is a teacher in a studio classroom teaching a mythical group of students in a studio. Such an experience is probably excellent teacher training inasmuch as few classroom teachers have had an opportunity to see other teachers teaching a full course since they themselves left high school or college. Teachers can learn new classroom techniques this way, but there are undoubtedly better ways of using the medium as an instructional device for children.

In essence, television has been made to televise <u>teachers</u> rather than to televise <u>instruction.</u> An example of the concern for instruction rather than for the TV teacher is described by George Hall, Director of Television at North Carolina State College. A mathematics professor and the station's staff were unhappy about the generally poor results of mathematics teaching directed toward home students. Among other things, they were concerned with the essential passivity inherent in the act of merely being a spectator. Active response on an intellectual level is needed to sustain mathematics learning.

This educational group began to feel that the commercial broadcast convention had conditioned instructional broadcasting to an insistence and expectation that televised material must be fluently produced with constant sound and motion, with much showmanship unrelated to instructional objectives. The broadcast convention assumes that the screen should never go dead except id rare moments of punctuation. Sound should be maintained at all times unless silence be supported by sharp, visual meaning. The viewer tends to expect a self-contained, self-motivating presentation, not requiring any real effort on his part.

The group decided to try to make use of the television receiver as a teaching device rather than as a purveyor of an instructional "show." Two visual symbols were contrived, one a white circle on a black background. This is used to trigger a problem-solving response. When this appears on the screen the audio goes silent for such a length of time as is necessary for the students in the classroom to complete the problem. The second symbol is a small white rectangle on a black background. When this appears the student is to pay particular attention to the sound as there is nothing the teacher wants him to look at at this point. It is conceivable that other symbols could appear when the set goes completely dead and during which time the students are to discuss an issue raised on camera.

Much of the teaching material is prepared ahead of time, much as programmed instruction frames are prepared, and the teacher is rarely photographed standing at a blackboard or talking at the camera. The teacher's face or body is included only at those times when it is necessary for him to communicate vis-a-vis with the student. Mr. Hall indicates that "Instructional elements are allowed to preempt the screen to the virtual exclusion of any secondary personality or locus factors." (Hall, 1962)

This is a unique example of educators attempting to use television as an instructional medium, rather than as a device to televise teachers or shows. All of the conventions of commercial television and theatrical presentation are discarded. Experiences are carefully sequenced with specific behavioral objectives in mind. The student is not allowed to sit passively while viewing a teacher performing in a self-contained theatrically oriented classroom on the screen.

Here, then, you have a television group attempting to apply the broad principles of programmed instruction to television instruction. A mathematics instructor specifically defines what information and skills he wishes the students to attain; he analyzes his medium in terms of what it can present and then limits its use to those stimuli which it effectively can transmit and which are related to the learning experiences desired; he then prepares sequences or units of material that will be presented over television; he provides for active response on the part of the students at specific periods and during which time the TV set presents nothing; presumably the material is tested and presumably there is some sort of validation whereby the effectiveness of the series is carefully judged after it has been used in a normalized working situation.

Programmed instruction, then, in the broader sense, is a methodology, an approach to structuring educational experiences. As a methodology applied to the curriculum, learning objectives will be carefully defined, the feasibility of using a number of technological devices to present stimuli to the students will be considered, and a system of learning experiences structured which use all technological devices in an "orchestration" carefully scored and tested bar by bar.

From Teaching Aids to Instructional Systems

Even the simplest teaching aids are now being packaged so that units of instructional materials are available to the classrom teacher as never before. Kits containing a filmstrip, record, teacher's guide, and reference

booklets for the students are offered by publishers with greater frequency. Many of these packages provide a complete unit of instruction so that all the teacher must do is follow instructions in presenting the material.

Entire courses are being filmed or televised especially in areas such as science, math, and foreign language where substantial curriculum revisions have been taking place in recent years. Numerous studies show that students learn as much or more from filmed or televised courses as they do from traditional classroom instruction.

Individual listening and viewing devices are being used with increasing frequency, these ranging from reading pacers designed to increase reading speed to tape recorders and rear-screen filmstrip viewers designed to be used by individuals in reviewing sequences of materials. Often, the instructions to the student are given via a tape recorder and he chooses visual materials and reading materials according to the voice direction on the tape.

Language laboratories are tape-recording and playback units interconnected in one of several ways to permit student language practice either individually or in groups. The growth of language laboratory equipment in the United States represents an interesting study in the growth of technology in education. (Finn, 1962). In 1958, a language laboratory was an experimental device used in a few of the 35,000 school districts in the country. At that time, the National Defense Education Act was passed, providing federal matching funds to states for the purchase of language laboratory equipment for schools. Also in the National Defense Education Act were funds for foreign language teacher training institutes. During the past five years, thousands of teachers have been trained in these institutes in the use of new methods and materials.

