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ABSTRACT
        Evidence indicates that instructional technology,
appropriately applied, can facilitate a more individualized,
flexible, and adaptable educational program of medical instruction.
It is recommended that support be provided for programs that will
systematically educate medical instructors in the applications of
instructional technology; that high funding priority be given to
innovative applications of instructional technology; that the
government support research to design and test new ways of using
technology, and encourage industrial innovations. (SP)

INSTRUCTIONAL TECHNOLOGY IN MEDICAL EDUCATION

By Hilliard Jason*

INTRODUCTION

The profession of medicine depends heavily on technology. Both practice and research have used and prompted new applications of technology for many years. Yet, instruction in medicine has not had a comparable orientation. Serious study and improvement of the instructional process in medicine has only recently begun. This attention is now leading to the implementation of approaches borrowed from other fields, as well as to explorations of new approaches specifically adapted to the particular needs of this profession.

These new developments, and the directions in which they will likely go, will be reviewed against the background of the recent history of medical education and its current major trends. This will involve an analysis of the central tasks of medical instruction and of the ways in which technology has made or can make its most important contributions.

Throughout this presentation the orientation will be exclusively toward technology as a factor in direct instruction, rather than a component of such administrative support functions as student record keeping, library management or budget handling.

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Accomodation to the assigned space limitations required
the setting of priorities, which have led to the selective exclusion
of many issues. The highest priority and, therefore, most attention,
has been given to those aspects of medical education which seem most
in need of strengthening and to those forms of technology which are
believed to hold the most promise as responses to these needs. It
is emphasized that these priorities, emphases, and omissions are
reflections of my own views and predispositions. While a wide vari-
ety of personal experiences as well as systematic studies of my own
and others have contributed to this paper, the categories selected
for attention, the conclusions drawn and the recommendations offered
must be interpreted as a distillation of informed judgments and sub-
stantiated findings, not as exclusively the latter.

The National Medical Audiovisual Center has compiled a
bibliography of relevant references in this field, prior to October,
1966. We have developed a supplemental bibliography, bringing that
one up to date. Both are attached as Appendices 2 and 3.

BACKGROUND AND PERSPECTIVE

The Tasks of Medical Education

The applications of technology in medical education must be
considered against the perspective of the instructional purposes
which are to be achieved. Undergraduate medical education is charged
with the rather staggering task of negotiating a virtual transforma-
tion in the young men and women who are selected to become physicians.
In some ways, this educational process is unlike any other. In
addition to the huge and growing body of information and the large
array of intellectual, manual and sensory skills which the students
are to be helped to acquire, medical school faculties are increasing-
ly seeing themselves responsible for helping students undergo some
measure of personality modification. They are to enhance or develop
the students' capacities for: establishing and sustaining high
standards; making judgments and taking action in the face of consid-
erable uncertainty; dedicating themselves to the notion that the
welfare of others takes precedence over their own comfort and con-
venience; remaining productively engaged with experiences that tax
the instincts and offend the senses; being supportive and empathetic
while objective and clear-headed; putting aside a lifetime of becoming
socially proper and discreet in relations with others, in favor of
such activities as directly and comfortably asking virtual strangers
for the most highly personal information; to mention only some of the
highlights of this incredible educational challenge.

These and other goals must be fulfilled to an extent suffi-
cient to grant each candidate privileges which are accorded

no other group in society. In their professional roles they will no longer be bound by usual considerations of emotional or physical privacy, they will be entrusted with the judgments and tools of life and death, and they will be put in the position of having to give advice which can cause others to significantly modify their total life style.

The Characteristics of Medical Education

The pattern of the past century has been for almost exclusive attention to be given to the sub-task of helping students acquire the largest possible body of information, to the relative exclusion of attention to the many other sub-tasks noted above. These other sub-tasks are now coming to be increasingly recognized as in need of systematic instruction for optimal development.

Until relatively recently medical education in this country was a rather standardized process. With very little exception from school to school, the first two years consisted of lectures and laboratory exercises in the basic sciences of anatomy, biochemistry, microbiology, pathology, pharmacology and physiology. The next two years consisted of "clinical clerkships" in which the students rotated through full-time experiences on the clinical patient-care services of internal medicine, obstetrics-gynecology, pediatrics, psychiatry, and surgery with a possible special out-patient experience in addition. The most outstanding feature of this curriculum was its "lock-step" quality. The implicit assumptions of such a rigid system were that all medical students must learn in the same way, at the same rate, and that all M.D.'s must have an identical basic preparation.

The inflexibility of this system, coupled with its primary preoccupation with the acquisition of information led, predictably, to the employment of a narrow range of instructional methods and a limited use of instructional technology. The nearly exclusive application of technology in this traditional setting was: occasional slides to illustrate formal lectures, occasional 16mm sound movies shown to large audiences, microscopes and other laboratory equipment used according to proscribed, "cook-book" type assignments, and, using the broadest definition of aids to instruction, indigent patients, who served as subjects on which students could practice skills.

Current Medical Education

The above description is a necessary background for understanding the circumstances from which many medical schools are now emerging. While the characteristics described above remain more or less current at a significant number of schools, the majority of medical schools in the country are currently engaged in a serious re-examination and modification of their instructional program.

Within the past ten years an accelerating series of events has led to a significant alteration in the basic structure and orientation of the educational process in medicine. There are increasing efforts to introduce flexibility into the curriculum, through reducing the number and length of required experiences, adding elective options and free time, developing tutorial and advisory systems, and

fashioning multiple-track rather than single-track pathways through the curriculum. Twelve medical schools have created offices of Research in Medical Education, in formal recognition of their efforts to study and improve their instructional programs, and nearly twenty other schools are now trying to identify suitably qualified individuals to develop similar units. In the largest national growth spurt ever, seventeen new medical schools are in the process of being developed as additions to the previously existing 86. Most of these new schools are capitalizing on the flexibility of their newness to test innovative instructional ideas. This country-wide spirit of change has brought many efforts at modification of instructional methods and introduction of new applications of technology.*

In this atmosphere of change, the growing variety of available technological aids to instruction is being adopted, even grasped at, with an eagerness that is both promising and worrisome. Of greatest concern is the propensity of many teachers to regard new devices as equivalent to new ideas. The act of accomodating old instructional notions to new packages, such as putting an old lecture on television or on a computer, can prove to be worse than no change at all. The glossy new packaging tends to deceive both the student and the teacher into believing that something new, and assumedly better, is happening. In actual fact, what has often happened is that considerable energy and money have been invested in creating a situation that is now even harder to change than was the conventional instruction it is mimicking.

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*The most recent data on changes in the use of technology in medicine were assembled as part of a survey on curricular innovations, conducted by a Steering Committee of the Association of American Medical Colleges, of which I was a member. These data are presented as Appendix 1.

There have already been repeated examples in medicine of live lectures, poorly delivered and stultify... g in person, which became even more evidently so on the TV monitor. One can now find a small but growing number of computer-based instructional units which are, in actuality, electronic reincarnations of the pompous, arrogant professor whose instructional strategy is the demand of compliance from the student rather than the promotion of independent skills. Simply put: bad instruction isn't made good by inclusion in a new medium.

