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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 relat ed 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 be tween 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 efficien cy 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 experienc 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.

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  of Rio de Janeiro.

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; consequent
ly "they bring to their planning a system of values, con-
cepts, and beliefs that conform in general to those of the
social group who entrust them with educational responsibi-
lities". (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 dependes 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.

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(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 Universi-
    ty - in E rich, A. C., Campus 1980
    Dell Publishing Co., N.Y., 1968, p. 303

HIGHER EDUCATION-BRAZIL

STUDENTS
TEACHERS

NUMBER OF STUDENTS AND TEACHERS IN HIGHER EDUCATION INSTITUTIONS

YEAR
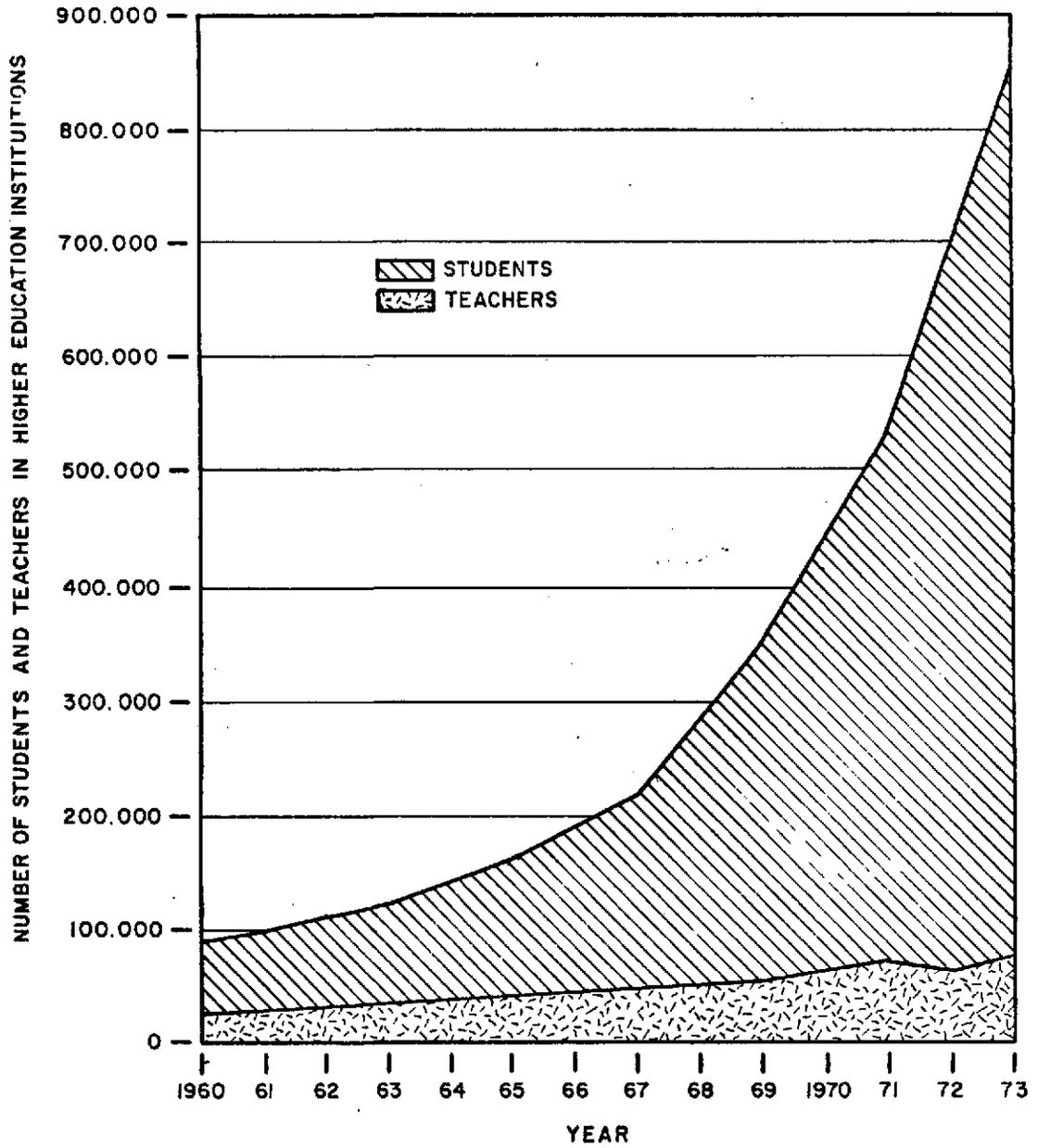
FIG. 1

"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 preventi
ve 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 recei
ve 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

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(3) Flexner, A. - Universities: American, English, German.
    Oxford University Press, N.Y., 1930 - ed. 1968, p.3.

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 differ
ent 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 irrespon-
sible. 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 thouroughly humane, realiz
ing 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

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(4) Flexner, A. - Universities: American, English, German.
     Oxford University Press, N.Y., 1930 - ed. 1968,p.15,
        16.

the sick, he will cease to discharge his duty to the univer
sity - 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 expos-
ed 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 cephaleia, 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.

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(5) White, K.L. - Pattern in Medical Practice in Clark, D.
     W. and Mac Mahon, B. - Preventive Medicine, Little
     Brown Co., Boston, 1967.

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 univer-
sity'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 conceiv-
ed today, should be used mainly for specialized and post-
graduate 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 terciary 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 expos-
ed 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.

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(6) Miller, H. - Fifty Years After Flexner - Lancet, ii:
    647, 1966.

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 potencialities 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 envolved 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 integrat-
ed to previous existing cognitive structures that   will
permit its analysis, evaluation, categorization,classifica
tion, conceptualization, etc ...

Thus, process objectives correspond to "action schemes" or
