EDUCATIONAL TECHNOLOGY VOL I

panacea or placebo?

a report by

DAVID LEONARD

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OR

THE CURRENT AND EXPANDING ROLE OF TELECOMMUNICATION SYSTEMS IN EDUCATIONAL COMMUNICATIONS IN CANADA:
an overview of user requirements

by

(1)
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PREFACE

While this report deals with the various aspects of educational technology under appropriate headings (arbitrarily created for convenience in dealing with the subject at hand), an intertwining relationship exists between the various categories.

Therefore, at the risk of seeming redundant, similar ideas may recur under various categories. For example, environmental factors, in addition to being dealt with under the heading Needs of the Learner, are the subject of a separate section.

Perhaps the repetition of certain issues could be interpreted as inferring their greater significance to educational technology than some other areas which are not so stressed. This, however, is not meant to minimize the importance of any single issue dealt with in this report. ALL are important and integrally related to the field of educational technology.

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INTRODUCTION

This report shall survey the current state of educational technology in order to identify areas of priority importance for a program of research into audio/visual technology and transmission systems in support of education.

Since the scope of educational technology is almost without boundaries, this report should be considered exploratory and suggestive rather than exhaustive in content.

> "The next three decades will see man in a continuous transition away from a largely mechanical environment dependent on transportation towards a telecommunication one, in which his experiences will be increasingly based on the use of electronic devices. This transition will profoundly alter (for better or worse) the shape and characteristics of most of our ways of life."[1]

Since education is becoming increasingly more important in the lives of every Canadian, a systematic approach to educational planning seems inevitable.

In dealing with the complex subject of educational technology, this paper will be divided into sections as outlined in the table of contents.

DEFINITION OF "EDUCATIONAL TECHNOLOGY"

Much misunderstanding of the true meaning of the terms "education", "technology", and 'educational technology' has taken place in recent years. The term "educational technology" is often confused with the phrase "audio/visual aids in education". One of the more accurate and meaningful explanations of "educational technology" is given by the National Council for Educational Technology in Great Britain.

> "Technology can be defined as the systematic application of knowledge for pratical purposes. Educational technology, therefore, is concerned with trying to find systematic ways of applying existing experience and knowledge of resources and methods to the problems of education and training. Or to put it another way, educational technology is the development and application of systems, techniques and aids to improve the process of human learning.
>
> It is not merely a newfangled term for audio-visual aids in education. Certainly education is making increasing use of audio-visual devices, as they greatly enhance the resources of the teacher and therefore help him to do a better job. But in themselves they are no panacea for educational ills. They must be part of an organised arrangement of learning, where the exact way in which they will help the teacher has been carefully worked out. A classroom jammed with every kind of audio-visual device would be useless unless the teacher knew how to use it to help his students to learn."[2]

Technology, if properly integrated into the educational system, can be an invaluable asset to the educational process; however, serious problems confront the educational technologist, in particular, and the educational community, in general. Some of these issues will be dealt with later on.

A BRIEF HISTORY OF EDUCATIONAL IDEAS

In the early days of primitive communities, while education did exist, it was neither formalized nor structured. Yet, education has always been an integral part of Man's life for "learning itself is life's ultimate purpose."[3]

While education under the ancient Greeks was highly developed, nevertheless, it was not universally available to all. Plato, in the third century B.C., suggested an educational system in which each person was given the opportunity to seek his fullest potential. Furthermore, he believed in a balance between individual liberty and social stability. Aristotle (384-322 B.C.), on the other hand, suggested that the purpose of education was to serve, to preserve, and to protect society.

Pestalozzi (1746-1827) stressed the concept of "universal education" since he believed that every individual has a right to an education.[4] A disciple of Pestalozzi by the name of Felenberg stressed the concept of vocational, industrial, and agricultural schools.

It is difficult to imagine an educational philosopher who has had more influence on modern educational theory and practice than John Dewey.[5] Progressive education stems from his ideas; the aim of education is more education; education is growth.[6]

Two of the leading schools of educational psychology stem from the work of Jerome Bruner (born 1915) and B.F. Skinner.

First, Bruner, a cognitive psychologist, is concerned primarily with intellectual develppment in learning theory. According to Bruner there are five stages of intellectual growth:

a) increasing independence of response to stimulus;

b) the internationalization of events in a"storage system" which corresponds to the environment;

c) the conscious use of language (verbal and mathematic) for communication; language is one of the crucial factors in intellectual development;

d) the systematic interaction between the learner and the tutor;

e) the increasing ability to deal with alternatives simultaneously or in sequences.

Bruner's earlier preoccupation with the nature of the processes underlying perception, thought, learning, language, and other social phenomena lead him to study the nature of the educational process and cognitive development in children.

Bruner's theory of instruction stresses four themes:

a) how the role of 'structure in learning' may be made central in teaching; that is, curriculum development;

b) 'readiness for learning';

c) 'the nature of intuition' - 'analytic thinking';

d) 'the desire to learn'; an intrinsic desire to learn must be present.

John Goodlad,[9] in commenting on Bruner accepts the premise that any child, at any age, can learn anything (the concept of 'non-grading') although he questions the value of this premise. Furthermore, in suggesting that the curriculum not be structured, he brings out the idea of 'continuous progress'. Goodlad goes on to suggest that instruction should be both goal-oriented and individualized. Alexander Neil leader of the free school movement criticizes goal orientation in favor of a free-flowing process of educational experiences.[10]

B.F. Skinner,[11] a behavioral psychologist and proponent of the 'stimulus-responsive concept of learning' (in the Pavlovian sense) suggests that learning must be goal- oriented behavior. In his theory, which is based on experiments with pigeons, he emphasizes two themes:

a) positive (reward) and negative (punishment) reinforcement;

b) the time factors in learning (that is, memory and forgetting)

The most effective learning results from a situation which is positive and comes immediately after the desired behavior, followed by reinforcement which is frequent.

The best-known application of Skinner's operant conditioning principle is in his development of 'the teaching machine'[12] and 'programmed learning' originally created by Pressey in 1926.

With respect to instructional objectives, a work in cognitive theory that must not be overlooked is the Taxonomy of Educational Objectives: Cognitive Domain[13] by Benjamin S. Bloom.

"A Basic Reference Shelf On Learning Theory"[14], excerpted from Theories Of Learning (Third Edition) by Dr. Ernest R. Hilgard, appears as Appendix , at the end of this report; it summarizes most of the educational learning theories applicable today.

Based on the foregoing outline of the history of education, it should be evident that any pedagogical system - if it is to be effective - must be responsive to the educational (and socio-cultural-economic) needs of the users of the system in the total educational environment. In particular, a study should be made of the needs of: a) the learner, b) the teacher, c) the administrator - each in relation to the academic, the governmental, and industrial environments in which they must perform.

HISTORY OF THE AUDIOVISUAL MOVEMENT [15]

Several well-documented books dealing with the development of educational technology are available. Therefore, it would be redundant at this time to outline the history of instructional technology. Attention should be drawn, however, to one outstanding work in this field, A History of Instructional Technology by Paul Saettler.

> "Part I of this work traces instructional theory and method from its beginning in early cultures, through the various Greek methodologies, and notes the contributions of such men as Abelard, Cemenius, Pestalozzi, Herbart, Dewey, and Skinner.
>
> Part II systematically covers the emergence and development of the audiovisual instruction movement with chapters on the school museum, instructional film, instructional radio, instructional television, programmed instruction and an excellent chapter on the systems approach to instruction.
>
> Part III traces the background of instructional media research from its beginning in 1918 with the first studies on instructional film to the present.
>
> The book contains more than a historical report of the field of instructional technology; it carries a strong thread of instructional theory through the entire work. This work is highly recommended for those interested in the significance of the shift from audiovisual instruction to instructional technology or, as Saettler puts it, the shift from a physical science concept of instructional technology to a behavioral science concept." [16]

CHANGES IN THE APPROACH TO EDUCATION

> "Hitherto, schools and universities have grown up around libraries, recording past human achievement. Teachers and professors, both generalists and specialists, often isolated by academic life from wordly influences, have sought to interpret and to pass on to their students what they believed most significant both in this information store and in the new knowledge gained within academic walls. This is where the latest information and the best education were!
>
> Today, the entire communication process involves continual learning by everyone, everywhere. The rapidity and all-pervasiveness of electro-magnetic media have established a fundamentally new environment for both education and instruction. The community itself has become the repository for most recent advances in both the 'sciences' and the 'humanities'. And, through 'electro-magnetic space', our planetary system is now becoming our 'electric village', our school for everybody, our 'university-without-walls'. This is where the latest information and the best education are!" [17]

While learning space used to be confined to the classroom, its boundaries are less clearly defined now and include not only the 'schoolhouse' but also the home, the community, the city, and all telecommunication space within reach of the learner.

In the World Future Society's journal, The Futurist, a recent issue, devoted to 'education and futurism', outlined changing trends in education. [18]

> "Society is placing an increasing premium on more and better education, in recognition of the fact that change demands versatility and flexibility, and these, in turn, demand even more education and a continuing flow of new knowledge. Education and knowledge have, of course, for centuries been important factors in society, but both the degree and the character of their importance are now changing fast. Whereas education, up till now, has

> been largely concerned with the transmission of accumulated knowledge and perpetuation of the culture, from now on, we are told, it will be more a process of developing skill in thought-processes and of preparation for change."[19]

> "Perhaps it is not too much to say (according to Daniel Bell) that if the business firm was the key institution of the past hundred years, because of its role in organizing production for the mass creation of products, the university will become the central institution of the next hundred years because of its role as the new (sic) source of innovation and knowledge."[20]

Because of the increasing complexity of the educational system in Canada - including the need for educational planning, research, and management, and the development of educational telecommunications media - a systems approach[21] seems to be one of the more viable methods for dealing effectively with the educational process. "Systems procedures, if properly considered, can be effective tools for dealing with major educational needs."[22]

"They appear to offer the educator the following advantages:

a) a way of viewing large problems within a productive perspective;

b) the effective organization of the parts into meaningful systems for dealing with problems;

c) the effective application of resources based on alternative organizations;

d) a context for understanding the constraints imposed upon the institutional structure of education;

e) a group of planning techniques which makes possible large-scale, long-range planning;

f) an interdisciplinary, problem-oriented approach to research and development." [23]

Despite contradictory claims, there are some problems that systems procedures cannot handle, as listed below:

"a) Systems procedures cannot show ways to operate below certain necessary minimums.

b) They cannot remove the constraints imposed by institutional force, but they may suggest ways to work around them.

c) Systems analysis cannot compensate for a lack of clear-cut purpose or for a confused operational philosophy.

d) Systems analysis cannot provide simplistic procedures for arriving at incontestable conclusions.

e) There can be no guarantee that procedures developed in one discipline will be automatically transferable to another field.

f) Systems analysis cannot replace judgements." [24a]

Despite the many problems that must be faced in adapting systems procedures to handle the design and development of any educational (tele)communications system, such procedures offer considerable promise for effective educational planning.