The basic issue is that the automatic response of many medical educators has been the accomodation of conventional instruction to available technology. The pressing need is for continuous study and modification of the instructional process itself, with adaptation of technology to the needs of that instruction.

THE USES OF INSTRUCTIONAL TECHNOLOGY

The conventional uses of technology have tended to rein-
force the conventional approach to medical instruction: that is, the
primary preoccupation has been with the transmission of information.
One of the major changes now taking place in medical education is
the growing awareness that in the domain of information-learning,
acquisition is merely the first of three necessary steps. Simple
acquisition of information at some point in time is of no value if
the conditions have not been arranged for effective retention of that
information and for its availability for transfer to a variety of
different settings. A companion recognition is that retention and
transfer are optimized by having the original acquisition occur in
a setting that is maximally like the setting in which this knowledge
will later be applied. For medicine, the implication is that much
learning must occur in the context of clinical problems which require
solution.

Other major changes taking place in medical education are
the increased attention being given to the areas of highly complex
intellectual skills, such as problem solving, and to the non-cogni-
tive areas of learning, such as inter-personal relationship skills.
Among the major requirements for effective learning in these areas
are the provision of models of what it is the student is to become
and opportunities actually to engage in the application of increasing-
ly refined approximations of these models, in maximally real settings.

The foundation premises of the review that follows are
framed in terms of the primary requirements of medical education.

These are: 1) to identify the requisite knowledge, skills and atti-
tudes of medicine, 2) to devise techniques and settings for the practice
of these competencies, and 3) to provide frequent and reliable feedback
to students on their success in acquiring these competencies.

The current major uses of technology can be seen as falling
into four categories which derive from these requirements. They are
the processes of: 1) transmitting information, 2) serving as role
models, 3) assisting with the practice of specific skills, and
4) contributing to the provision of feedback. These four categories
will be reviewed in terms of actual current applications, the
directions in which these uses appear to be moving, and their poten-
tial for the decade ahead.

Purveying Information

The primary preoccupation of most instructors in most
medical schools remains the transmission of information. The two
primary vehicles for this transmission are still the spoken word and
assigned readings in textbooks and journals. There has been a slow
and steady increase in the use of projection slides, overhead trans-
parencies, movies and, more recently, television for information
transfer to large groups. An important but frequently unrecognized
instructional aid for information transfer has become the ubiquitous
duplicating machine. The distrubution of lecture notes, diagrams,
summaries and selected items from the published literature is becom-
ing a more common practice. Nonetheless, the non-illustrated, non-
supplemented lecture remains a very common instrument in American
undergraduate medical education. The chalkboard is still its most

common accompaniment, even in lecture halls where it is impossible
for chalkboard writing to be seen by a large proportion of the
audience.

Serving to offset the increasing use of aids in large
group settings is the trend toward reduction of the proportion of
instruction oriented toward large groups. The diminishing "core"
of required learning in medical school and the growing recognition
of individual differences in backgrounds and career plans have
reduced the need for aids to knowledge transfer in large groups.
While the balance is still some distance from being tilted toward
the side of individualized instruction in medicine, there has been
a growing interest in programmed texts, cartridge-contained self-
view movies, projection slide-audiotape combinations, and more com-
plex multi-media carrel arrangements. As in most other branches of
education, the major problems delaying the growth of these approaches
have been: lack of preparation of the teachers for the change in
attitudes and skills required for new deployments of their own
energies, as required for this different concept of instruction;
the lack of administrative and financial support for the effort
necessary to produce the materials to be used on an individualized
basis; the absence of a systematic source of funding for the hard-
ware necessary for these approaches; the failure of industry to take
proper initiative in producing and distributing appropriate instruc-
tional materials; and the absence of any central agency or other
systematic arrangement for sharing and distributing non-commercial
materials among institutions.

Serving as Models

A very limited but potentially important use of technology has been the provision, on movie film or videotape, of expert examples of particular behaviors from which students might model their own behavior. This approach has been most frequently employed for presentations of skilled clinicians performing parts or all of a model physical examination of a patient. Less commonly, this approach has been used as part of the teaching of medical-history taking. The most elegant application of this approach to date was directed by Dr. Allen J. Enelow (now of Michigan State University) while he was at the University of Southern California. He and his colleagues developed a series of ten videotapes which were programmed to give the viewer an opportunity to select among three options of possible physician behavior at multiple branching points in the course of the conduct of interviews of patients who presented particular paradigmatic problems. This imaginative technique appears to have maximized student engagement and growth and is coming into increasing use around the country.

All of these approaches to providing models for students are fundamentally different from the much shorter presentations of particular skills which are meant to be repeatedly viewed while the skill is actually being practiced by the student. In these cases, the presentations are providing "supervisory," more than "model," functions. They will be discussed below.

Facilitating the Practice of Skills

Two separate but related new approaches to the use of

instructional technology hold great promise for improving the
learning of complex skills in medicine. The first consists of short
projection slide-audio tape, movie film or videotape sequences
designed to serve as both models and reference checkpoints for indiv-
idual students who are practicing particular technical skills. The
instructional materials include the equipment, devices or synthetic
models which the student practices manipulating, while referring to
the visual demonstration, which serves as a "supervisor." A fair
range of such units now exist, including instruction in such diverse
skills as withdrawing blood from a vein, doing a spinal tap, scrubbing
for surgery and plating out a bacterial culture.

The second application of technology in this category
involves simulation, in which the technological device itself becomes
the equipment with which the student interacts in the process of
practicing the skills he is learning. There are three major cate-
gories of skills in medicine: manual, sensory and intellectual.
Simulation techniques have begun to be developed for instruction in
all three areas. They will each be reviewed.

One of the older instructional aids in medicine is the
mannequin created to represent the female birth canal. Together with
a doll the size of a newborn it provides the student with his first
practice of the maneuvers necessary in delivering a child. At the
other end of the continuum from this simple and straightforward
simulation is the highly sophisticated application of modern techno-
logy known as "SIM 1". This life size, life-like computer-controlled
mannequin was developed under the direction of Drs. Stephen

Abrahamson and J. D. Denson at the University of Southern California, with the collaboration of Aerojet General. It permits the practice and effective learning of many of the complex skills involved in the administration of anesthetics. SIM 1 breathes, has a heartbeat, pulse and blood pressure, and the pupils of his eyes dilate and constrict. All of these functions and many others respond approriately to varying dosages of several different drugs, administered either by injection through a "vein" or by face mask through the "lungs." This is one of the most effective illustrations to date of the application of modern technology at a level of sophistication which matches in complexity some of the skills which must be learned in medicine. It seems clear that SIM 1 will be the forerunner of a large family of devices which will provide varying degrees of approximation of aspects of human functioning as a basis for the practice and mastery of the complex technical skills of medicine.

The most advanced approach to instruction in the area of sensory skills so far developed are the various "heart sound simulators", pioneered by Dr. Abe Ravin of Denver, Colorado. Using a variety of approaches, these simulators have in common the capacity to generate a virtually infinite variety of life-like heart sounds at controllable rates. Learning to distinguish a particular heart sound on a live patient may be nearly impossible, with that sound being buried amidst a variety of other natural sounds, while occuring at a rate of, say, 90 a minute. With the simulator, the particular sound can both be isolated for exclusive attention and can be slowed to the easily discernible rate of, say, 10 per minute. A gradual increase in the rate of repetition and the quantity of other sounds permits

the systematic learning of the discriminatory skills which are required. It seems indisputable that analogous devices to assist in the learning of other complex sensory skills, such as interpreting breath sounds or eye findings, are needed and deserve to be developed.

