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APPLICATION OF EDUCATIONAL TECHNOLOGY IN THE DEVELOPMENT 
OF HUMAN RESOURCES ON HEALTH 

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Technology is the application of theoretical knowledge and scientific principles to the solution of problems; as related to education technology aims to improve the design, implementation and evaluation of teaching and learning. Thus, educational technology does not correspond to the introduction and operation of various kinds of technological devices, but it is oriented towards the interaction process between teacher, instructional material, media, and learner, fighting to increase and improve the learning outcome.

The expansion of students' enrollment not paralleled by the increase in the number of teachers (fig.1), the low efficiency of learning, the cry for the individualization of the teaching-learning process, have led to a search for a more scientific approach to education.

Analysing the scarce progress of education throughout the years, one wonders what part scientific research has played on it. Making research findings available to educators is a method being used for years. However the rate at which this method brings about change is extremely slow. Teachers and administrators still consider research data as something remote from their own experience and day-to-day problems.

Since most of the important changes to be introduced in teaching must be implemented by teachers, changing their training should bear a direct effect on educational change. Thus, the importance of teacher's training activities.
On the other hand, there is some educators who believe that the most likely agent for change in the schools appears to be the materials, equipment, and situations with which the students interacts to learn. Teachers are generally against changes. They have been thoroughly educated in the culture of the group for whom they plan a school program; consequently "they bring to their planning a system of values, concepts, and beliefs that conform in general to those of the social group who entrust them with educational responsibilities". (1)

On this regard said Clark Kerr (2): "Few institutions are so conservative as the universities about their own affairs while their members are so liberal about the affairs of others; and sometimes the most liberal faculty member in one context is the most conservative in another ... when change comes it is rarely at the instigation of this group of partners as a collective body. The group is more likely to accept or reject or comment; than to devise and propose. The change will eventually come in the face of much faculty hesitation and even some resistance".

Matter in fact, the tendency to be reactionary is so strong, that even innovators tend to be reactionary to any change proposed in relationship to their innovations!

But the stability of man's institutions depends on their ability to change continuously, adapting to social changes; and schools are no exception to this truism. They must adapt to the evolution of society or they will decay.

(1) Saylor, J. G. and W. M. Alexander
Curriculum Planning for the Modern School
Rolt, Rinehart and Winston, N. Y., 1966 p. 84

(2) Kerr, C - Conservatism, Dynamism and Changing University - in E rich, A. C., Campus 1980
Dell Publishing Co., N.Y., 1968, p. 303
FIG. 1

HIGHER EDUCATION—BRAZIL

NUMBER OF STUDENTS AND TEACHERS IN HIGHER EDUCATION INSTITUTIONS

YEAR

1960 61 62 63 64 65 66 67 68 69 1970 71 72 73
"A University is not outside, but inside the general social fabric of a given era. It is not something apart, something historic, something that yields as little as possible to forces and influences that are more or less new. It is on the contrary an expression of the age, as well as an influence operating upon both present and future". (3)

Medical education has been oriented through the years towards the formation of physicians prepared to offer quality care for a relatively limited number of patients in a hospital setting, often sophisticated and specialized. The preventive medicine programs added in recent years to the medical curriculum are generally developed in "teaching" health centers or community "laboratories" which do not provide the environment and the learning opportunities needed to form an "integral" physician.

Large portions of the world population do not receive appropriate care for their health problems, or simply receive no care at all, and medical education does not take these facts into consideration.

On the other hand, one of the big problems of our society is the widening gap between existing knowledge and its application to the solution of day-to-day problems. This implies the need to develop new approaches in health care, in order to provide services for all, using available and often limited resources.

The use of screening systems, the work in health teams, the delegation of functions to allied health personnel, the transfer of activities from physicians to nursing personnel, the responsibility for the care of defined populations are

all part of these new health care approaches; and to make them accepted new teaching settings must be organized; new attitudes and values developed, and new professional models offered to the students.

Integration of the Health and Educational Systems

The medieval university was formed by students from different countries that would meet in a city to learn from professors of different nationalities; (thus teaching was delivered in a common language, Latin). This explains why the universities, fearing the communities where they were located, fought continuously to obtain special privileges and autonomy. The isolation of academia from its social environment was established, thus explaining the concept of "ivory tower".

In relationship to health sciences, separation between the health care system and the university was often complete. This concept was expressed by Flexner who said (4): "I have been urging that universities maintain contacts with the actual world and at same time continue to be irresponsible. Are the two attitudes incompatible?" Flexner accepted that the answer was no, and took the example of medicine saying: "The professor of medicine needs patients, just as the social scientist needs his environment. The professor of medicine ought to be thoroughly human, realizing fully that he is dealing with, and in that sense responsible for human life. But the professor of medicine is primarily a student of problems and a trainer of men. He has not the slightest obligations to look after as many sick people as he can; on the contrary the moment he regards his task as that of caring for more and more of

the sick, he will cease to discharge his duty to the university - his duty to study problems, to keep abreast of literature, to make his own contribution to science, to train men who carry on ...