However, one must not lose sight of the fact that

> "despite teaching machines, TV lectures and so on, education has been only superficially changed by technological advance in this century. Most children in modern society are being trained by the same methods and in most cases inculcated with the same world view as they were a generation ago.....
> In the United States the boom in higher education has done little to raise cultural levels among many attending classes, even when measured by the standards of previous centuries, much less the twenty-first..." [24b]

NEEDS OF THE INDIVIDUAL LEARNER

Since it would be impossible, in any single report, to highlight even part of the voluminous literature concerning 'the needs of the learner in an educational milieu' this section will merely draw the reader's attention to the great variety of sources of literature on the subject.[25]

Suggestions as to some learner needs should be evident from a review of the previous two sections.

Throughout the literature on current educational ideas, the following key phrases seem to recur more than any others. It would represent myopic thinking if these terms were not emphasized in this report. They are:

a) team teaching

b) independent study

c) individualized instruction[26]

d) non-grading[27]

e) continuous progress (removal of 'lock-step' process)[27]

f) open (wall-less) classrooms[28]

g) behavioral goal setting[29]

h) exceptional/disadvantaged learners[30]

i) audio/visual aids; learning media[31]

j) educational technology[32]

k) curriculum development[33]

l) continuous (adult) education[34]

m) CAI[35]

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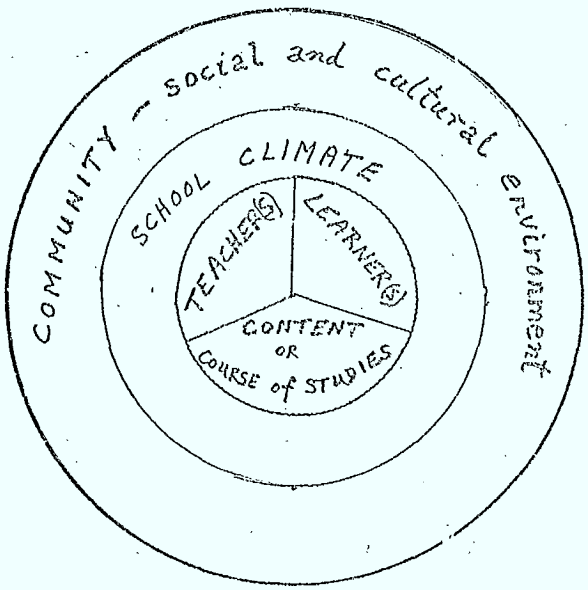
Hitherto, the traditional educational environment was characterized by an authoritarian system; at the head of each classroom, which was filled with immovable furniture, loomed a presumed-authority-in-all-fields; the student received limited individual attention; there was little compensation for individual differences in learning abilities; the student's promotion to a higher 'grade' depended on a 'lock-step' process and the successful completion of all courses taken during the school year; the physical resources available to, and used by, the teacher were very limited (in both kind and quality); the curriculum was autocratically determined; learning had vocational and social utility and terminated after a specific number of uninterrupted school-years, at which time the graduate sought a career which utilized his former formal education; the education took place in specifically designated learning spaces.

Today, the needs of the learner are being met more adequately than in previous times, due to the implementation of the aforementioned concepts and ideas (as listed on the previous page). While it would be presumptuous to suggest that these ideas in pedagogy are just short-lived fads, it would be even more fallacious to assume that these concepts of education can be taken as the ultimate and final truths in pedagogical thinking (simple because we live in a dynamically-changing environment). What is certain about these ideas is that, today, they seem to work - as supported by the findings of educational research.

In designing a curriculum tailored to the needs of the learner both physical, social, and emotional factors should be considered. For example, the curricular needs of a six-year old would be significantly different from those of a sixteen-year old.

In designing educational media (hardware and software), the above needs must also be considered.



The above diagram indicates the broad scope of the concept of curriculum; however, the term "curriculum" is often misunderstood and taken to mean that narrow aspect of curriculum known as "content".

Designers of educational hardware (as well as software designers) must appreciate and cater to the needs of the learner.

Up until now, the media used in education have, for the most part, been derived from the entertainment industries (e.g., film, television, radio, records). While some educational research findings suggest that this is an effective approach, other findings reveal that educational technology be tailored to specific educational behavioral goals.

If education implies 'learning a living', then the vocational and/or professional-training requirements of the learner must be met.[37] This indicates that educational communication systems should be developed to coincide with well-researched educational objectives.

Today, there are four major sources of learning for young children:

a) the home
b) the school - teacher, schoolmates, media
c) peers - at home, school, neighbours
d) media themselves (TV,radio,books,film) - at home and in school

Regardless of the theoretical foundations, a quantitative change has resulted with the availability of modern telecommunications in education.

THE TEACHER'S ROLE AND NEEDS

The teacher's role has been changing in recent years from that of lecturer/authoritarian figure to that of counsellor/guide/facilitator in the educational process.[38]

As modern 'teaching machines' gain their foothold in the educational environment, it becomes increasingly important to reassure the teacher that he/she is not being replaced by a machine but is being freed to perform the tasks that no machine (in existence today) could .

> "Educational technology can provide the learner with more information, more accurately, more effectively than the teacher. ...modern information technology reduces the need for the professor to deliver timely information to his class and requires a shift in his teaching style. He now discusses the more theoretical and heuristic-type information in a seminar, and the student obtains information by means of educational technology." [39]

Furthermore, the learner receives individualized instruction,[40] the essential characteristics of which are:

> "a) definition of goals or objectives
> b) immediate feedback to the student
> c) mastery of a concept before proceeding to the next concept
> d) progression at the student's own pace
> e) providing an individual curriculum to meet the student's interest and needs
> f) providing the instructor with a history of student performance.
>
> To supply this broad spectrum of characteristics we must necessarily have recourse to technological aids to education; in particular, to the computer." [41a]

The modern-day teacher is faced with several major kinds of problems

as outlined below:[41 & 42]

a) adjusting to new learning theories (as they develop) and innovations in teaching techniques;

b) adjusting to innovations in audio/visual equipment and other learning media that may be employed in schools;

c) accepting innovations in audio/visual production techniques.

Teachers are not only faced with the necessity of using instructional hardware and software for teaching but now must be prepared to use the media to create their own software. Some are adapting to the changes more readily than others.

One method for coping with these changes is the workshop/conference/retraining program.

A study of teacher characteristics in the late 1950's[43] in the United States revealed that teachers were generally mobile working-class individuals whose social status was low, personality was authoritarian, and suffered from a basic sense of insecurity. This view is gradually changing today.

What does it mean to be a teacher? One definition might be: to act and react in such a way, employing whatever media seem most beneficial, as to motivate potential learners - at all ages, levels, in all disciplines of human, scientific, philosophic, and commercial endeavor - to acquire knowledge with the goal of furthering mankind's progress and of seeking the ultimate truth (regarding

the universe and human existence within it).

The Parent Commission on Education in Quebec (1965) sheds some light on the goals of the new education. In part it says: "in modern societies the educational system has a three-fold goal: to afford the opportunity to learn, to make available to each the type of education best suited to his aptitudes and interests, to prepare the individual for life in society". 44a

If effective teaching methods are coupled with the new technologies, the promise for achieving these goals is very high.

The teacher can be considered as part of an information-processing system. But, what is his/her role?

> "The ultimate objective of teacher information processing is the acquisition of information (i.e., the learning of facts, concepts, and rules relating to cognitive, affective, and psychomotor behaviors) by pupils in order that it subsequently may be retrieved (i.e., subsequently recovered from the individual's 'memory' or information storage) for use in some life situation. " 44b

Teacher information processing results in teacher behavior. We can assume five major categories into which teacher behavior falls:

> "a) motivating-reinforcing teacher behavior;
> b) presenting-explaining-demonstrating teacher behavior;
> c) organizing-planning-managing teacher behavior;
> d) evaluating teacher behavior;
> e) counseling-advising teacher behavior." 44c

A study to determine which of the above categories of teacher behavior can be performed by 'technology' (machines) - and to what degree of effectiveness in each case - would be most useful in order to determine the priority importance of the various A/V systems andtechnologies in an educational setting.

THE ROLE OF EDUCATIONAL TECHNOLOGY and THE ACADEMIC ADMINISTRATOR

The role of the academic administrator (e.g., the high school or university principal, the school-board superintendent) relates to: a) the learner, b) the teacher, c) government, d) industry, e) trade associations, f) other academic institutions, g) unions, h) research-oriented groups (foundations, etc.), i) other pressure groups.

Educational technology communication systems can be used not only for disseminating knowledge in a teacher/learner interaction situation but may also assist the educational manager or administrator in his varied responsibilities of curriculum planning, research, development, evaluation and control.[45] The computer utility, a hybrid of many other technologies (with a very specific character of its own), offers the greatest promise to the educational planner, while freeing him to employ his unique talents in more creative endeavors than 'data processing' - a function best performed by the computer.

A major concern of the academic administrator is determining the technological needs of his educational environment; he must display sound judgement in accepting one product salesman's pitch over another's, for innovation[46] often outdates and renders useless an instructional media system before its cost has been fully amortized (and sometimes even before the system has been installed.)[47]

The role of computer-based management systems, as an aid to academic planning and administration,[48] is well-documented in the literature on educational planning.[49] Computer simulation[50] is just one technique available to the administrator, enabling him to build and develop complex educational models.