In addition to instruction in manual and sensory skills, the acquisition and refinement of intellectual skills is now receiving increased attention. Technological reinforcement of this task is now made possible with the advent of the remote access time-shared computer. Probably the most generally required, and possibly the most poorly developed, intellectual skill in medicine is that of systematic inquiry: subsuming the skills of problem sensing, problem formulation, systematic information search and the formulation of judgments and plans for action. The characteristics of the computer make it possible to repetitively present the student with instances of sequential complexity which require the application of these component skills. These intellectual skills are less well understood than are technical and sensory skills such as drug administration or heart sound differentiation. As a consequence, we do not yet have the prototype application of effective instruction in the area of intellectual skills. Work is being done, however, in several centers which should lead to such a development in the near future. Potentially, the most powerful approach will involve the computer as a major instructional resource.

This review of newly appearing computer based and technological simulations has been all too brief. In my view, the instructional needs in medicine are of such complexity that simulation is likely to become the most important new educational development of the decade.

To re-emphasize the sources of this great potential, several of its major advantages will be mentioned:

1) The setting in which the knowledge and skills which are being learned will be applied can be maximally approximated.

2) The number of stimuli with which the student is confronted can be manipulated. This permits an avoidance of the sometimes overwhelming impact of having to deal with all the dimensions of the full, real situation and enables a systematic acquisition of component skills, leading to their progressive amalgamation into a total set of skills.

3) The amount of "noise" in the system can be artificially reduced, permitting concentration upon the competencies being acquired. There can then be a gradual introduction of these distracting influences, up to the level actually found in reality.

4) The content of the material to which the student is being exposed can be made maximally relevant to his level of readiness and to his current pre-occupations. These usually derive from the other instructional activities with which he is then engaged. (A patient with a particularly relevant disease does not have to be searched for, he can be created.)

5) The student can repeatedly practice a skill as often as is appropriate for effective learning. (One cannot subject real patients to repeated procedures.)

6) The student is freed of the distracting risk of making a sick patient even sicker or an uncomfortable person even more uncomfortable. He can concentrate on the specific skill being acquired and can separately deal with whatever anxieties he might have about patients, under more appropriate circumstances.

7) The stimuli to which the student is responding are under precise control and therefore "standardized", so that the student's response can be accurately evaluated for purposes of "diagnosis" of his further instructional needs.

All of the above considerations regarding simulation have

led to the recent development of an especially important innovation in instructional aids in medicine, although technology in its usual sense is not involved. This is the use of live people as simulators of specific medical conditions or of the general role of the patient. Doctor Howard Barrows of the University of Southern California pioneered this approach in training actresses to simulate the history and physical findings of particular neurological conditions, primarily to increase the reliability of student examinations. At Michigan State University, Drs. James B. Thomas, Norman Kagan and I have employed trained drama students and housewives as "patients" to help medical students begin to learn the skills and self-awareness necessary for the establishment of an effective and productive doctor-patient relationship. In combination with a feedback approach described below, this technique has led to rapid and lasting acquisition of some of the most complex competencies required in the field of medicine.

Providing Feedback

It can be safely asserted that learning occurs very inefficiently without effective feedback. In medicine, modern technology has very recently begun to make possible more sensitive and more complete readings on student behavior than had previously been provided. Potentially, it can carry this development forward dramatically.

The growing use of programmed texts, teaching machines and erasure or tab-test examinations has begun to contribute significantly to the quality and quantity of information students receive about their own learning progress. In addition to these increments in the

area of knowledge acquisition, technology is now making possible the provision of comprehensive feedback in the previously largely neglected areas of intellectual skills and professional behavior.

In addition to its function as a large teaching machine, providing moment to moment feedback during the process of information and concept acquisition, the computer brings the exciting promise of providing feedback on the development of complex intellectual processes. A student who is engaged with a computer in the solution of medical problems can receive more than just item-by-item responses to his individual actions. The computer's capacity to retain a total record of all transactions in which it has engaged enables the student to be provided with the cognitive equivalent of a videotape of his thought processes. In fact, the computer print-out of the problem-solving process in which the student has participated is far more flexible than a videotape. It is more like a map which can be scanned in its entirety and compared to other maps, for critical evaluation. Much like the golfer who makes startling progress through being confronted with a playback of a videotape of his own swing, the medical student who is learning intellectual skills, when provided with the feedback of a print-out, will certainly make unprecedented strides in areas that were previously barely touched by conventional medical education.

The memory and adaptability of the computer permits storing great ranges of evaluation materials and recording all its transactions with students, enabling the creation of an unusually comprehensive and elaborate evaluation system, both of student performance and

instructional effectiveness. The singularly attractive possibility which emerges is that of "ccmputer-monitored" instruction. In a way that has not been possible before, student progress can be assessed from day to day, rather than term to term, and instructional adjustments can be made, literally, as needed. This process can be seen as analogous to the continuous inventory which industries now use. It can, of course, be developed independently of whether or not the instructional program uses the computer as a teaching device. The extent to which this monitoring process might elevate our efficiency can, at present, only be imagined.

Television is now beginning to be applied to the provision of quite a different form of feedback, which is likely to have substantial impact in the next few years. Among the most complex of the skills to be learned in medical school are those of relating effectively to patients. The combined skills necessary to establish a productive, professional relationship have only recently begun to be carefully defined and explicitly taught. One of the central features of the doctor-patient relationship course using simulated patients at Michigan State University is the videotaping of the medical students as they conduct this first series of interviews with patients. These interviews are witnessed, live, by instructors and other students and then immediately played back to the observing group and the interviewer. The playback can be stopped at any time for purposes of questioning and discussion. The feedback effect of being confronted with one's own behavior appears to be one of the most instructional factors of the many at work in this program.

CONCLUSIONS AND RECOMMENDATIONS

As James Reston has pointed out, the ancient Chinese exhibited great wisdom in formulating two separate characters to convey alternative interpretations of the concept of "crisis." For them, crisis could mean either "danger" or "opportunity". Medicine in general, and medical education in particular, have been described as currently facing a severe crisis, in several forms.

There is mounting pressure for significantly more doctors to be produced. At the same time there is a strong push to create a new kind of physician who is more responsive to current social needs than were his predecessors and who is a far more effective continuing self-educator, among many other things. In addition, all this is to be accomplished in less time than medical education now takes.

These forces for a dramatic change in the character, effectiveness and efficiency of medical curricula come at a time when we do have an increased understanding of the educational process and when the number of potentially available technological aids to instruction have mushroomed. If the conditions could be arranged for us to take suitable advantage of the new resources available, the current crisis, which has all the earmarks of a dangerous situation, could be converted to a welcome, indeed exciting, opportunity.