Taking the European university, specially the German, as his model of university, Flexner emphasized the teacher-researcher in detriment of the teacher-practioner; the student was trained in a "university hospital" being exposed almost exclusively to special and "interesting" cases and not in a community hospital, as a part of a health care system, treating the pathological problems prevalent in the region; at the same time an attitude of admiration towards research, and the study of the difficult and rare case was developed on him.

As a result of the Flexner report University Hospitals were established as the training ground for medical students. Nevertheless, by their sophisticated equipment, interest on pure and applied research, they do not correspond to the best environment to train medical and other health sciences students.

White et al. (5) following 1000 patients during 1 month observed the following: 750 reported symptoms of medical problems, including cephalgia, asthenia, nervousness, anxiety and general malaise; 250 consulted a physician; 9 were hospitalized, 5 referred to an specialist and one, just one, was hospitalized in an University Hospital.

Taking the American university as their models the Latin American universities have been fighting for decades to build up their own hospital where they would them teach their student in detriment of the use of community hospitals.

We believe that it is a phalacy to assume that an integral medical formation, i.e., the fully integrated teaching of preventive and curative medicine visualizing the man with all his somatic, psychocological and social problematique, will be possible to achieve in an "University Hospital". As stressed by Miller "diseases and illness are not limited by the walls of the hospital but are community matter at both the individual and the collective levels... Today also the academic is adjured to come down from the university's red-brick tower and throw himself into life and work of the community, refreshing it with his wisdom and expertise." (6)

For all these reasons, the University Hospital, as conceived today, should be used mainly for specialized and postgraduate training and we should use the health care system as a whole, including the community that it serves, as the training ground for health sciences professions.

The University Hospital as a tertiary care or referral agency, would be the basic unit of a system that would comprehend general hospitals (secondary care), community health units - urban, and rural - (primary care), including thus from the sophisticated intensive care unit to the extensive home visiting services and the sanitary control of the environment.

Working actively in the different levels of health care, the student of a health sciences profession will be exposed to the full spectrum of health disease, will understand the importance to know the natural history of diseases in order to detect vulnerable point where his action will result in the recovery of health, or will diminish the possibilities of physical or functional sequella.

He will understand the importance of team work and the need of a multidisciplinary approach to solve health problems.

He will have the opportunity to study man in his environment and will grasp the importance of socio-cultural factors in the genesis of diseases and in the men own conceptualization and valorization of health and disease.

He will understand, finally, that his work at the hospital will not improve significantly the sanitary situation of the people if not complemented by activities developed at the community focused on the individual, the family, and the collectivity.

Last, but not least, the utilization of all potentialities of the health care system to train health manpower will improve the quality of the services rendered to the population, through the continuous upgrading of medical knowledge of the health sciences professionals involved in teaching, and simultaneously would form professionals better prepared to promote, maintain and recover the health of man.

But how the university would ensure the quality desired for the teaching developed in health care services other than its own University Hospital? How to provide a frame of reference that would orient and organize teaching? Through the definition of educational objectives, the preparation of instructional material and the design of evaluation systems.

Thus the following actions could be proposed:

- Critical analysis of instructional content.
- Development of self-instructional programs.
- Design of multi-media packages
- Development of new instructional materials.
- Establishment of learning resources centers.
- Development of a formative evaluation system.
- Definition of the teacher's role and teacher's training.
Critical Analysis of Instructional Content

The content of the educational programs must be critically reviewed in order to assure its relevance in relationship to the terminal objectives of the health sciences courses. On this regard, emphasis should be put not just on content objectives, referring to specific knowledge and skills to be retained by the students, but also to process objectives representing what Piaget calls "schemes of action" (7).

Matter in fact, a knowledge is retained when it is integrated to previous existing cognitive structures that will permit its analysis, evaluation, categorization, classification, conceptualization, etc ...

Thus, process objectives correspond to "action schemes" or "what in an action is transferable, generalized or discriminated from one situation to another, or what is common in successive repetitions or applications of one mission". (8)

Process objectives such as to recognize, to identify, and to formulate a medical problem, ask for relevant data about a problem, propose and test working hypothesis, should be stressed and the instructional experiences designed to develop these skills on the students planned and implemented.