Despite the potential of technology as an aid to educational planning, educational innovation - in the past - has met with strong resistance.

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A NOTE ON EDUCATIONAL INNOVATION, PLANNING, and RESEARCH

Educational planning and development do not necessarily go hand-in-hand. For example, development of educational systems have, till recently, taken place in North America with little or no long-range planning. In Canada, planning on a national level has been all but non-existent. UNESCO feels very strongly, on the other hand, that educational planning is essential (in particular, in the developing countries) for effective development.

Educational innovation should be linked with research in order to optimize the learner's interface with his educational environment. In the past, education has not developed very rapidly, for the following reasons:

"a) Educational institutions are closed systems (usually keeping outsiders out);
b) Educational institutions tend to be static;
c) There is a lack of significant educational research simply because the effects of education require long terms to measure (e.g., the effects of a child's inferior education may only be measurable a generation later). Therefore, because of the waiting time involved, educational research may not be very popular;
d) The cost of education is constantly rising and our value system raises the question: Is education of significant priority importance to warrant the expense?
e) the "ivory tower" syndrome: the professor does not care if his theories are put into practice or not;
f) Lack of knowledge of educational research and research methods has also held back the progress of educational innovation and research." 53

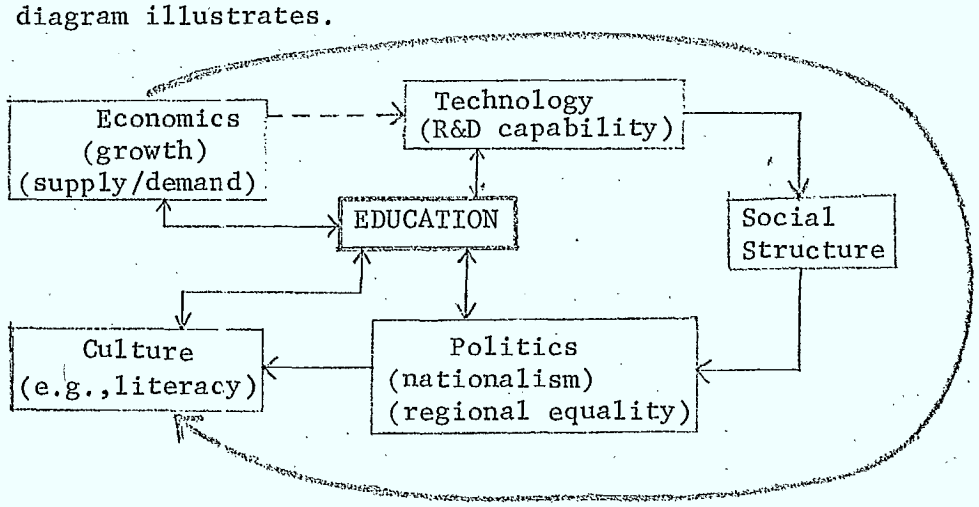
What are the sources of educational innovation?

"a) Some are conjured up by 'educationists' in order to improve the quality of education;
b) Some arise out of economic and political pressures (e.g., the teaching machine is a proposal to handle the shortage of available high-quality teachers);

c) Technological advance (e.g., the invention and development of the computer) is a cause for innovation;
d) Sociological and psychological research have brought about innovations in education (e.g., I.Q. testing);
e) as a direct result of educational research (in such areas as child-centered education, individualized instruction)." 54

In the future, innovation in instructional technology must be followed by an intensive program of educational research - covering the interface between man (teacher/learner/administrator) and machine - in the areas of both hardware and software design. Research into 'software design' implies more than a study of content that will be created for the hardware system; it suggests an analysis of the methodology required to achieve specific behavioral goals.

The educational sub-system is inter-related with all of the other sub-systems that make up the Canadian nation as the following diagram illustrates.



The educational literature suggests that certain of the sub-systems diagrammed above exert greater influence than others on the field

of education; the curved arrow on the diagram indicates the order of priority importance that each discipline seems to exert over the educational system (according to the overall literature on education and educational technology). In other words, economics seems to have the strongest influence on educational planning; technology, the second strongest, and so on. However, this order of emphasis is not unchangeable (although it would require major changes in the nation's value system to effect such changes). Government can be instrumental in effecting these changes.

From an economic point of view, "while policy normally strives mainly to increase the commitment of resources to innovation, it must guard against the very real danger that a society become too innovative, at least in certain directions."[55]

"Certain controls may be necessary if we are to preserve any freedom at all. Of paramount importance is the control of technological and economic innovation. Control does not mean that new techniques will not be introduced, but rather that they will be channeled in such a way as to serve the general rather than simply a private good. ... Means must be found to channel technological advance into areas where it has the greatest potential for social usefulness."[56]

THE ROLE OF GOVERNMENT IN EDUCATIONAL TECHNOLOGY

To date, for historical/constitutional reasons, the federal government of Canada has not taken any position in the area of educational technology - other than in an ancillary way through communication systems that presently exist and may be used in education but have not been designed primarily for educational use with educational objectives in mind. Specifically, film and television are communication media that have existed in Canada for many years - as entertainment media.

According to the BNA Act,[57] education is under provincial jurisdiction. Until now, this has caused little concern from the point of view of developing the educational system(s) in the country.

Now, because education is depending more and more on complex technologies (which, according to BNA Act, come under federal jurisdiction; e.g., the regulation of standardization of hardware, control of telecommunication systems), it becomes increasingly important for governments at all levels (federal,provincial,and municipal) to cooperate in the planning,research, and development of the future educational 'environment' of all Canadians.

In the United States, while telecommunications comes under federal jurisdiction, education is primarily under state jurisdiction. Nevertheless, the federal government - in realizing the close relationship between educational content and technolgical systems - has intensively researched its potential role in education; the

President's Commission on Instructional Technology,[58] in its final Report published in two lengthy volumes last year,[59] recommended the formation of the National Institutes of Education along with a National Institute of Instructional Technology.

In Canada, to date, the concerted effort between governments at different levels to coordinate educational planning and research has been minimal.

What are some of the areas in which the federal government could be of assistance to the provincial departments of education? The next few sections of this report offer some suggestions.

THE MANUFACTURER OF EDUCATIONAL HARDWARE

Two major problems exist today in the hardware manufacturing industry: a) lack of standards [60 61]

b) compatibility problems

Just to quote one example: videotape recording equipment is becoming very popular in the classroom; but since no standards have been adopted, manufacturers are producing VTR equipment using ¼" , ½", 1", and 2" videotape (although the ½" variety may be the more popular of them all). A ½" tape cannot be played on a ¼" machine and vice versa; in fact, some tapes cannot be played on various machines using the same width-format. What is the reason for this? One suggestion is that lack of standards and non-compatibility force the user to buy not just one component from a given manufacturer but an entire system - since only that manufacturer's components may be compatible with each other.

This problem, however, has given rise to a new industry: the interface equipment manufacturer. Electronic firms are now producing 'black boxes' that interface two pieces of equipment that were,hitherto, not compatible.

Various federal government departments (such as Department of Communications, Department of Industry,Trade and Commerce) are now faced with the option of either assisting in the establishment of educational hardware equipment standards or maintaining the status quo. The implications of both options should be obvious.

THE MEDIA SOFTWARE PRODUCER 62b

A more detailed study of the educational media software producer should reveal his technological, economic, and creative manpower needs.

At this time, it will be simply pointed out that the media 'producer' presently stems from three sources:

a) within the academic institutions. Some of the more affluent academic institutions (at all levels) have access to media production equipment (TV, film facilities) and produce their own learning materials; some, less fortunate institutions produce learning materials employing simpler A/V aids;

b) private production houses (film, TV producers, publishers)

c) federal and provincial government agencies (NFB, CBC, OECA)

All of the above must produce software that is more than entertaining; 62a it must be informative and educational. But it should be pointed out that an educational film or TV show can be entertaining as well as educational in order to be effective.

EDUCATIONAL MEDIA HARDWARE 62c

A comprehensive list of currently-available educational communications hardware appears in Appendix I .

Another approach is "to group the technology into clusters in a functional approach in terms of capabilities in performing needed instructional tasks...

Distribution Technology
Ways of Transmitting and Distributing Information

Television (Broadcast)
Instructional Television Fixed Service
Closed-Circuit TV 62d
CATV
Radio
Telelecture
Telewriting
Facsimile
Satellite Communication

Retrieval Technology
Ways of Storing and Retrieving Information

Remote access information retrieval systems
Microforms
Computers

Individualized Learning Technology
Ways of Individualizing Instruction

Filmstrips
8mm films
Video Tapes
Audio tapes and Cassette Cartridges
Programed Instruction
Computer-Aided Instruction
Tele-Class Service (Telephone Teaching)
Educasting
Electronic Video Recording/Selectavision

Interactive Technology
Ways of Obtaining Interaction & Participation with the Technology

two-way radio
two-way Television
multiple-track programs
instructional uses of computers
talking typewriter
language and learning labs
feedback and response mechanisms" 62e

Much research remains to be done and many questions have to be answered regarding educational media; some of the key issues are raised below.

> "What are the characteristics of the several types of media? How does one medium interact with other media? How do these media interact with different types of learners, different types of teachers, and different class sizes? What happens when different combinations of media are employed? To what extent can media assume the instructional function? What is the appropriate role of the teacher in schools committed to a technology of instruction? What administrative patterns and arrangements are appropriate in such schools?" 63a

While the federal government's restricted role in education to date has been constitutionally defined, it may, nevertheless, be a very welcomed move (by educationists) if the federal government were to act in, at least, an advisory capacity in order to respond to some of the above-stated questions. Various federal government departments and agencies might fund large scale research projects 63b in connection with the above issues.

EDUCATIONAL COMMUNICATIONS SOFTWARE

A detailed list of currently-available software materials appears in Appendix J .

Also, the previous section: Educational Media Hardware should be consulted.

Because of constant innovation in media design, it is / impossible for a list of software/hardware in instructional technology to be up-to-date for very long without continual revisions taking place.