It is asserted that the evidence is now in hand to indicate that instructional technology, appropriately applied, holds the promise of facilitating a distinctly more individualized, flexible and adaptable educational program. These characteristics, in turn,

will significantly elevate the quality of medical instruction. The
pressing need is for those changes which will encourage and enable
the most appropriate exploitation of technology by the largest number
of individuals. The key steps toward this goal are presented below.
My major recommendations appear in italics.

More than anything, the effective use of technology requires
careful planning. The instructor must have clearly defined his
general goals, he must have ascertained the specific competencies his
students are to acquire and the steps necessary to get them there,
and he must have determined which instructional materials exist or
need to be created for those purposes which can be best achieved with
media. For understandable reasons, this type of advance planning is
still rare in medical education. Medical faculty members bring with
them an expertise in a medical discipline but no specific preparation
for their role as instructors. The large majority tend to teach using
the only model they know: the way they themselves were taught.
Responding to the current ferment in medical education, as well as
trying to exploit the potentials of technology, requires significant
departures from that pattern. Medical faculty will need special help
to learn how to plan instruction and use technology. *It is, therefore,
strongly recommended that support be provided for programs that will
systematically educate medical instructors in the applications of
instructional technology.*

In addition to the educational program required to achieve
a meaningful change in the teachers who are to deploy their own talents
differently, there must be a change in the administrative format within

which these teachers work. The medical schools will have to alter
their reward system to provide suitable recognition for contributions
to instructional programs at the level of detailed planning, instruc-
tional materials development and the fashioning of innovative
techniques. *This transformation can be facilitated by modifying the
basic support grants to medical schools to give high priority to
innovative applications of instructional technology.*

It seems clear that the most promising instructional
technology is both the most expensive and the least well developed
at this time. The potential applications of multi-media carrels,
television and computers can be imagined but have not yet been
realized. *The need at this time is for government support of research
and development projects and feasibility studies which design and
test new ways to use technology.* It does not seem as justified, at
this time, for support to be given to the implementation of programs
using expensive technology unless they incorporate systematic experi-
mental attempts to evaluate the differential effects of alternative
approaches.

Despite the lack of systematic support and minimal institu-
tional encouragement, many individual faculty members have begun to
generate new instructional materials which are being used in their
local setting. A major economy move as well as source of support and
professional prestige for the developers of instructional materials
would be the opportunity for regular dissemination of quality materials
among other institutions. *It is recommended that the National
Library of Medicine, through the National Medical Audiovisual Center,*

*e invited to explore the possibility of serving as a central clearing-
ouse to facilitate and promote the distribution of quality materials
hroughout the country.*

An impediment to the effective application of instructional
echnology has been the failure of industry to respond to the educa-
ional needs of the consumer. The confusion created by the lack of
tandardization of equipment, especially in television; the efforts to
oist onto unsuspecting educators equipment which was really designed
or use in sales promotion and which is lacking in the flexibility
eeded for instruction; the relative absence of quality control of the
rogrammed texts and other instructional materials being promoted; all
ndicate a need for some form of intervention. If we are to success-
ully profit from the potential contribution of American industry we
ust find ways to make it economically attractive for new avenues to
e explored and for high standards to b. maintained. To illustrate
ith a simple example: movie film will not have achieved its full
nstructional potential until it can be used like audio tape; that is,
ntil it can have the flexibility in use which is made possible by
ast forward and fast reverse controls in a simple cartridge mechanism.
e would have had this breakthrough by now if suitable incentives had
een available. *It is recommended that government support, guided by
he best available educational thinking, be provided to encourage
ndustrial innovations.*

This paper cannot be concluded without an examination of the
requently raised question: Can technology replace the live human
eacher? B.F. Skinner could have been referring to all technology when
e said, "Any teacher that can be replaced by a teaching machine . . .".

deserves to be!" Technology has indeed been demonstrated to do better
than live teachers many of those things that teachers now spend time
doing. The challenge we face was anticipated more than 50 years ago
by E. L. Thorndike when he wrote, "A human being should not be wasted
in doing what 40 sheets of paper or two phonographs can do. Just
because personal teaching is precious and can do what apparatus cannot,
it should be saved for its peculiar work." We have only barely begun
to identify what is, in fact, the "peculiar work" of the live teacher.
It clearly involves much more at the level of instructional planning,
individual guidance, personal supervision and direct observational
evaluation of students, and much less at the level of information
dispensing than has conventionally pertained. Technology holds the
remarkable promise of relieving the teacher of the burden of doing a
variety of routine tasks which he can now carry out more effectively
through the proxy of careful planning. He could then turn his attention
to far more subtle and complex issues, including many for which his
own abilities would be significantly bolstered by the proper use of
technology. These changes could elevate the quality of medical
instruction and medical learning to levels we have heretofor hardly
dared imagined. This is not a hollow dream. The necessary educational
expertise and technology are at hand to permit implementation of the
studies necessary to convert this dream into a reality. Let us hope
that the necessary support can be found so that this conversion process
can be accelerated..

APPENDIX I

AAMC CURRICULUM QUESTIONNAIRE*

Section V.   TEACHING AIDS OR MATERIALS

Question Posed:
Information is requested in the following table about selected teaching aids or materials used in your NEW CURRICULUM as compared to their use in the BASE CURRICULUM. Using the scale below, please assess the intensity of use of the aids or materials (listed vertically).

Summary of Responses Received:

TEACHING AIDS OR MATERIALS	USE IN NEW CURRICULUM				USE IN BASE CURRICULUM			
	Extensive	Moderate	Minimal	No	Extensive	Moderate	Minimal	No
Models & Mannequins	6	35	7	7	1	30	34	9
Programmed Instruction	7	22	35	20	0	5	30	40
Bibliographic Reference & Supplements	29	51	5	0	16	44	13	1
Projection Slides	52	28	5	0	42	28	4	0
Movie Films	14	52	17	0	9	38	25	2
Single Concept Films or TV Tapes	10	38	25	10	1	11	37	25
Live TV	9	37	20	17	1	9	27	38
Taped TV	11	34	22	17	2	12	23	39
Audio Tapes	6	25	38	11	1	5	40	26
Computers	10	16	35	21	1	4	30	41
Role Playing	2	10	33	30	0	1	24	47
Mechanical Simulators	1	3	29	40	0	0	16	55

*Distributed to the 117 Canadian and U.S. Medical Schools.

Appendix 2

TOWARD IMPROVED LEARNING

A Bibliography of Significant Articles for the Medical Educator[*]
Prior to September 1966

OVERVIEW

Currie, D.J., and A. Smialowski, "Teaching and Audio-Visual Aids," Journal of the Biological Photographic Association, 33, 137.

Greenhill, L.P., "Communication Research and the Teaching-Learning Process," Journal of Medical Education, 38, 495-502.

Ham, T.H., and C.A. Miller, "The Need for Critical Review and Evaluation of Audiovisual Instructional Materials," Journal of Medical Education, 40, 792-5.

Harris, J.J., "Survey of Medical Communication Sources Available for Continuing Physician Education," Journal of Medical Education, 41, 737-55.

Markee, J.E., S.A. Agnello, and F.D. McFalls, "Medical Communications in Basic Science Teaching," Journal of Medical Education, 38, 226-38.