A third component of this legislation provided research funds for the development of new language materials. This package of federal help, consisting of funds for equipment, funds for teacher training, and funds for development of new materials, matched with a keen national interest in foreign language instruction, has permitted phenomenal growth in the language laboratory field. Although we do not possess firm figures beyond 1960, it is likely that close to 10,000 language laboratories now exist in American schools and colleges.

A new development which may have a significant impact on teaching methods is the eight millimeter sound film. Although sixteen millimeter film has been used for many years in most schools everywhere, it has been on the periphery of instruction, generally used for "enrichment" material. For the average school teacher, the mechanics of ordering and previewing the film, setting up the projector and showing the film have been a block to extensive use of the medium. Furthermore, films, with rare exception, have not been made as a part of a course of study, but have tended to be documentaries of general rather than specific value.

Eight millimeter sound film, however, combined with self-loading cartridge projectors which require no skill or ability on the part of the user, and which preclude film damage, may change film utilization patterns. The economics are such that an eight millimeter film projector and a library of single-concept cartridge-load films can be provided for a specific course at a fraction of the cost of similar sixteen millimeter films and projectors. Such equipment and materials may well become standard in many classrooms, with film sequences to teach specific skills and concepts on the shelf for use by the teacher or the student at any point in the course or during individual study.

A similar device which permits greater classroom flexibility than in the past is the overhead projector. Now in cases no larger than a portable typewriter, this equipment permits projection of overhead transparencies in a lighted room and provides for writing by the teacher on the transparency while the teacher talks to the students from the front of the room. More significantly, perhaps, sets of overhead transparencies are becoming available which provide the basic material for an entire course.

Programed instruction devices differ from most of the above equipment in that they are for the display of materials especially designed for individual self study. More elaborate programed instruction systems provide for computer analysis of the students responses and the computer selects the subsequent sequence of materials appropriate to help the student progress. Some experimental systems make possible the automatic selection of a number of different kinds of material which are viewed via closed-circuit television on a display panel at a study console.

School designs for the future suggest the need for classrooms which have built-in film and slide projectors, tape recorders, overhead projectors, audience feedback devises, television receivers, closed circuit television cameras and programed instruction study consoles. Such facilities

would make possible the use of any and all materials by the teacher and/or the use of computer controlled display consoles on each desk by the student for self study.

Such new concepts of school design imply such an increased use of a variety of new teaching materials that the school would rely heavily on automated information storage and retrieval systems. Conceivably, the business of ordering a film, searching for a book, digging for information from printed lists or bibliographies, and other similar time-consuming mechanics can be eliminated if all such material is coded and stored in a central location and available for call-up on viewing consules by simply pushing buttons or dialing code numbers. Similarly, information from other school systems or universities throughout the world could be exchanged via devices and transmission systems now available.

Certainly, such instructional systems of the future will go far beyond what programed instruction attempts to do today. Dr. Sydney Pressey of the Ohio State University, who constructed in the 1920's what many consider the first "teaching machine," expresses grave concern that the present format of most programed instruction materials is most limited. He suggests "adjunct auto-instruction...which keeps, makes use of, and enhances meaningful structure, the auto-instruction serving to clarify and extend meaningfulness. Texts, manuals, laboratory exercises, instructional motion pictures and television would be kept (though often improved) and the auto-instruction would aid in their use and increase their value. The (auto-instruction) materials would be perhaps a tenth as bulky as present programs; and being objective their use could be greatly facilitated by automating devices." Pressey suggests that much instructional material can be taught much more effectively if it is in initial textual form, extremely well organized and well written "much like a good textbook." The auto-instruction "should follow and should be like a series of questions in a very good discussion of a chapter." (Pressey, 1962).

Impact on Education and Its Institutions

Whatever the strategies for systematizing the materials of instruction, it is obvious that we are merely on the threshold of systems of the future. How will these new methods, materials, and instructional systems effect education?