Furthermore, since the educational system is designed to train human resources to meet the demands imposed by the social environment, the terminal objectives of this system must be compatible with these demands. An attempt must


also be made to foresee how society will developed and to establish educational objectives that not only satisfy present demands, but also the ones that will exist at the time when the student will effectively practice his profession.

Process objectives are once again emphasized because they will build up the cognitive structures to which new knowledge will be assimilated.

Finally, the revision of the content of the instructional program must contemplate the approach of common problems by several specialists. Oriented by well formulated terminal objectives we also foresee the initial coordination, and progressive integration of different disciplines towards interdisciplinarity.

**Development of Self-Instructional Programs**

Learning is an individual process. Each student will learn in accordance with his own characteristics, such as interest toward the subject-matter, aptitude, perseverance, previous knowledge, availability of both time and instructional resources.

Carrol (9) introduced in 1963 the concept of "Learning for Mastery" when he defined the aptitude as the amount of time required by the learner to attain mastery of a learning task. This author said that since the students' aptitude for some subject-matter is normally distributed, if all the students receive the same instruction, regarding quantity and quality of instruction and time available for learning,

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(9) - Carrol, J. - A Model of School Learning - Teachers College Record, 64: 723, 1963.
the end results will be also normally distributed. Thus, instead of fixing the quantity of matter and time of students interaction with the matter (which will produce different learning outcomes as related with different student's aptitudes) Carrol proposes to fix the expected learning results making the other factors variables.

This concept was extended by Bloom (10) who defined the three factors that determine the learning time as: aptitude, ability to understand the instruction (which varies with different learning experiences), and quality of instruction. Two factors are responsible for the time effectively used by the students to learn: time available to interact with the subject-matter, or learning opportunity, and time that the student intends to expend in order to learn, or perseverance.

Bloom also emphasized the need to present well formulated instructional objectives to be met by the students, to provide instructional opportunities and different and alternative ways to interact with the subject-matter, to provide feedback information that will guide and correct the student's learning, and, finally, to offer flexibility on the learning time. Meeting these conditions, Bloom states that theoretically all students can conceivably attain mastery of a learning task.

The need to individualize instruction and, at the same time, to increase the emphasis on the development of self-teaching study programs, thereby transforming the student's role from a passive to an active one. The student will be the active agent in the learning process, and the teacher will act more as a guide than as a source of information.

On the other hand, active learning is essential if one wishes to individualize instruction, and ensure continuity of the educational process. In fact, it seems to be very difficult for a student who has learned passively while in school, to change his attitude toward learning after graduating and proceed to seek, evaluate, and synthesize information on his own.

Individualization of the educational process can be defined as an attempt to adapt the learning process to each student's characteristics (flexibility in learning-time, content of the curricula, and utilization of learning resources). This will evidently depend on definition of clear educational objectives which will help the student's choice of the learning activities offered by the different courses. Diversified and available resources are thus necessary, as well as orientation and guidance by teachers who have been trained in modern pedagogic techniques.

As was stressed by Houle (11) "if you teach a person what to learn, you are preparing him for the past. If you teach him how to learn, you are preparing him for the future."

**Development of Multi-Media Packages**

Comprehensive utilization of programmed instruction, and the use of information media such as films, video-tapes, slides, transparencies, microfiches, simulation of biological phenomena, and the presentation of problems through computers must be adopted as teaching tools if we wish to deal with large numbers of students, while providing them with sound and individualized instruction.

However, it should be stressed that all instructional materials prepared should be validated through their experimental use by pilot groups, so that they may be revised before used on a large scale.

The majority of the instructional resources currently available have not been adequately tested and evaluated, steps that are necessary for continuous improvement and assessment of efficiency within the educational system. The validation through experimental application is considered indispensable for the use of new educational technology.

**Development of New Instructional Materials**

New instructional materials should be developed in order to offer diversified learning opportunities to the students. Among these new instructional resources emphasis should be put on the use of simulations.

Simulations copy or imitate the reality in controlled situations designed with variable number of relevant and/or irrelevant factors, different degree of risk and diversified experimental conditions. Simultaneously they offer an opportunity for active training of the students in the development of complex behaviours and in solving problems of different levels of difficulty.

Simulations are designed in such a way as to allow the effective use of learned behaviors, or problem-solving strategies, in real situations, offering the students opportunity to interact with the simulation as many time as needed to develop the desired behavior or skill. Frequent feed-back will inform the student about the quality of his performance.
Simulations may be used in the training of interpersonal skills, through the use of actors, in the development of psycho-motor skills, using manekins, in the interpretation of clinical and experimental data, and in the management of health problems, through simulations presented graphically (12) or via computer. (13)

Establishment of Learning Resources Center

It should be emphasized that unless the instructional materials developed as part of comprehensive multi-media packages, and in accordance with well formulated educational objectives, remain at the students' disposal for their use, individually or in small groups, they will be of little value.