Orr, R.H., "The 'Newer' Media for Post-Graduate Education — Their Promises and Problems," Journal of Medical Education, 37, 137-44.

"Teaching with Audio-Visuals," Lab World, 15, 766-68.

AUDIO TAPE

Aitken, A., "Audio Methods in Continuing Medical Education," Medical and Biological Illustration, 14, 259-62.

Asher, H., "Teaching on Tape," Medical and Biological Illustration, 12, 253.

"C.M.A.'s Audio-Digest — A Decade of Progress," California Medicine, 100, 50-2.

Graves, J., "The Use of Tape in Medical Teaching," Postgraduate Medical Journal, 41, 208-12.

COMPUTER

"Electronics at the Bedside," Medical World News, 7, 52-63.

Feurzeig, W., P. Munter, and J. Swets, "Computer-Aided Teaching in Medical Diagnosis," Journal of Medical Education, 39, 746-54.

Harrington, J.J., "Computers and Health: Some Prospectives," Harvard Public Health Alumni Bulletin, 23, 14-23.

Swets, J.A., and W. Feurzeig, "Computer-Aided Instruction," Science, 150, 572-6.

[*] Prepared by the National Medical Audiovisual Center of the National Library of Medicine, USPHS, 1966

FILM

Dryer, B.V., J.E. Markee, and D.S. Ruhe, "Selected Films for Medical Teaching. A Suggested Basic Motion Picture Library," Journal of Medical Education, 40, suppl., 1-76.

Forsdale, L., "8mm Film: A New Tool for Research," Papers and Proceedings, Single Concept Teaching Film Conference, April 1-2, 1965, Public Health Service Audiovisual Facility, Atlanta, Georgia.

Humphreys, M.H., L.W. Nesmith, and S.L. Pohl, "Development of a Reviewing Procedure for Audiovisual Materials by Students of Medicine," Journal of Medical Education, 40, 742-52.

Leveridge, L.L., "Films for Medical Education," Journal of Medical Education, 38, 307-14.

McKim, J.W., T.C. West, and W.T. Stickley, "The 8mm Film as a Dynamic Instruction Medium in the Biomedical Education," Journal of the Biological Photographic Association, 33, 161-8.

McRae, R.K., "Eight MM. Filming By and For the Teaching Department," Medical and Biological Illustration, 14, 237-43.

Matthias, R.C., "Simplified Graphic Illustrations and Animation in Medical Film Production," Journal of the Biological Photographic Association, 31, 63-70.

West, T.C., and W.T. Stickley, "Reinforcement Experiment in Laboratory Pharmacology by Film: A Model for Cinematic Self-Instruction in Medical Education," Journal of Medical Education, 40, 990-2.

MISCELLANEOUS

Barabas, A., "Blackboard Drawing in Medical Teaching," British Medical Journal, 5437, 782-4.

Bowker, J.H., W.L. Kermond, and R.H. Jones, "Disease-Simulation Technics in Rehabilitation Teaching," New England Journal of Medicine, 270, 243-4.

Derbyshire, R.C., "On Science Fairs and Careers in Medicine," Southwestern Medicine, 44, 319-20.

Dobson, J., "The Training of a Surgeon," Annals of the Royal College of Surgeons of England, 34, 1-36.

Feder, R.J., "An Otologic Study Model," Archives of Otolaryngology (Chicago), 82, 25-7.

Poppensiek, G.C., "Teaching to Impart an Understanding of Infectious Diseases," Cornell Veterinarian, 53, 575-619.

MULTI-MEDIA

"ASCP Steps Up Continuing Education Pace," Lab World, 17, 726.

Cole, C.R., "Teaching of Pathology in the Veterinary Medical Curriculum,"
American Journal of Veterinary Research, 26, suppl., 450-60.

Goodwin, A.H., "The Role of Medical Illustration and Photography in Medical
Education," New Physician, 12, 449-51.

Heiser, J.J., and B.H. Traven, "Emergency Respiratory and Cardiac Resusci-
tation: Experiences with a Training Program in a Community Hospital,"
Journal of the American Osteopathic Association, 63, 945-50.

Huber, J.F., "The Multi-Media Approach to the Teaching of Anatomy," Medical
and Biological Illustration, 13, 96-9.

Julian, L.M., "The Teaching of Anatomy in the Veterinary Curriculum,"
American Journal of Veterinary Research, 26, suppl., 401-13.

Kingrey, B.W., "Education in Large Animal Surgery and Obstetrics," American
Journal of Veterinary Research,26, suppl., 510-5.

Matzke, H.A., R.H. Geertsma, and C.F. Bridgman, "The Study of Anatomy: Cur-
rent Perspectives at KUMC," Journal of the Kansas Medical Society, 66,
106-10.

Postlethwait, S.N., "Audio-Tutoring: A Practical Solution for Independent
Study," Medical and Biological Illustration, 15, 183-7.

Sudman, E., "'Phototheca Chururgica' and Audiovisual Series for Teaching
General Surgery," Medical and Biological Illustration, 15, suppl., 72-3.

Taxay, E.P., W. Atkinson, and R. Jones, Jr., "A Bilingual Audio Visual Aid,"
Journal of Medical Education, 38, 80-1.

PROGRAMMED INSTRUCTION

Elder, S.T., G.R. Meckstroth, and C.M. Nice, "Comparison of a Linear Program
in Radiation Protection with a Traditional Lecture Presentation," Journal
of Medical Education, 39, 1078-82.

Geis, G.L., and M.C. Anderson, "Applying Principles of the Technique in Pro-
ducing Materials," Nursing Outlook, 11, 662-5.

Geis, G.L., and M.C. Anderson, "Programed Instruction in Nursing Education,"
Nursing Outlook, 11, 592-4.

Lysaught, J.P., "Self-Instructional Medical Programs: A Survey," New
Physician, 13, 144-7.

Lysaught, J.P., and H. Jason, "Programmed Instruction in Medical Education:
Report of the Rochester Conference," Journal of Medical Education, 40,
474-81.

Lysaught, J.P., C.D. Sherman, Jr., and C.M. Williams, "Programmed Learning. Potential Values for Medical Instruction," Journal of the American Medical Association, 189, 803-7.

Mathis, J.L., C.M. Pierce, and V. Pishkin, "An Experiment in Programmed Teaching of Psychiatry," American Journal of Psychiatry, 122, 937-40.

Miller, G.E., J.S. Allender, and A.V. Wolf, "Differential Achievement with Programmed Text, Teaching Machine, and Conventional Instruction in Physiology," Journal of Medical Education, 40, 817-31.

Nice, C.M., Jr., "Education and Training in Radiology," Southern Medical Journal, 59, 214-6.

Owen, S.G., R. Hall, and J. Anderson, "A Comparison of Programmed Instruction with Conventional Lectures in the Teaching of Electrocardiography to Final-Year Medical Students," Journal of Medical Education, 40, 1058-62.

Owen, S.G., R. Hall, and J. Anderson, "Programmed Learning in Medical Education. An Experimental Comparison of Programmed Instruction by Teaching Machine with Conventional Lecturing in the Teaching of Electrocardiography to Final Year Medical Students," Postgraduate Medical Journal, 41, 201-6.