"what in an action is transferible, generalized or discri-
minated 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 implement
ed.

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

(7) - Ferreira, J.R. - Las Ciencias Fisiologicas en la For-
        macion del Medico - Documento Preliminar, 2a. Reunion
        del Comité del Programa de Libros de Texto - OPS/OMS
        en la Ensenanza de las Ciencias Fisiologicas -OPS,1964.

(8) - Piaget, J. - Biologie et Connaissance - Ed. Galimard,
        Paris, 1967, p.23.

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 profess
ion.

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 re-
sources.

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 pro vide instructional opportunities and different and alterna tive ways to interact with the subject-matter, to provide feed-back 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.

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(10) - Bloom, B.S. - Learning for Mastery in Evaluation
        Comment - Center for Study of Evaluation of Ins-
        tructional Programs, UCLA, Los Angeles, vol. 1 ,
        nº 1, 1968.

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.

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(11) - Houle, C.D. - The Lengthened Line in Perspectives in Biology and Medicine, Vol. II, nº 1, 1967, p. 37.

However, it should be stressed that all instructional mate-
rials 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 avail
able 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 situa
tions 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

(12) - McGuire, C.A. and Solomon, L. - Clinical Simulations - Appleton-Century-Crofts, New York, 1971.

(13) - Jouval Jr., H.E. and Lobo, L.C.G. - O Uso de Técnicas de Simulação em Educação Médica - Educación Medica y Salud, 8: 158, 1974.

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 process es 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 indi - cated 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.

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(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 sys
tem.

The emphasis of the educational process was on teaching on
the transmission of facts through lectures and on the evalua
tion 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 continously and actively upgrade
his knowledge, to accept criticism and, through self-evalu-
tion 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).

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(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 design-
ed 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 determi
nation 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 de-
veloped.

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 success
full changes in order to accept new approaches towards teach-
ing.

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 educa-
tional researches to develop new educational models.

On this regard the teaching-service integration program spon
sored by the Pan-American Health Organization will play an im
portant role in the development of a new approach on   health
sciences education aiming to form the manpower needed to ex-
tend 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 allienating, 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.