Learning resources centers must be organized in order to offer the student opportunity to interact with instructional materials presented in diversified audio and/or visual formats, from slides, microfiches, and audiotapes, to video-cassettes, and computer terminals.

Development of a Formative or Tutorial Evaluation System

The availability of a tutorial or formative evaluation system is an important component in any educational program that emphasizes active learning processes. Tutorial evaluation can be made by use of computers, and includes "conversation" between the student and the machine through individual terminals. Such dialogue aims to measure the student's comprehension of the didactic material, and at the same time provides an evaluation of his capacity to use logic in solving problems presented to him. In this sense, the student must be able to grasp and


formulate the problem. He must also collect information, searching within himself for knowledge already stored and structured in his memory and searching in external sources for additional data. He must then be able to formulate and test a working hypothesis, and finally reach a solution for the problem.

After all, the way a student stores and recalls information is much less important than the way through which he processes such information for the solution of the problems.

As an alternative approach, formative evaluation may be delivered through tutors with different levels of expertise, including students, although in this case there will always be the problem of lack of standardization and objectivity of the evaluation.

Current studies (14) suggest that the introduction of a program of systematic diagnostic testing which is used to generate specific educational prescriptions can lead to a significant reduction in the range of individual differences both in terminal achievements and in time required to attain a determined level of competence. Such studies have indicated that virtually all the students in a class (provided that they have fulfilled the established prerequisites) are capable of achieving a high level of mastery of the subject matter, and also, that if a flexible time for the learning period of the initial units is offered, a gradual diminution of individual differences required to reach the desire level of competence is observed in subsequent instructional units.

(14) - McGuire, C.H. - Diagnostic Examinations in Medical Education - WHO/EDUC/72.151.
Definition of Teachers' Role and Teachers' Training

Until recently most of the teacher's activities were related to the transmission of knowledge and the evaluation of the student's ability to recall information. The teacher was conceived as an individual knowing everything about his discipline and almost infallible. Students were expected to copy him as their model; students' mistakes were punished through a subjective and frequently non-valid evaluation system.

The emphasis of the educational process was on teaching on the transmission of facts through lectures and on the evaluation of the students ability to recall information.

Nevertheless, what is important is not the student ability to recall information but his ability to use the information to solve problems; and the intellectual skills needed to recall information are different from those used to solve problems.

Thus it is not sufficient to increase the efficiency of the teacher's work through techniques that raise the efficiency of information transmission and retention, but it is necessary to change the focus of the educational process, from teaching to learning, from simple factual recall to problem-solving skills.

Therefore, the teacher must accept that he is no more a source of information, often in the past the only source, but a student's guide, or tutor. The student, on the other hand must learn to study, to continuously and actively upgrade his knowledge, to accept criticism and, through self-evaluation of his own performance look for his self-improvement. He must understand that there is no absolute truth, and learn to live and work with the concept of what Hilliard Jason calls the "management of uncertainty", concept of special importance in relationship to the health professions (15).

(15) - Jason, H. - Conference delivered at the Latin-American Center of Educational Tecnhonology on Health, July, 1973 (not published)
Teacher's Training Programs

The production of diversified instructional resources designed to meet well-determined objectives, curriculum revisions, the organization of a tutorial evaluation program, problem simulation in computers, and the undertaking of educational research, cannot be effective if the faculty does not take into consideration the new trends in Health Sciences Education.

Intensive training courses in special topics (such as determination of instructional objectives, instructional methods, evaluation, etc.), regular courses dealing with educational planning in Health Sciences and eventually courses to train specialists in Health Sciences Education must be therefore considered as one of the most important activities to be developed.

These courses should not be described as courses to teach the teachers to teach but as courses to help the teachers learn how to guide the student's learning.

Perhaps no factor plays a more important role in promoting change than the offering of a new model to copy. When we say "do what I say, not what I do" we are stressing the importance of modeling in learning. Teachers meeting new situations and challenges need often to be informed about examples of successful changes in order to accept new approaches towards teaching.

Besides the organization of a teacher's training program, the Latin American Center of Educational Technology on Health aims to provide this information to teachers and to promote educational researches to develop new educational models.

On this regard the teaching-service integration program sponsored by the Pan-American Health Organization will play an important role in the development of a new approach on health sciences education aiming to form the manpower needed to extend and improve the health care rendered to the people.
After all it is a shame for mankind to realize that despite our technological power, communities and environment continue to deteriorate, poverty and inequality persist, work remains alienating, and man and women are not liberated for their self-fulfillment.

Let us work to legate to future generations a better world where these words shall be considered past, remote and absurd.