Owen, S.G., R. Hall, and I.B. Waller, "Use of a Teaching Machine in Medical Education, Preliminary Experience with a Program in Electrocardiography," Postgraduate Medical Journal, 40, 59-65.

Polony, L.J., "Programmed Instruction and Automated Education for Hospital and Other Medical Personnel," Hospital Progress, February, 1965.

Weiss, R.J., and E.J. Green, "The Applicability of Programmed Instruction in a Medical School Curriculum," Journal of Medical Education, 37, 760-6.

Weiss, R.L., and D.W. Darby, "Continuing Education Outside the Dental School Setting," Journal of the American Dental Association, 70, 1488-96.

RADIO

Ebbert, A., Jr., "Two-Way Radio in Medical Education," Journal of Medical Education, 38, 319-28.

Woolsey, F.M., Jr., and W.T. Strauss, "Postgraduate Medical Education in Maine: A New Experiment Utilizing Two-Way Radio and Television," Journal of the Maine Medical Association, 55, 172-3.

TELEVISION

Agnello, S.A., J.E. Markee, and F.D. McFalls, "The Central Television Facility Duke University Medical Center," Medical and Biological Illustration, 15, 39-45.

Anderson, L.D., "Telecourse in Nursing," American Journal of Nursing, 64, 79-82.

Benschoter, R.A., M.T. Eaton, and P. Smith, "Use of Videotape to Provide Individual Instruction in Techniques of Psychotherapy," Journal of Medical Education, 40, 1159-61.

Berger, M.M., and D.M. Gallant, "The Use of Closed-Circuit Television in the Teaching of Group Psychotherapy," Psychosomatics, 6, 16-8.

"California Medical Television Network Helps Keep Hospital MD's Up to Date," Medical Tribune, 7, 22.

Cameron, C.S., "Five Schools Linked Together for TV Teaching," Journal of Medical Education, 34, 1077-81.

DiSanto, S.A., "New Techniques in Closed-Circuit Television for Dental Teaching," Journal of the Society of Motion Picture and Television Engineers, 73, 770-2.

Dryer, B.V., "A Nationwide Plan for Continuing Medical Education," Journal of the American Medical Association, 189, 35-9.

Engel, C.E., "Television in Medical Education," Nature (London); 200, 725-8.

Groom, D., "The South Carolina Experiment in Medical Television," Journal of Medical Education, 38, 202-6.

Harris, J.J., "Television as an Educational Medium in Medicine: An Historical Purview," Journal of Medical Education, 41, 1-19.

Heiss, W.H., "Closed-Circuit Television in a Teaching Hospital," Medical and Biological Illustration, 14, 244-50.

Lennox, B., and F.C. Path, "The Glasgow Postgraduate Medical Television Series: Production Problems on the Medical Side," Postgraduate Medical Journal, 41, 220-2.

Lewis, A.A., "American Evaluations," Postgraduate Medical Journal, 41, 216-7.

McGuinness, A.C., "The New York Academy of Medicine TV-PG Efforts in a Metropolis," Journal of Medical Education, 40, 878-81.

McGuinness, A.C., H. Menzel, and C. Rogers, "Continuation of Medical Education by Open-Circuit Television: A Preliminary Report," Journal of Medical Education, 39, 735-45.

Markee, J.E., S.A. Agnello, and F.D. McFalls, "Examinations in Anatomy: Use of Video Tape Recordings," Journal of Medical Education, 40, 214-9.

Menzel, R., R. Maurice, and A.C. McGuinness, "Evaluation of the New York Academy of Medicine's Television Programs," Journal of Medical Education, 41, 826-43.

Michaux, M.H., M.J. Cohen, and A.A. Kurland, "Closed-Circuit Television in the Scientific Measurement of Psychopathology," Medical and Biological Illustration, 13, 49-57.

Moses, C., and R. Wolfe, "Grand Rounds via Television: An Experiment in Continuing Education," Pennsylvania Medical Journal, 67, 23-8.

Moses, C., and R. Wolfe, "The Pittsburgh Regional Medical Television Programme," Medical and Biological Illustration, 15, 247-52.

Pender, J.L., "Dietitian Teaches Patients via Closed-Circuit TV," Hospital Topics, 44, 46-7.

Ramey, J.W., "Television: Growing Pains of a New Teaching Medium," Journal of Medical Education, 39, 1107-13.

Rising, J.D., and W.D. Nelligan, "Practical Considerations in the Use of Television in Continuing Medical Education," Journal of Medical Education, 38, 75-9.

Robertson, G.J., H.F. Pyke, Jr., and E.M. Friedlander, "Boston Medical Reports. A Postgraduate Educational Television Series for Practicing Physicians in the State of Maine. A Preliminary Review and Report of Initial Evaluation," Journal of the Maine Medical Association, 56, 41-3.

Roy, A.D., "Scottish Television Experiment," British Medical Journal, 5420, 1321-3.

Ruhe, D.S., and K.C. Gentry, "Television in Medicine," Journal of the Kansas Medical Society, 62, 94-99.

Ruhe, D.S., S. Gundle, P.C. Laybourne, L.H. Forman, M. Jacobs, and M.T. Eaton, "Television in the Teaching of Psychiatry: Report of Four Years' Preliminary Development," Journal of Medical Education, 35, 916-27.

Samson, F.E., Jr., G.N. Loofbourrow, and D.S. Ruhe, "Utilizing Television for Laboratory Experiments in Physiology," Journal of Medical Education, 39, 780-4.

Schiff, S.B., and R. Reivich, "Use of Television as Aid to Psychotherapy Supervision," Archives of General Psychiatry (Chicago), 10, 84-8.

Scott, G.B., "Demonstration of Histology by Closed-Circuit Television," Medical and Biological Illustration, 14, 251-4.

Seegal, D., "Videotaped Autobiographical Interviews. An Adjunct for Medical Education," Journal of American Medical Association, 195, 650-2.

Smith, G., and J.H. Wyllie, "Use of Closed-Circuit Television in Teaching Surgery to Medical Students," British Medical Journal, 5453, 99-101.

"Television in Higher Education: Ten Examples in the South," Southern Regional Education Board, January, 1966.

"Television for Hospitals—Network to go Nationwide with Medical and Nursing Programs," Hospital Topics, 43, 62-3.

Thomas, H.A., "Television as a Teaching Medium in Surgical Education," Maryland Medical Journal, 14, 49-53.

Trowbridge, M., Jr., "Boston Medical Reports," Journal of Maine Medical Association, 55, 83.

Trowbridge, M., Jr., "Boston Medical Reports," Journal of Maine Medical Association, 55, 174.

Appendix 3

BIBLIOGRAPHY OF INSTRUCTIONAL TECHNOLOGY
IN MEDICAL EDUCATION

September 1966-June 1968

OVERVIEW

Beckel, W.E., "The Teacher and the Taught," The Canadian Medical Association Journal, 98:1085-1089, 1968.

Jason, H., "Evaluation of Audiovisual Methods of Medical Teaching," The Canadian Medical Association Journal, 98:1146-1150, 1968.

_____, "Self Instruction in Medical Education: Principles, Practices, Prospects," British Journal of Medical Education, 2:20-23, June, 1968.