The problem in software design, today, is trying to attain the same high-quality of creative production in software as in the hardware, for the hardware we have today has almost unlimited capability; it is the software that requires much more planning and research in order that technology be more effective in achieving desired 'educational objectives' (whatever they may be).

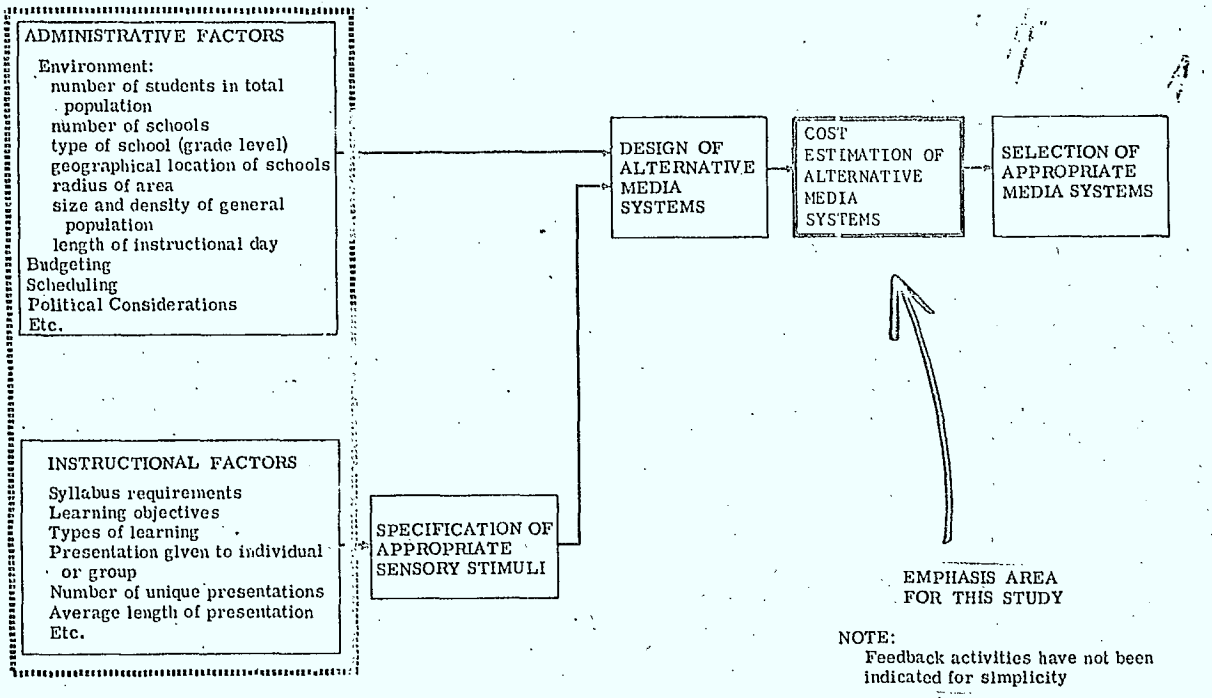
COST-BENEFIT CONSIDERATIONS FOR VARIOUS MEDIA

It is extremely difficult to establish the parameters for measuring 'cost-benefits' in education.

> " What is meant by cost-effectiveness? What are the difficulties encountered in establishing a cost-effectiveness study? ... How do we define media, technique and technology? How do we establish criteria for evaluation? Communication would seem to be the keystone' ... Is there danger in confusing economics with educational effectiveness? Does the educational system we live with place emphasis upon administrative convenience units rather than upon achievement satisfaction? How do you place a value upon the gain that a disadvantaged youngster realizes? How do we measure non-performance on the part of the learner?" [64]

These are some of the questions that were raised at a recent conference on Media Cost-Effectiveness in the United States.

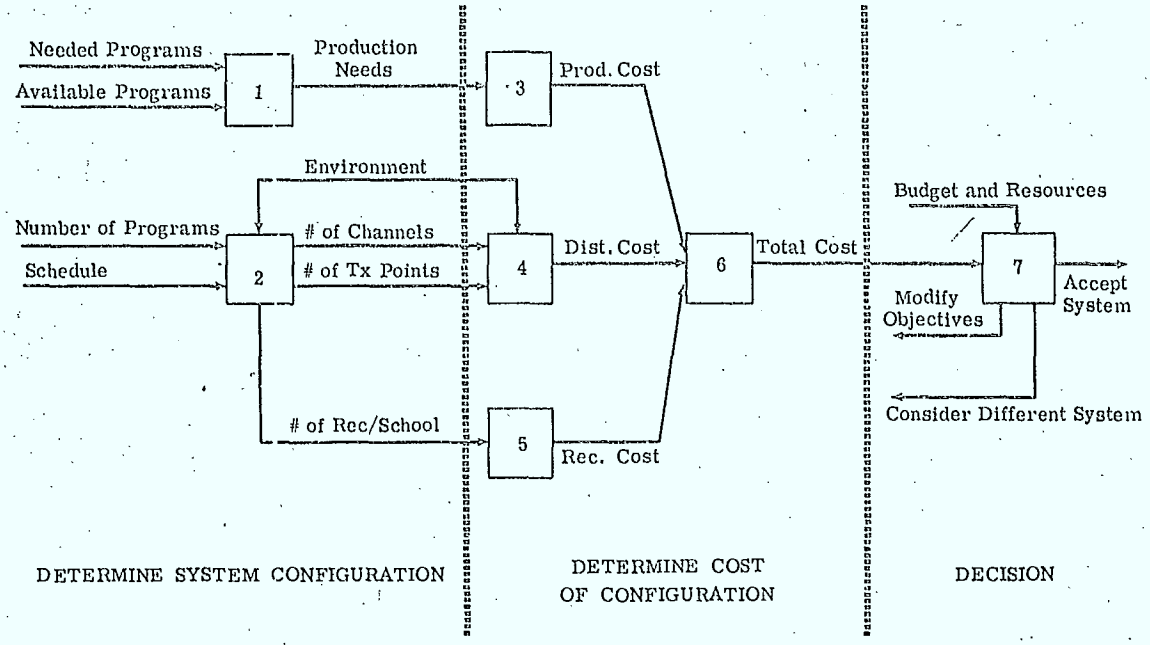
The following chart[65] gives an overview of the process of media system selection.



Selection of a Media System—An Overview

66

The following diagram illustrates the sequence of general steps taken to determine the cost of an educational media system.



Cost Determinations

The literature on costing educational media systems is extensive,[67] but due to the general scope of this report, an in-depth study of the economics of educational technology systems cannot be made at this time.

68

EDUCATION OF THE DISADVANTAGED AND OF EXCEPTIONAL CHILDREN

This category of learners, which deserves very special attention, consists of the following:

a) the handicapped[71a]
- physically (blind, deaf, crippled, heart)
- intellectually (retarded, slow-learners)
- perceptually (aphesic, learning problems)
- speech
- socially (infantile deprivation)
- emotionally[71b]

b) the gifted[69a]

c) cultural/ethnic minorities[69b][70]

d) regionally-disadvantaged

Creating optimum environmental conditions becomes a major criterion for the improvement of learning of handicapped children. The literature on physical environment and special education is profuse.

The media provide great promise for aiding the education of the disadvantaged. Four important points come out of the research on innovative development (in educational technology) for compensatory education:

"a) Media are useful in extending frames of reference and providing models and motivation for the disadvantaged (e.g., 'Sesame Street' from The Children's Television Workshop);

b) Media can emphasize each individual's approach to learning (thereby de-emphasizing the learning disadvantages with which some children come to school);

c) Media can teach basic skills, but seem to be inadequate to teach assimilation skills to the disadvantaged (e.g., literacy via TV, preschool skills via programmed materials, the language lab, 'readers' vs audio/visual techniques, the Stanford-Brentwood CAI project);

d) Projects that focus on older disadvantaged children or adults will have greater difficulty in achieving noticeable success in a short period of time, mainly because these individuals are more difficult to reach." [72]

The pervasiveness of telecommunications media (including broadcasting and computers) offer great promise for educating the regionally-disadvantaged with the same quality of education as the population in the densely-populated areas (where till now access to information has been more readily available).

As remote access to information becomes more prevalent (through the development of telecommunications media), the physical environmental factors (so important in educational facilities design today) will have a reduced effect on the learning process.

However, at the present time, educators and educational technologists are placing an ever-increasing importance on the role of the 'environment' in aiding effective instruction, not only in the education of the disadvantaged but in all learning.

"The environment in which learning takes place... can be considered a variable that could affect learning." [73]

> "The classroom as we have always known it... is fast becoming extinct. It is getting bigger, swelling to lecture-hall size so that 100 to 150 students or more can be gathered together for a common experience - a demonstration, a film, a wise visitor. It is getting smaller, shrinking to seminar-room size so that 10 or a dozen youngsters can engage in dialogue with a teacher and each other, the crossfire of discussion replacing the question-and-answer pattern of classroom recitation. It may even shrink to desk-size, becoming a carrel or study station or other work space where one child on his own can acquire, absorb, and apply information dispensed by books or tapes or slides or other inanimate sources, preparatory to discussing with his teacher and his classmates the meaning of what he has learned.
>
> Or the classroom may disappear altogether, melting into great zones of mutable, malleable space - the equivalent in area of four or five classrooms - whose functions are defined not by size or shape but by what the teachers and children within them have planned to do together at each moment in time. Large group instruction, small group discussion, independent study - all are accommodating, not by moving from room to room, but by moving people and things within the same room."[74]

The increasing use of telecommunications ("transmission over a distance") in education opens up further possibilities "in instantaneous communication and in the exchange of materials and resources between schools in all parts of the nation and eventually the world,"[75a, 75b] thereby increasing communications <u>effectivity</u> which is measured by:

> "a) the ease with which stored human experience can be accessed;
> b) the size of the common information space shared by the communicants;
> c) the ease with which the society using the system can discover and develop a plurality of new and fresh concensuses."[76]

But, returning to the not-so-distant future, three types of interrelated facilities are required if a program of instructional

technology is to be successful in an educational institution:

"a) spaces for learning - in which groups of students come together with media, and usually with a teacher, for the purposes of instruction and learning,

b) spaces for production, origination, and support - in which media in a variety of forms are produced or originated to meet the needs of particular learning situations. Here, also, the teaching staff receives assistance and support in their uses of media,

c) spaces for storage and retrieval - in which media in various forms are catalogued, stored and made readily accessible for individual learning and for developing group instruction." [11]

Because of the rapid changes that are taking place in educational technology, the one characteristic that must be built into every environmental facility is flexibility and adaptability. This would be the only way of justifying the enormous expenditures required for effective architectural design of learning spaces.