Obviously, the role of the teacher is changing and must change. Let me read several recommendations of the 1960 National Conference on New Media in Teacher Education, convened by the American Association of Colleges for Teacher Education (USA). (AACTE, 1960). Some forty deans, presidents, and

instructors in teacher education institutions met with fifteen educators from public school systems, ten representatives of other academic disciplines, ten consultants in the psychology of learning and the new media, and five academic personnel in higher education. The group concluded that the media "will radically change the character of teacher training, the design of school plants, grading and grouping practices in the classroom, and inevitably the teacher who uses them." These educators also recognized the dangers:"... the questions of thought control, dictatorial curricula and canned (commercially prepared) materials." They pointed to the "... value of cooperative effort in meeting technological challenge." Not only must the problem be adequately conceived but cooperative effort was seen as the only means of introducing effective use of automation into the schools. Cooperative effort between local school systems and teacher education institutions, audio-visual experts and learning psychologists, discipline representatives and teacher education personnel was seen fruitful for research and dissemination efforts and for active involvement in policy decisions.

The technology of education implies a new look at the student as well as the teacher. If the student does not learn, it is not he who has really failed, it is the instructional system that has failed.

Educational technology implies a concern for the machines of education. New kinds of data storage and retrieval systems, display devices, audience feedback devices, and instructional systems must be devised precisely suited to the appropriate instructional tasks.

The machines are useless without the proper content. The new technology implies a vigorous interest in specific definition of behavior objectives. It implies a continuing new look at what we are trying to teach and why we are trying to teach it.

Appropriate content must be combined with appropriate method. It is not enough to define what you want to teach unless this is translated into a method that appropriately uses the machine, the teacher, and the materials in an orchestration of instruction.

All of this must happen in a new kind of teaching-learning environment. No longer can we have the honeycomb kind of school situation with cubicles for thirty students and a teacher and nothing more. We must look to individual study carrels, spaces for small group instruction, spaces for large group instruction, new kinds of library facilities, and new kinds of work spaces of all kinds.

All of this implies a new kind of school and college administration to make this all possible. We are not at all sure as yet what the economic implications of individual pieces of the instructional system may be. For instance, we are not clear how programmed instruction will affect the cost of education, nor how instructional television may affect the per-student cost of instruction. We are a long way from knowing the ultimate cost a total "systems" approach to instruction.

Scheduling of students and the testing of students will require computerized operations as yet used only experimentally in certain schools and colleges. Guidance and counseling activities will increase and will require computerized backstopping.

A Systems Approach

One of the first systems approaches to higher education is being attempted at a new university being built at Boca Raton, Florida. This university will open its doors in the fall of 1964 with an enrollment of 2000 students. The unusual thing about the university is that the first year's faculty consists of 86 academic staff in four schools and 86 planning and development staff in a division of learning resources. In essence, there is one-to-one ratio between academic staff and instructional resources staff.

Within the division of learning resources, as on this organization chart, will be four "systems design" offices, one for each of the academic schools. These four offices will be charged with planning instructional systems for each academic course and for each academic school.

Supporting planning and production staffs include the Office of Library Information and Retrieval Services, the Office of Television and Radio, the Office of Learning Laboratories, a Graphics Production Unit, and a Learning Resources Facilities staff charged with keeping equipment in good order and managing the cameras, television equipment, and so on.

Lecturers will talk at the students very seldom. They will largely be tutors, guiding students to appropriate learning materials and helping to prepare these materials with the learning resources staff. The learning resources division is characterized as a "systems approach to the use of educational media and technology, designed to make maximum use of non-human teaching resources without destroying the unique function of the professor. It involves (a) determining the nature and quality of a learning experience (operations analysis), and (b) selecting and designing a combination of media and technology which will actualize the desired experience most efficiently

and effectively (systems design). Functioning under an administrative head, the five areas combined to bring the specialized knowledge and professional skills of a team of experts to bear on each instance of prescribed educational need." (Singer, 1963).

Florida Atlantic University, indeed, is attempting to apply programmed instruction in its broadest sense to higher education.

A Programmed Instruction Methodology

Programmed instruction is more than a series of frames with appropriate responses. Programmed instruction is the methodology of educational technology. The devices, machines, and methods are with us to provide the student and the teacher with an effective systems approach to instruction. The materials, for the most part, are not with us. The purchase of teaching machines, television sets, data storage and retrieval equipment, and so on, will be of little value unless adequate research and development on the materials of instruction is undertaken.

In addition to providing schools, classrooms, and a textbook budget, schools and universities must provide staffs to develop the materials of instruction and plan the instructional systems. The day of the self-contained classroom in which the students depend solely on the personal resources of the teacher and the textbooks is on the way out.

Paraphrasing the earlier definition, educational technology is the practical art of education utilizing our scientific knowledge of teaching and learning. As we continue conference discussions let us be bold in considering the applications of educational technology to accelerating the quantity and improving the quality of education in our various countries.

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