Lysaught, J.P., Editor, Programmed Instruction in Medical Education: Proceedings of the First Rochester Conference, Rochester, The University of Rochester Clearinghouse, 1965.

_____, Self Instruction in Medical Education: Proceedings of the Second Rochester Conference, Rochester, The University of Rochester Clearinghouse, 1967.

Lysaught, J.P., "Self-Instruction for the Health Professions: Trends and Problems," Medical Times, 95:1025-32, October, 1967.

Lysaught, J.P., Editor, Individualized Instruction in Medical Education: Proceedings of the Third Rochester Conference, Rochester, The University of Rochester Clearinghouse, 1968.

Lysaught, J.P., "Self-Instruction in Medical Education: Report of the 3rd Rochester Conference," Journal of Medical Education, 43:759-63, June, 1968.

Lysaught, J.P., Editor, Proceedings of the Fourth Rochester Conference on Self Instruction in Medical Education, (Forthcoming).

Manning, P.R., et al., "Research in Medical Education. Comparison of Four Teaching Techniques: Programmed Text, Textbook, Lecture-Demonstration, and Lecture-Workshop," Journal of Medical Education, 43:356-9, March, 1968.

Romano, M.T., "Audiovisual Education: Yesterday, Today and Tomorrow," The Canadian Medical Association Journal, 98:1127-1132, 1968.

Russell, W.O., and R.A. Kolvoord, Editors, A Symposium: Implications of Developments and Trends in Educational Technology, Chicago, American Society of Clinical Pathologists, 1966.

COMPUTERS

Abrahamson, S., "Evaluation of the Use of Computers in Medical Education," Conference on the Use of Computers in Medical Education, Oklahoma City, University of Oklahoma Medical Center, 1968.

Bowden, D.H., "Computer-Aided Instruction in Pathology," Canadian Medical Association Journal, 97:739-42, September, 1967.

Fonkalsrud, E.W., et al., "Computer Assisted Instruction in Undergraduate Surgical Education," Surgery, 62:141-7, July, 1967.

Harless, W.G., "The Development of a Computer-Assisted Instruction Program in a Medical Center Environment," Journal of Medical Education, 42:139-45, February, 1967.

Jason, H., "Computers in Undergraduate Medical Education," Conference on the Use of Computers in Medical Education, Oklahoma City, University of Oklahoma Medical Center, 1968.

Ovenstone, J.A., "Computer-Assisted Instruction in Undergraduate and Post-Graduate Medicine," Medical Journal of Australia, 2:487-91, September, 1966.

Shulman, L.S., "Inquiry, Computers and Medical Education," Conference on the Use of Computers in Medical Education, Oklahoma City, University of Oklahoma Medical Center, 1968.

Starkweather, J.A., "Computer-Assisted Learning in Medical Education," Canadian Medical Association Journal, 97:733-8, September, 1967.

INSTRUCTION

Balson, M., "Programmed Learning in Medical Illustration," Medical Journal of Australia, 2:176-8, July, 1967.

Hawkridge, D.G., et al., "Programmed Course in Biostatistics for Medical Students," British Journal of Medical Education, 2:36-40, March, 1968.

_____, "The Use of a Programmed Text During a Course in Genetics for Medical Students," Journal of Medical Education, 42:163-9, February, 1967.

Jason, H., "Programmed Instruction: New Bottle for Rediscovered Wine," The Canadian Medical Association Journal, 92:711-716, April, 1965.

McRae, R.K., "Illustrations in Programmed Learning: A New Linear Teaching Machine," Medical and Biological Illustration, 16:252-7, October, 1966.

Pishkin, V., et al., "Analysis of Attitudinal and Personality Variables in Relation to a Programmed Course in Psychiatry," Journal of Clinical Psychology, 23:53-6, January, 1967.

Stone, G.C., "Supplementary Use of Programmed Instruction in a Parasitology Course," Journal of Medical Education, 41:683-9, July, 1966.

Stretton, T.B., et al., "Programmed Instruction in Medical Education: Comparison of Teaching Machine and Programmed Textbook," British Journal of Medical Education, 1:165-8, June, 1967.

Weller, J.M., et al., "Programmed Instructional Material for a Medical School Laboratory Course," Journal of Medical Education, 42:697-705, July, 1967.

Wilds, P.L, et al., "Evaluation of a Programmed Text in Six Medical Schools," Journal of Medical Education, 42:219-24, March, 1967.

_____, "Programmed Instruction in Gynecologic Cancer at the Medical Student Level," American Journal of Obstetrics and Gynecology, 100:128-35, January, 1968.

MULTI-MEDIA SELF INSTRUCTION

Fiel, N.J., "A Preparation Laboratory for Advanced Mammalian Physiology," Individualized Instruction in Medical Education: Proceedings of the Third Rochester Conference, Lysaught, J.P., Editor, Rochester, The University of Rochester Clearinghouse, 1968.

Fiel, N.J., and P. Ways, "Multi-Media Self Instruction," Proceedings of the Fourth Rochester Conference on Self Instruction in Medical Education, (Forthcoming).

Garcia, E.N., et al., "A Multimedia Approach to Biochemistry Laboratory Instruction," Individualized Instruction in Medical Education: Proceedings of the Third Rochester Conference, Lysaught, J.P., Editor, Rochester, The University of Rochester Clearinghouse, 1967.

Garcia, E.N., and K. Ibsen, "Progress Report on a Program of Individualized Medical Instruction," Self Instruction in Medical Education: Proceedings of the Second Rochester Conference, Lysaught, J.P., Editor, Rochester, The University of Rochester Clearinghouse, 1967.

Harden, R.M., "Teaching Without Teachers: An Audiovisual Method of Self-Instruction " Scottish Medical Journal, 13:206-7, June, 1968.

Hood, J.H., "An Aud _ Visual Teaching Unit for Radiology," British Journal of Radiology, 41:150-1, February, 1968.

GENERAL AUDIO-VISUAL AIDS

Broadbent, D., "Audio-Visual Techniques in Professional Medical Education," Medical Journal of Australia, 2:174-6, July, 1967.

Harden, R.M., et al., "An Audiovisual Technique for Medical Teaching," Medical and Biological Illustration, 18:29-32, January, 1968.

Hayden, J. Jr., et al., "An Initial Evaluation of Animated Serial Sections as an Instructional Method for Facilitating Three-Dimensional Awareness of Anatomic Regions," Journal of Medical Education, 42:447-52, May, 1967.

Jones, B., "Audio-Visual Aids in Medical Teaching," Proceedings of the Royal Society of Medicine, 61:89-94, January, 1968.

Manley-Cooper, N.C., "Projectors," British Journal of Medical Education, 1:221-223, June, 1967.

Russell, J.K., "Sound and Visual Teaching Aids in Obstetrics and Gynecology," Medical and Biological Illustration, 16:218-22, October, 1966.

Tuddenham, W.J., "The Use of Logical Flow Charts as an Aid in Teaching Roentgen Diagnosis," American Journal of Roentgenology, Radium Therapy and Nuclear Medicine, 102:797-803, April, 1968.

FILMS

Barrows, H.S., "Self-Instructional Film Cartridges in Medical Education," The Canadian Medical Association Journal, 98:1094-96, 1968.