The Educational Facilities Laboratories, Inc. (established by the Ford Foundation to encourage research, experimentation, and the dissemination of knowledge regarding educational facilities) has published numerous articles and books on various aspects of environmental design as it relates to instructional technology. [13] The visual, thermal, acoustic needs of the media must be considered.

And equally important are the environmental needs of the users of the space. Viewing angles and ambient light levels as well as adequate hearing conditions must be considered in order to optimize the learning process. Furthermore, thermal conditions affect learning ability. And one must not ignore the significance of aesthetics in design as an aid to effective learning.

> "Learning involves interaction between the learner and his environment, and its effectiveness relates to the frequency, variety and intensity of the interaction." [79]

Several experiments in architectural psychology (the study of the behavioral basis of design [82b] - i.e., how various environmental factors affect man's perception of his environment and can influence his behavior therein) have rendered correlations between the spatial, thermal, luminous, and aural factors of the learning environment AND the attitudes of the teachers and learners in the environment. Correlations have also been found between the above and socio-cultural factors. Anglophones and Francophones react differently to the various environmental components (visual, thermal, auditory space).[80]

Therefore, while "the physical form of schools and universities could be altered by the wiring of cities" in which case "they might almost cease to be institutions with campuses, classrooms and large centralized libraries"[81] (a project is currently under way at Memorial University, Newfoundland, which using electronic media de-emphasizes the importance of architecturally designed space), such is not yet the case in any more than a very few experimental situations; consequently, in the absence of a 'wired city' environment, "the design of a school, its spaces and its facilities must permit and support the educational function."[82a]

EDUCATIONAL TECHNOLOGY IN....[84]

a) pre-school (e.g., Sesame Street)

b) primary grades

c) high school

d) vocational training [83]

e) on-the-job training

f) correspondence schooling

g) universities [86]

h) medical schooling

i) continuing (adult) education [87]

While all educational media (hardware and software) can be used in all of the above-listed levels/categories of training and education, a more detailed investigation may reveal:

i) that some media are more effective as teaching/learning aids than others (depending on the category concerned), and

ii) that the effectiveness of the learning (short-term and and long-term retention of concepts, understanding, etc.) is, in part, dependent upon the quality of the software - i.e., how effectively the software is designed to achieve the desired behavioral goals in the learner.

THE ROLE OF COMPUTERS IN EDUCATION [77]

While computers and Computer-Assisted Instruction (CAI) have been [85] referred to in other sections including Educational Media Hardware and Software, they deserve particular attention on account of their overwhelming potential for educational planning, research, management, and teaching.

> "Few areas of computer application hold greater long-term promise than the field of education." [88]

In addition to the list of eight 'educational' services that can be provided by the 'wired city' (as enumerated in the Department of Communication's Telecommission Study 8(d)) [89], another categorization of 'educational services' is provided in Telecommission Studies 5 (a),(c),(d), and (e) as follows:

> "Administrative Services: record storage, curriculum generation, marketing, financial, supply, progress monitoring, testing, report generation.
>
> General Encyclopedia: history, mathematics, language,... current affairs, art, social, sports, trade data...
>
> Teaching: drill and practice, tutorial, dialogue, generation of teaching programs, game playing, simulation." [91]

The three main areas listed above "provide a convenient format for categorizing the thousands of possible uses... the administrative services area is currently the most highly developed and both 'stand alone' and remote access computers are in extensive use by school systems throughout the world." [92]

The NRC, [93] in cooperation with various provincial educational authorities, is currently undertaking to evaluate some possible techniques and systems configuration in the 'teaching' field with an experimental system.

." Widespread operational use of computer assisted instruction

> even in the school environment, not to mention private homes, is however still some years away. Major obstacles at the moment include the high cost and crudity of program material; the high cost of terminals; central processor and communications costs and the need for extensive research and pilot experiments to determine the proper role of CAI in the teaching process." [94]

What is CAI? It can be defined as:

> " a man-machine interaction in which the teaching function is accomplished by a computer system without intervention by a human instructor. Both training material and instructional logic are stored in computer memory." [95]

Individualized CAI may, in the future, provide:

> "each student with the equivalent of a private tutor embodying the best judgment and total experience of the world's greatest educators. Education thus might become a continuing process largely independent of age and geographical location....Both the form of the school and the role of the human teacher could undergo drastic changes as 'fireside computer consoles', universal electronic encyclopedias, teaching utilities and academic administrative utilities come into widespread use.... the concepts of grades and of classes based on calendar age might have to be abandoned." [96]

Each student would progress in his own 'track' at a pace controlled according to his individual performance. Much of the student's instruction and study could take place in the home, the school being devoted to seminars, group discussions, and consultations with the teachers.

"The growing pains of CAI are evidenced by:

a) excessive theoretical speculations which extend to the notion that there will be a theory of CAI;
b) unrealistic expectations that CAI will take over the major instructional role in schools;
c) the poor quality of many CAI instructional programs and of the research-evaluation of the programs; and
d) a tendency to become overly concerned with computer hardware and systems.

There appear to be some things which CAI will become able to do better than any other media:

a) secure, store and process information about the student's performance prior to and/or during instruction to determine subsequent activities in the learning situation;
b) store large amounts of information and make it available to the learner more rapidly than any other medium;
c) provide programed control of several media such as films, slides, TV, and demonstration equipment;
d) give the author or teacher an extremely convenient technique for designing and developing a course of instruction; and
e) provide a dynamic interaction between student and instructional program not possible with most other media." [97]

There are three modes that have been almost universally accepted within CAI. The first and least complex is the 'drill and practice' mode, which is used for supplemental instruction; the 'tutorial mode' is more complex in that more instructional material is presented and more sophisticated student responses are often called for." The 'dialogue mode' is the most complex - in which the student is in 'conversation' with the computer.

Despite the many praises of CAI, much research remains to be done:

"a) on students' affective reactions to CAI,
b) on the use of CAI to teach creative thinking, logical thinking, and problem solving,
c) on known principles of learning and on specifically related CAI capabilities,
d) curriculum development (for CAI)." [98]

The writings of Anthony G. Oettinger[99] cast a very pessimistic note on the educational promise of CAI; his work should be read, if only to balance the optimism of people like Patrick Suppes and Doug Parkhill.[100]

LEGAL IMPLICATIONS OF EDUCATIONAL TECHNOLOGY

Since the legal domain is most competently handled by lawyers, this section will only draw the reader's attention to the fact that a need exists for further analysis of legal issues, among which are:

a) the federal/provincial jurisdiction in educational telecommunications (hardware vs software; ETV, CATV, CCTV, etc.) [101]

b) international jurisdiction (in satellite communications, e.g.) [102]

c) reproduction rights (copyright infringement) [103]

d) regulation of hardware manufacturing industry (to develop and protect a viable Canadian manufacturing industry) [104]

e) access to information; invasion of privacy (regarding, say, access to students' academic records) [105]

SOCIOLOGICAL CONSIDERATIONS [106]

The psychological needs of the individual learner [107a] have been considered in an earlier section. However, an educational system must also serve the needs of the 'society' at large. Individual and group needs are not necessarily congruous. [107b]

Modern telecommunication systems provide the opportunity for regional equality of educational services for ALL Canadians. This is not to suggest that the technology necessarily creates homogeneity (a subject of deep concern to academicians, anthropologists, and politicians alike).

The technology can not only ease one's accessibility to educational information but also can create a learning environment that acts as agent: [108, 111]

- for social change;
- for pure research;
- for guarding and preserving national, community, and ethnic ideals and differences;
- for preparing one for coping with techniques of survival (learning a living);
- for self-fulfillment. [110a]

A most recent development that merits mention on accountof its sociological implications (for development of northern Canada) is the potential creation of a 'University of Canada North', the brain-child of Richard Rohmer, a Toronto lawyer. A conference to discuss preliminary policies regarding formation of the University is being held in Inuvik, NWT, November 20, 1971. Should university life in the North take the conventional form of 'university buildings' ? or is this not an ideal opportunity in which to experiment with a 'telecommunication' teaching/learning environment?! "The aim (of the U. of Canada North) is to pioneer a new form of educational institution where the purpose is all important and the northern people, especially the original residents, are fully involved." [110b]

PROBLEMS CONFRONTING EDUCATIONAL TECHNOLOGISTS

a) Coping with innovation -
   i) in technologies
   ii) in pedagogical theories
   and the interfacing of the two

b) Compatibility

c) Information Retrieval

d) Distribution System Alternatives

e) Research but no development (financial limitation)

f) Environmental needs

Throughout the report, numerous problems have been aluded to. However, this section will emphasize several of the main problems confronting the educational technologist.

Alvin Toffler, in Future Shock, points to the problem of coping with innovation and change in the area of education. New technologies are being constantly developed. Since most teachers are not trained in the use of the new technologies, they offer resistance to using the media. But, in addition to innovations in technologies, teachers must also cope with changing trends in pedagogical theories and also in the interfacing of educational theories with technological developments. New technologies alter the mix of choices available to us and change our value system, which in turn necessitates our adapting to change.

One of the major problems facing educational technology and educational communication systems is that of equipment and systems compatibility. In the past, major manufacturers of media hardware have perpetuated the system of designing hardware that was not

necessarily compatible with hardware systems produced by other manufacturers of similar equipment - for purely selfish economic reasons. In order to have a viable, extensive educational communications network, the problem of compatibility must be solved.