Creer, R.P., "Use, Abuse and Misuse of Teaching Films," The Canadian Medical Association Journal, 98:1090-94, 1968.

Guéguen, Y., "Medical Film Production: Criteria, Problems and Potentialities," The Canadian Medical Association Journal, 98:1081-84, 1968.

Hirschowitz, B.I., "The Use of Motion Pictures in Teaching and Diagnosis," Annals of the New York Academy of Sciences, 142:455-60, March, 1967.

North, A.F. Jr., "Learning Clinical Skills through the Use of Self-Teaching Films," Journal of Medical Education, 42:177-80, February, 1967.

TELEVISION

Bell, A.E., et al., "Scottish Television Medical Programs: A Preliminary Assessment," Scottish Medical Journal, 11:250-7, July, 1966.

Brayton, D., "Postgraduate Education in Medicine by Television," Biomedical Sciences Instrumentation, 3:81-8, 1967.

Brayton, D., R.R. Getz, and D. Sachs, "Encoded Broadcast and Video Recorders: Two Television Modalities Useful in Continuing Medical Education," The Canadian Medical Association Journal, 98:1133-36, 1968.

Green, J.H., and J.P.S. Thomson, "Use of Videotape Recording and Live Closed Circuit Television in Teaching Medical Students," British Journal of Medical Education, 1:135-43, March, 1967.

Groom, D., "Television in Post Graduate Education: Some Lessons from Five Years' Experience," Journal of the American Medical Association, 198:275-80, October, 1966.

_____, "Experiences with Television Broadcasting: A Report," The Canadian Medical Association Journal, 98:1113-16, 1968.

Heinivaara, O., "Professional Television Facilities in a New University Hospital," Medical and Biological Illustration, 18:8-11, January, 1968.

Huber, J.F., "Intramural Closed-Circuit Television Teaching: Pre-Clinical Uses," The Canadian Medical Association Journal, 98:1106-09, 1968.

Hunter, A.T., "The Use of Broadcast Television in Continuing Medical Education," Canadian Medical Association Journal, 98:34-9, January, 1968.

Ide, T.R., "Educational Television: Problems, Resources and Utilization," The Canadian Medical Association Journal, 98:1140-42, 1968.

Judge, R.D., "Television in Clinical Medical Teaching," The Canadian Medical Association Journal, 98:1109-13, 1968.

Lennox, B., and F.C. Path, "The Glasgow Postgraduate Medical Television Series: Production Problems on the Medical Side," Postgraduate Medical Journal, 41:220-2, April, 1965.

Meighan, S.S., and A. Tresender, "Continuing Medical Education
through Television," Journal of the American Medical Association,
200:762-6, May, 1967.

Meyer, T.C., et al., "Report on an Experiment in the Use of Tele-
lectures for the Continuing Education of Physicians and
Allied Health Personnel," Journal of Medical Education, 43:
73-7, January, 1968.

Flatzer, W., "The Epidiascope and Television in Medical Teaching,"
Medical and Biological Illustration, 16:243-5, October, 1966.

Ramey, J.W., "Teaching Medical Students by Videotape Stimulation,"
Journal of Medical Education, 43:55-9, January, 1968.

Rechnitzer, P.A., "An Account of Variations '67, a Videotape
Presentation," The Canadian Medical Association Journal,
98:1145-46, 1968.

Robertson, G.J., "Television in Continuing Education of the Physician,"
Annals of the New York Academy of Sciences, 142:487-92, March,
1967.

Robertson, G.J., and H.F. Pyke, Jr., "Television in Continuing
Medical Education," Medical and Biological Illustration, 18:
4-7, January, 1968.

Smart, C.R., et al., "Initial Experience with Encoded Two-Way
Medical Television," Journal of Medical Education, 41:977-81,
October, 1966.

Stone, D.C., "Educational Television Programming: Problems, Resources
and Utilization," The Canadian Medical Association Journal,
98:1143-45, 1968.

Tampas, J.P., and A.B. Soule, "Experiences with Two-Way Television
in a Teaching Hospital Complex," Journal of the American Medical
Association, 204:1173-5, June, 1968.

Torkelson, L.O., and M.T. Romano, "Self-Confrontation by Videotape:
A Remedical Measure in Teaching Diagnostic Evaluation,"
Journal of the American Medical Association, 201:773-5,
September, 1967.

de G. Vaillancourt and M. Gill, "Continuing Medical Education by
Television: A Canadian Experience," The Canadian Medical
Association Journal, 98:1136-39, 1968.

Wagner, H.N., Jr., "Videotape in the Teaching of Medical History-
Taking," Journal of Medical Education, 42:1055-8, November, 1967.

Waine, S.R., "Applications of Closed Circuit Television in Medical
Education," Medical Art, 16:22-6, 1965.

Wilmer, H.A., "Television as Participant Recorder," American Journal of Psychiatry, 124:1157-63, March, 1968.

SIMULATION

Barrows, H.S., "Simulated Patients in Medical Teaching," Canadian Medical Association Journal, 98:674-6, April, 1968.

Dinperstein, A.J., and M. Lowenthal, "Teaching Demonstrations of Simulated Disability," Archives of Physical Medicine and Rehabilitation, 49:167-9, March, 1968.

McCarthy, W.H., and J.S. Gonnella, "The Simulated Patient Management Problem: A Technique for Evaluating and Teaching Clinical Competence," British Journal of Medical Euucation, 1:348-52, December, 1967.

Ramey, J.W., "Teaching Medical Students by Videotape Stimulation," Journal of Medical Education, 43:55-9, January, 1968.

MISCELLANEOUS

Adams, S., "Hospital Libraries as Learning Centers," Bulletin of the Medical Library Association, 56:175, April, 1968.

Barrows, H.S., et al., "Introduction of the Living Human Body in Freshman Gross Anatomy," British Journal of Medical Education, 2:33-5, March, 1968.

Dergen, S.S., "Use of Two Way Radio by a Volunteer Health Organization for Continuing Medical Education," New York State Journal of Medicine, 66:2694-7, October, 1966.

Doray, V., "Medical Illustration: Yesterday--Today--Tomorrow," The Canadian Medical Association Journal, 98:1097-1105, 1968.

Elkinton, J.R., "Self Assessment of Medical Knowledge," Annals of Internal Medicine, 68:247-9, January, 1968.

Geertsma, R.H., "A Student-Oriented Learning Center in the Biomedical Sciences, Journal of Medical Education, 42:681-6, July, 1967.

Johnson, P.C., et al., "Research in Medical Education. The Effect of Grades and Examinations on Self-Directed Learning," Journal of Medical Education, 43:360-6, March, 1968.

Netter, F.H., "The Role of Illustration in Medical Education and Medical Progress," Journal of the Mt. Sinai Hospital, New York, 34:396-400, July-August, 1967.

Oakley, C.L., "Tape Recordings in Medical Education. The Pioneering Role Played by the California Medical Association's Audio-Digest Foundation," <u>California Medicine</u>, <u>104</u>:534-7, June, 1966.

West, K.M., "Books as Clinical Tools. The Medical Center and Continuing Self-Education," <u>Journal of the Oklahoma State Medical Association</u>, <u>59</u>:531, September, 1966.