A possible solution to the compatibility problem lies in the setting of standards. The Educational Media Council and the Bureau of Libraries and Educational Technology of the United States Office of EDucation recently sponsored a conference in Washington on standards in educational communications. The solution strategies discussed included:

"a) short-range What specific steps and actions can industry take immediately under existing condition to alleviate the current problem? What can schools do specifically right now to mitigate the problem? What can government agencies do immediately to alleviate the problem or help bring about change? What can professional organizations (e.g., NAEB,AECT,NAVA,SMPTE,ALA,ASCD,AASA,etc.) do in leading the way in setting standards co-operatively and disseminating the information?

b) long-range What changes - legal -etc. - need to take place; and how might industry, schools, and government bring about these changes? What legislation might be needed? How can development of standards allow for new product development?"

Traditionally, the library was the source that one turned to for storage and retrieval of educatinnal information.

> "The past decade has witnessed an explosion of literature in forms for which traditional library organization has not been designed...The size and subject scope of research libraries requires computer memories together with rapid access capabilities which the present technology cannot now provide but which may soon be realized. Economic imperatives will require an integration of library functions to justify and support the economic costs of such developments." 1126

As the educational system becomes more complex and as the amount

of information fed into the computer utility increases, more efficient methods of information retrieval become necessary. The IRTV experiment in Ottawa was an experimental proposal along these lines.

At present, there are a number of media distribution system alternatives (ETV,CATV,satellite communications,etc.). For a system to be totally interactive, the various sub-systems must be compatible. If there is to be a national educational communications network, there must be cooperation between all provincial educational authorities(re the medium,if not the message).

Educational research in the United States has been extensive in recent years (more limited in Canada). However, unlike in industry where research is logically followed by development, rarely is educational research followed by large-scale development (The Brentwood CAI project is just one example of large sums being spent on research with little follow-up in developing the concept on a national basis).

The environmental factors affecting learning deserve considerable attention. While the conventional closed-classroom is a thing of the past, the student's interaction with the environment plays a significant role in motivating the learner to achieve behavioral goals. Educational Facilities Laboratories is dedicated to research in this very area.[13]

RECOMMENDATIONS [114]

Based on the current and expected role of telecommunication systems in educational technology, the following recommendations are suggested for consideration:[115]

A. An inventory shall be taken of the current and anticipated extent of utilization of all educational communication systems in Canada (including film, ETV, CATV, filmstrips, phonograph records, CAI, and all other audio/visual aids).

B. An inventory shall be taken of all the major production houses of educational hardware and software in Canada (including both print and non-print media - and including both production and distribution components of the industries concerned).[116]

C. An inventory shall be taken of all past, current, and anticipated experiments involving telecommunications in Canada (e.g., the Ottawa Information Retrieval Television-IRTV-experiment, the TEVEC experiment in the Saguenay area in Quebec, the Memorial University media experiment, the Scarborough College ETV experiment, the NRC's CAI project).

D. A "Delphi Study"[117] shall be made involving leaders in academic institutions (at all levels), government, and private industry exploring the possible alternatives for educational communication systems in Canada in 1980.

E. An investigation shall be made as to the legal implications of standardization, compatibility, and innovation in educational technology systems (a) within a given 'community' and (b) between various 'communities' in Canada.

F. An investigation shall be made as to the political implications of standardization, compatibility, and innovation in educational technology systems (a) within a given 'community' and (b) between various 'communities' in Canada.

G. An investigation shall be made as to the economic implications of standardization, compatibility, and innovation in educational technology systems (a) within a given 'community' and (b) between various 'communities' in Canada.

H. An investigation shall be made as to the socio-cultural environmental implications of standardization, compatibility, and innovation in educational technology systems (a) within a given 'community' and (b) between various 'communities' in Canada.

I. A national body on educational technology (such as the National Council for Educational Technology in Great Britain and the proposed National Institute of Instructional Technology in the U.S.A.) shall be formed whose purpose shall be to foster and coordinate the research and development of a national educational technology system for Canada while providing assistance to provincial governments on issues in educational communications of interest to all concerned - with the objective of providing for the highest possible quality of life for every Canadian.

J. A study shall be made investigating the international applications (and implications) of the various communication and telecommunication systems available for use in an educational setting (including, but not restricted to, CAI and satellites); organizations such as CIDA and UNESCO shall be consulted as resources.

K. A study shall be made of cost-effectiveness (in educational terms) of all currently employed educational media systems in Canada.

L. A survey shall be made of current and anticipated specific courses and general programs of study related to both the theory and application of educational communication systems that supplement or totally replace traditional lecture methods.

M. A detailed inventory shall be made of all the primary and secondary sources such as libraries, clearinghouses, publishers, film distributors (both outside and inside Canada) from which literature and non-print media concerning "educational technology"could be derived.

N. A detailed bibliography of all the literature and non-print media (related to educational technology) that are available from sources in M above shall be created and continually up-dated.

O. A "national library of educational technology" consisting of materials (both print and non-print) referred to in N above and available from the sources mentioned in M above shall be formed; the aim of the library shall be to provide a centralized source of information on educational technology that would be available to anyone interested in the study of educational technology. The library would be continually up-dated.

P. Interdisciplinary Curricula shall be created and developed within pedagogical training colleges or institutes, which are geared to producing a new breed of educator - or educational technologist - one who is <u>both liberally educated</u> and <u>technologically trained</u> to

deal sensitively with the multifaceted educational system of the decades ahead.

Q. A preliminary study shall be made of the environmental design (or physical or architectural) requirements of educational 'institutions' of the future - the study to take into account, not only the educational management requirements, pedagogical theories, and technological systems but also, the behavioral consequences of the learning environment. In other words, the study would come to grips with the question: In order to achieve behavioral objective "X", what environmental conditions (visual, acoustic, thermal, olfactory, proprioceptive) and facilities would most likely tend to produce that goal? If a strong, positive correlation is found to exist between the results of this study and the work of the Educational Facilities Laboratory, then Canadian educators could advisedly turn to E.F.L. for further advice on the environmental design requirements of educational spaces and facilities; if, on the other hand, such was not found to be the case, then a strong recommendation would be to create an "educational environmental design research institute" as part of the "national institute on educational technology" (as mentioned in I above). The purpose of this "educational environmental research institute" - which would work closely with academic leaders, Central Mortgage and Housing Corporation, the Ministry of Urban Affairs, the New Learning Media Secretariat of the Association of Universities

and Colleges of Canada, and others - would be to research and foster the development of the kinds of educational environments that would optimize the learning process.

CONCLUSIONS

Insofar as educational telecommunication systems are concerned, the challenge of the 1970's is how they may:

"a) create a technology specifically adapted to widespread use for the development of human resources, as well as for the design and construction of low cost radio, television and computer equipment, of satellites with adequate capacity for educational transmissions and of receivers for non-electrified areas;

b) allocate adequate resources and frequencies for educational and cultural use;

c) blend the efforts of telecommunications engineers and management with those in charge of planning and operating educational systems.

A systems approach is required which englobes all modern resources of education, including telecommunications, and combines them in such a manner as to draw the maximum benefit from each component, benefits not only of an economic but equally of an educational and psycho-sociological nature. Hence a need for new training in educational technology which provides, on the one hand, knowledge of the educational dimensions to experts in telecommunications, and on the other hand, full familiarity with the techniques, the production processes and technological potential of the media to educational professionals at all levels.

What is called for is nothing less than a new profession which is master of a new technology, which is prepared to work within new legal and financial structures, and is ready to apply the resources of educational technology to new fields and new perspectives for man in this age of rapid change and world-wide interdependence."

"Is it too much to conclude that the newer media potentially connect the individual learner with any available knowledge in the world of past or present? In this sense the goal of education - the ultimate development of the individual - is joined with the ultimate goal of communication - the unification of human society." 122

FOOTNOTES

1) Telecommission Study 8(d), D.O.C., J. deMercado, G. Gliuski, M. Krieger, C. Lemyre, (Information Canada, 1971) p.68

2) News From NCET, National Council for Educational Technology, Report Summer, 1969, p.1

3) George B. Leonard, Education and Ecstasy (Dell, 1968), p.216

4) Roger DeGuimps, Pestalozzi: His Life and Work, translated by J. Russell (D. Appleton-Century, N.Y., 1895)

5) John Dewey, Experience and Education (MacMillan, N.Y., 1938)

6) James Mulhern, History of Education (Ronald Press Co., N.Y., 1946)

7) Jerome S. Bruner, The Process of Education (Vintage, N.Y., 1963)

8) Jerome S. Bruner, The Relevance of Education (W. Norton, 1971)

9) John Goodlad, "Diagnosis and Prescription in Educational Practice", Instructional Technology, eds. Knirk & Childs, (Holt-Rinehart-Winston, 1968)

10) Alexander S. Neil, Summerhill (Hart Publishing, N.Y.)

11) B.F. Skinner, "The Science of Learning and the Art of Teaching", Harvard Educational Review, v.24, pp.86-97, 1954.

12) for a detailed study of programmed instruction, see: Kay, Dodd, Sime, Teaching Machines and Programmed Instruction (Penguin, 1968). Also see: A Basic Reference Shelf on Programed Instruction, Robert Glaser & Mary L. Marino (June 1968)

13 Benjamin S. Bloom, Taxonomy of Educational Objectives: Handbook I: Cognitive Domain (David McKay, Inc., N.Y., 1956)

14) Ernest Hilgard, A Basic Reference Shelf on Learning Theory (ERIC, Stanford, Sept., 1967); also see appendix C.

15) for detailed study, see Paul Saettler, A History of Instructional Technology (McGraw-Hill, N.Y., 1968)

16) from A Basic Reference Shelf on Audio/Visual Instruction, by Edgar Dale & Gregory Trzebiatowski (ERIC, Stanford, Aug. 1968) pp.6-7

17) Barrington Nevitt, "Problems of Communicating with People Through Media" The publication, Northern Electric, 1970, pp. 11-12

18) The Futurist, V.IV, no.5, Dec. 1970, pp. 222-223; reproduced in this report as appendix A.

19) Ian H. Wilson, "Our Future Business Environment: Developing Trends and Changing Institutions" (Rising Tide of Education) pp.18-19, 1968

20) Emmanuel G. Mesthene, "How Technology Will Shape the Future", in Purposive Systems: First Annual Symposium of American Society for Cybernetics, Spartan Books, 1968.

21) Following are some publications dealing with Educational Systems Analysis:
Walt LeBaron,"System Theory: Some Applications for Curriculum and Instruction" (unpublished article from System Development Corp. 1969)
Richard W. Judy, "Systems Analysis and University Planning (a paper presented at the Symposium on Operations Analysis of Education, Washington, 1967)
John Pfeiffer, New Look at Education;Systems Analysis in our Schools and Colleges (Odyssey Press, N.Y., 1968)
R. Buckminster Fuller, Education Automation (S. Illinois Press, 1962)
R. Buckminster Fuller, Utopia or Oblivion (Bantam, 1969) Ch.11,12.
B. Eriksson,"A Systems Approach to Educational Technology" (Educational Technology, June 1969) pp62-69
R.E. Lave & D.W. Kyle,"The Application of Systems Analysis to Educational Planning", Comparative Education Review,Feb.1968,p39-56
H.J. Hartley, Educational Planning-Programming-Budgeting:A Systems Approach (Prentice-Hall,1969) ch.1-4

22) Walt LeBaron,"System Theory:Some Applications for Curriculum and Instruction" , p.21

23) ibid.,pp20-21

24) ibid., p.21

25) see footnote 14 ; also appendix B

26) see Serena E. Wade, A Basic Reference Shelf on Individualized Instruction, (ERIC, Standford,1968): detailed bibliography

27) Knirk and Childs, Instructional Technology (H-R-W, 1968),p71

28) James D. MacConnell, A Basic Reference Shelf on Facilities for Instructional Media ERIC,Stanford, 1968)

29) same as 26

30) Serena Wade, Media and The Disadvantaged (ERIC,1969)
Media and Social Concerns, Audio-Visual Instruction Magazine,v.XV, no.1

31) see 16

32) see definition, p.2 of this report

33) Rossi and Biddle, The New Media and Education(Anchor, 1967). pp372-377

34) ibid., p.329

35) see section in this report on CAI

36) see appendix A for comparison of 'old' and 'new' educational system

37) V.XV, no. 4 (April, 1970) of Audio-Visual Instruction magazine devoted to"Media and Vocational Training"

38) see appendix A

39) Andrew Molnar, "Higher Education and the Post-Industrial Society" in The Future, Office of Computing Activities, National Sciences Foundation, pp. 448-449

40) see footnote 26

41a) same as footnote 39, p450

42) Henry Ingle, A Basic Reference Shelf on the New Media and Teacher Training (ERIC, Stanford, 1968)

43) David Ryans, in Teaching: Vantage Points for Study "Teacher Behavior Theory and Research", (Lippincott, 1968) p.32

44a The Royal Commission on Education (Province of Quebec), PartI: The Structure of the Educational System at the Provincial Level

45) Donald Klemer, "Freedom for Creativity: Data Processing in the School's" an article in Revolution in Teaching: new theory, technology, and curricula, (Bantam, 1964), p.151.

46) see section on educational planning and innovation for further details

47) Richard S. Farr, Knowledge Linkers and the Flow of Educational Information (ERIC, Stanford, 1969)

48) Michael G. Sovereign, Costs of Educational Media Systems (ERIC, Stanford, 1969)

49) H.J. Hartley, Educational Planning - Programming -Budgeting (Prentice-Hall, 1969)

50) Robert M. Morgan, A Review of Educational Applications of the Computer, including those in Instruction, Administration and Guidance, (ERIC, 1969)
also see Tansey and Unwin's 'Simulation and Gaming in Education' bibliography of 443 publications

51) Alvin Toffler, Future Shock (Bantam, 1970), Ch. 18.
Economic Council of Canada, Report on Intellectual and Industrial Property (1971).
Fifth Annual Review of Economic Council of Canada "Science and Technology'
Werner Hirsch, Inventing Education for the Future, 1967.
Education and Technology in the 21st Century (1968)
The body of literature on futurology and futures research in education has been growing rapidly in recent years and is an indicator of the response of educators to the need for long-range planning.

52) see appendices D and E and H

53) personal communication with Derick Unwin, New University of Ulster, Coleraine, N. Ireland. (1970)

54) same as 53

55) Report on Intellectual and Industrial Property, p.10

56) Victor C. Ferkiss, Technological Man, (Mentor, N.Y., 1969)

57) see section 93 of the BNA Act for statement on jurisdiction.

58) see appendix F

59) see appendix G

60) Educational Media Council sponsored a conference Nov.11-12, 1971 on the subject of educational media standards.

61) Margaret Mead in Oct., 1970 ERIC Newsletter stated that machinery must be devised that can be used with a minimum of adjustment, since women form the largest part of instructional personnel.

62) a) Biddle and Rossi in New Media and Education (p4) define medium as device which is normally uswd to transmit information between people. An educational medium is such a device used used for educational purposes. Thus, a particular medium (e.g., TV) may or may not be educational depending on the use to which it is put.

63 a) Murray G. Phillips, "Learning Materials and Their Implementation", in Instructional Technology (ed. Knirk & Childs, H-R-W,1968) p.96

64) from Audio-Visual Instruction magazine: June/July 1970 p.77, "Media Seminar on Media Cost Effectiveness"

62b) see The Audio-Visual MarketPlace: a directory of all producers, distributors of hardware/software in U.S.A. 1971.

62c) see EPIE (Educational Products Information Exchange Institute), Report no.28 specifying instructional hardware. gives model hardware specifications for educational technologists.

65) Michael G. Sovereign, Costs of Educational Media Systems, (ERIC, Stanford, 1969).

66) ibid.

67) ibid. and The New Media and Education, Rossi and Biddle

68) Serena Wade, Media and the Disadvantaged (ERIC, Stanford, 1969)

69 a) Audio-Visual Instruction magazine, Dec. 1969 issue devoted to "Media and the culturally different"

70) Harold ALayer, Ethnic Studies and Audiovisual Media: a listing and discussion (ERIC, Stanford, 1969)

71a Physical Environment and Special Education : selected abstracts (54)
Ittelson, Proshansky, Environmental Psychology, (H-R-W, 1970)
Kenneth Bayes, Therapeutic Effects of Environment on Emotionally Disturbed Children (Society for Emotionally Disturbed Children, 1970)

62e) Harold Wigren, Telecommunications in Education, (1969 speech)

72) see footnote 68.

73) Rossi and Biddle, The New Media and Education, (Anchor, 1966) p.175

74) Harold B. Gores, "Educational Change and Architectural Consequences", in Instructional Technology, (Knirk & Childs) ; p. 173

75) Harold E. Wigren, Telecommunications In Education (Seattle, Wash., speech, Feb., 1969 Western Radio & TV Assoc.)

76) Gordon B. Thompson, "Moloch or Acquarius" The publication, (Northern Electric , Feb., 1970) p.60

77) Harold D. Hauf, New Spaces for Learning: the design of college facilities to utilize instructional aids and media (EFL, revised, June, 1966)

78) see footnote 28

79) George B. Leonard, Education and Ecstasy (Delta, 1968) p.19

80) Vrej-Armen Artinian, The Elementary School Classroom: a study of built environment - draft of a paper presented at the 2nd Environmental Design Research Association conference, Pittsburgh, 1970.

81) Telecommission Environment Report 6(d) Plugging into the Wired City p.40

82 EFL Report: Design for ETV p.5

83) see footnote 37

84) Instructional Technology (Knirk & Childs) and The New Media and Education (Rossi & Biddle) provide a good summary of this area.

85) John H. Feldhusen, A Position Paper on CAI Research and Development (ERIC, Stanford, 1970) - a critical analysis of CAI. also, see footnote 50 a.

82b) see Robert Sommer, Personal Space: the behavioral basis of design (Spectrum, 1969), Ch. 7. In addition to his more avant garde theories in 'architectural psychology', Sommer indicates that: "Technical innovations in the area of information systems will affect school design. According to MacConnell (J.D. MacConnell in 'Planning the School Environment', paper presented at 2nd National Conference on Architectural Psychology, Utah, 1966), it will soon be possible to arrange eight different television monitors around a table to enable students to view different programs on each monitor, all without wires. The communications system will be based on laser beams conveyed through carpeting or other floor surfaces. Teaching machines, talking typewriters, and computerized information storage-retrieval systems will affect school design, probably first in the library and audio-

visual aids departments... Unified schools, which replaced individual frame schoolhouses, are being combined into educational parks... A combination of the population explosion, educational television, programmed instruction, and the shorter work week may return some classroom functions to the home and to parents."

86) Alvin Eurich, Campus 1980: the shape of the future in American Higher Education (Delta, 1968) This book suggests that new teaching methods, courses, curricula, architectural design,etc. require imaginative rethinking in order to cope with education in the future.

87) ibid. Chapter: 'Learning Never Ends: A Plan for Continuing Education'by AA. Liveright. Also see footnote 89.

88) Telecommission Studies 5 (a),(c),(d),(e):'Policy Considerations with Respect to Computer Utilities' p.13 Educational Services.

89) Telecommission Study 8(d) 'Multi-service Telecommunication Systems -the Wired City' (Information Canada, 1971) - deMercado, Glinski, Krieger, Lemyre . pp40-41. The services include: correspondence schools, computer tutor,, CAI, school related communications, college catalog and related information, adult courses, evening courses, seminars, consultation with teachers, professors.

90) J. Miedzinski did a comprehensive study of 'telecommunications in education - Canada', which appeared in Telecommunication Journal (v.37,VII, 1970, pp335-340). He covered the framework for educational broadcasting and dealt with current educational telecommunication projects in action throughout the country as well as indicating projects under consideration for the future. Incidentally, this entire issue of Telecommunications Journal was devoted to the subject of 'telecommunications and education', and contained an introductory chapter by UNESCO followed by individual contributions from 34 specific countries.

At the first Inter-American Telecommunications Conference (OAS), Sept. 1971 in Caracas, Venezuela, "UNESCO was severely criticised for pressing the use of educational T.V. by communications satellite systems without first taking into account facilities already available, and was requested to give priority to examining the T.V. and radio broadcasting facilities already available in each country." V.C. MacDonald, p.8. Tele-education report, unpublished : Sept. 16,1971.

91) Telecommission Studies 5 a),c), d), e). p. 18, figure 7.

92) ibid. p.13

93) National Research Council, Newsletter of Associate Committee on Instructional Technology v.1, no. 1 and no. 2 (1970,1971) . CAL: a cooperative research project (Rome 1971) J. Brahan,NRC. W.G. Hoyle,'Information Storage and Retrieval',(NRC, 1971)

94) Telecommission Studies 5 a),c),d) e) . p.13.

95) Alan B. Salisbury, 'An overview of CAI' in Educational Technology magazine, October, 1971.

96) Telecommission Studies 5 a),c),d),e), p.20

97) John H. Feldhusen, (Purdue,1970)'A Position Paper on CAI Research and Development' p. 2

98) ibid.

99) arising out of Harvard University's 'program on Technology and Society', including : A Vision of Technology and Education (reprint 1) and Educational Tehhnology: New Myths and Old Realities (reprint 6).

100) D. Parkhill, The Challenge of the Computer Utility (Addison-Wesley, 1966) presents a positive view and lists numerous categories of usage for the computer.

101) see Canada Gazette,Part II, V.104,no7 , Appendix A ' Definition for the Reservation of Educational Broadcasting Time and Facilities' "...at least one channel of a cable transmission facility be set aside for the use of a provincial authority for educational broadcasting..." direction to CRTC pursuant to section 27 of The Broadcasting Act.

102) While not legal documents, the following two publications may give the layman insight into some of the problems and potentials of educational satellites:."Symposium on Commercial Satellites and America's Future Communications Network" (in Sept. 1971 SMPTE Journal); 'Possible uses of satellites in education' by Henri Dieuzeide in Communication in the Space Age :the use of satellites by the mass media.

103) see : An Analysis of University Policy Statements on Instructional Recordings and their Reuse by Fred S. Siebert (Michigan State U., ERIC,Stanford) - 'a comparative analysis of the major provisions of policy statements adopted by a selected list of colleges and universities on the subject of production, use and re-use of instructional materials which have been recorded ... for classroom use. '
also useful is appendix C (photocopying in educational institutions) of the Report on Intellectual and Industrial Property (Economic Council of Canada, 1971).

104) see : The Canadian Computer Communications Task Force - notes for a speech by H.J. von Baeyer for the Federal Institute of Management, Ottawa, 1971. p. 4 . The task force is addressing itself to "provide an adequate degree of Canadian control of industries and services."

105) The privacy issue has social,as well as legal implications, which are touched on in the next section. VonBaeyer (see footnote 104) lists the issues to which the CCCTF addresses itself: "to meet social and economic needs of Canada, to ensure equitable distribution of computer power at the most economical conditions, to provide an adequate degree of Canadian control

of industries and services, to maintain critical computer centres and data banks in Canada."

106) The list of publications on social communications is too lengthy to detail here; however, the reader may wish to commence a study of the field by reviewing some of the work of Wilbur Schramm, an authority on the subject of mass communication and its social effects. In 'Some Possible Social Effects of Space Communications' in Communication in the Space Age (UNESCO), Schramm deals with theeffects of increased information on decision making, the rise of the general level of knowledge, the reduction of the sense of remoteness, innovation, standards.

107) "Since motivation for learning is often a function that derives from the influence of the peer group, a technology of instruction needs to take social factors into account as a condition both favoring and limiting learning." A. Eurich, Campus 1980, p.253.

108) Several sections in New Media and Education by Rossi and Biddle deal with social factors in education. While the amount of research being done in Canada, sofar, on this subject is limited, the efforts of the NFB in their "Challenge for Change" program should not go un-noticed. Their work follows a suggestion that appears in Public Television: a program for action (Carnegie Commission Report on ETV, Bantam, 1967). The broadcasting media, to be most effective, should 'serve as the mouthpiece and mirror of the local community' (p.234) by designing the technology to foster interactive participation (p.203), the criterion for 'interaction' being that both the program and viewer be capable of influencing each other (p.203).

109) The essence of media evaluation is in the concept of 'feedback'. During the Summer of 1971, a Media Evaluation Workshop was undertaken under the direction of Duane B.Starcher of the ETV Centre of Memorial University, Newfoundland; the results of this Opportunities for Youth funded project are available in a detailed report.

The results of the Scarborough College media experiment have just been published in a book Test Pattern by John A. Lee (U. of Toronto Press, 1971), an analysis of learner reactions to the project.

The Centre for Learning and Development at McGill U. does much research in media effectiveness for learning and publishes same in regularly issued bulletins.

Toward 2000 by Porter, Blishen et al. is a comprehensive study of the future of post-secondary education in Ontario. OISIE is heavily committed to educational research as is OECA of the Province of Ontario.

see Bernard Trotter's booklet Television and Technology in University Teaching (Committe of Presidents of Universities of Ontario, 1970).

The Centre for Educational Research and Innovation of OECD has published (1971) a book entitled Educational Technology: the design and implementation of learning systems. The summary of chapters and summary of main conclusions appear as Appendix K to this report. Two other extracts from this OECD publication appear as Appendices L and M. M is a chart that suggests the creation of an Educational Development Institute and shows the interrelationship of other components of the community to it.

110 a see Abraham Maslow's 'Hierarchy of Needs' from physiological to self-fulfillment.

111) While all formal learning used to take place in the 'schoolhouse' today a variety of new life-styles are taking the learning process away from the exclusivity of the school; much learning takes place in the social community. Jacques Ellul in Technological Society deals with socialization as a function of technological development.

112 a) suggested in a recent conversation with Dr. Andrew Molnar of the National Science Foundation In Washington. Added to this list of problems dealt with in the report are the 'problems of educational technology' dealt with in an article by Molnar entitled media and cost-effectiveness.(in Transactions, 1970)

113) see EFL bibliography attached as Appendix N.

114) The Recommendations of The President's Commission on Instructional Technology are worth reviewing for comparison, as are also those of Bernard Trotter in Television and Technology in University Teaching.

115) It must be pointed out that the recommendations that appear in this report are the personal opinion of its author and reflect his own biases, based on his own review of the literature, interviews with people in educational technology and related fields in Canada and the United States, and his general background in the field itself.

116) An example of what is referred to here exists in the U.S.A. as Audio Visual Marketplace : a multimedia guide (1971) - a directory of the entire industry.

117) An experiment in 1965 using the Delphi method is documented in John Pfeiffer's New Look at Education (p.155)

118) Appendix O details much of the literature (U.S.) available on the subject of media cost-effectiveness.

119) See appendix P for list of ERIC Clearinghouses on education

120) The Division of Educational Technology of A.E.C.T. provides an up-to-date detailed bibliography of references on Educational Technology. It appears in this report as Appendix Q

121) A list of sources of references on educational technology appears as Appendix R in this report.

122) from Telecommunications Journal v.37, VII, 1970.p. 317.

107 b) see Appendix S for a bibliography of literature on educational social psychology

75b) See Kiyo Izumi's 'keynote Address' Some Thoughts about the Environment and Telecommunications (The Wired City Seminar, June 1970)

112 b) Instructional Technology (Knirk and Childs) p. 153.

110 b) from a press release sent to this writer with the program outline for the Inuvik Conference on the U. of Canada North.

44b) David G. Ryans, "Teacher Behavior Theory and Research: Implications for Teacher Education, in Ronald T. Hyman, Teaching: Vantage Points for Study (Lippincott, 1968)p.32.

44c) ibid. p. 33

24b) Victor C. Ferkiss, Technological Man (Mentor, 1969) p. 190.

63b) "Solutions for many of the pressing problems in our educational system may be provided by engineers associated with the educational technology field. There is a need for engineers who have studied the teaching-learning process or evaluation procedures..... An organization is required,at the Federal level, which can guide, recommend and evaluate new applications for instructional technology. One of the prime jobs of such an agency should be to serve as a clearinghouse for the exchange of information on education and training programs, media and instructional technology , so that all industrial organizations would know about the latest developments." paper by Robert E. Wood "Organizing Research and Engineering Services to Meet the Need of Education" in Journal of SMPTE October 1968 (v.77, p.1029)

41b) "Technology is changing the role of the teacher, but schools of the future will provide an opportunity to make effective use of the unique contribution a teacher can make. The teacher will cease to be... transmitter of data.... will become an educational diagnotician..... The teacher of the future must be capable of conducting research into effectiveness of his teaching program. He must be able to take part in the supervision of selection, production and utilization of new teaching materials and tools. .... Teaching is an art and,... the teacher has become even more important and appreciated." a paper by Wm C. Lewis "Technology for Education" in Journal of SMPTE (October, 1968). p.1031.

62d) The need for studying educational requirements before investing heavily in hardware is pointed out in this article by E.B. Crutchfield, Jr. "An Evaluation of Nonbroadcast Television Facilities for Educational Institutions" in Journal of SMPTE (Oct. 1968) pp. 1037-1042.

71b) see James J. Onder's paper "The Use of Television in Psychiatric Treatment and Education" in Journal of SMPTE (Oct. 1968) pp. 1034-1037. Thispaper suggests using the TV medium as a technique for 'self-confrontation'.

69 b) In "How Not to Cheat Children: the Theory of Loose Parts", by Simon Nicholson -- an article in Landscape Architecture magazine (Oct. 1971), he suggests that:

"a) there is no evidence, except in special cases of mental disability, that some young babies are born creative and inventive, and others not;
b) there is evidence that all children love to interact with variables, such as materials and shape...

In any environment, both the degree of inventiveness and creativity, and the possibility of discovery, are directly proportional to the number and kind of variables in it."

BIBLIOGRAPHY

Because of the use of extensive footnotes in this report (which themselves contain detailed bibliographic information) in addition to several appendices attached which also contain detailed bibliographic material, no references will be specifically listed in the bibliography.

LEONARD, DAVID
Educational technology : panacea or placebo?, or, the current and expanding role of telecommunication systems in educational communications in Canada : an overview of user requirements.