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ABSTRACT

It is suggested that a major weakness in individualized instruction has been the failure to provide for adequate Instructional Management Information Systems. This is a defect which can be remedied by linking such programs to more sophisticated and more readily accessible instructional data processing centers. An effective application of the satellite's communications versatility may be to provide the communication linkage between user schools and a large computer system centralized at the state or on a regional basis. Another approach to individualization on a course by course basis is Computer Managed Instruction (CMI) and is advocated as an operational model for wider use. Such use could be expanded by local schools having real time access to centralized instructional data processing facilities. More precise information about instructional objectives, individual student progress and teaching resources characterize both individualized instruction and CMI. With such information available to the student, the teacher and the administrator, orderly and systematic use as a teaching resource, can be made of adult volunteer teaching aids and peer tutors. Research has shown that these can be inexpensive and powerful adjuncts to instruction when properly supported and used. A selected bibliography is included with this paper. (Author)

DOMESTIC UTILIZATION OF COMMUNICATION SATELLITES FOR EDUCATION

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Abstract

In the past fifteen years public and higher education has been in a state of rapid change, and many innovative programs and concepts have been introduced on the education scene. The source of many of the more promising of these new approaches has been the emerging discipline of educational technology, building upon ideas and concepts derived from management, communications and psychology. The successes of some of these new programs, while far from unequivocal, suggested other ways in which the psychology of learning could be taken into account in the design, development and delivery of instruction. The Individulaized Instruction approach appears to be gaining considerable acceptance, though there are broad variations in the form of its use. One approach to individualized instruction in school use is typified by the programs at Oakleaf, Pennsylvania, Bloomfield Hills, Michigan, Duluth, Minnesota, and others. The concept was refined, and in the opinion of many, improved with Individualized Prescribed Instruction (IPI) and Project PLAN.

It is suggested that a major weakness in individualized instruction has been the failure to provide for adequate Instructional Management Information Systems. This is a defect which can be remedied by linking such programs to more sophisticated and more readily accessible instructional data processing centers. An effective application of the satellite's communications versatility may be to provide the communication linkage between user schools and a large computer system centralized at the state or on a regional basis.

Another approach to individualization on a course by course basis is Computer Managed Instruction (CMI) and is advocated as an operational model for wider use. Such use could be expanded by local schools having real time access to centralized instructional data processing facilities.

More precise information about instructional objectives, individual student progress and teaching resources characterize both individualized instruction and CMI. With such information available to the student, the teacher and the administrator orderly and systematic use, as a teaching resource, can be made of adult volunteer teaching aids and peer tutors. Research has shown that these can be inexpensive and powerful adjuncts to instruction when properly supported and used.

Statement of Objectives

Some of the objectives of this paper are as follows:

1. To review some of the concepts basic to educational technology and trace the developments of early applications to subsequent educational innovations such as individualized instruction and computer-managed instruction.

2. To provide an overview of individualized instruction and elaborate the premise that the teaching effectiveness of such instruction will depend upon: (a) clear definition of desired learning outcomes; (b) frequent assessment of student attainment of these outcomes; and (c) appropriate teaching interventions being introduced to the student and based on the congruence (or lack of it) between (a) and (b).

3. To point out that few, if any, of the present models of individualized instruction have adequate instructional management information systems and at least one reason for this deficiency for many schools is lack of access to adequate data processing facilities. A large central facility could be linked by satellite to remote user schools.

4. To suggest that the availability of communications systems sufficient for the success of individualized instruction would also permit computer-managed instruction, the use of other low cost instructional resources, centralization of media storage and retrieval, and regional networking of educational television capabilities.

DOMESTIC UTILIZATION OF COMMUNICATION SATELLITES FOR EDUCATION

R. M. Morgan[1]

If one examines on a world basis the evaluation of education for the past fifty years it is easy to become disheartened. Population growth has not significantly decreased and world overpopulation has reached near crisis conditions. The percentage of illiterate people in the world has only been slightly reduced and the absolute numbers of illiterates is greater in 1976 than ever before. Literally millions of people do not possess the basic minimum skills essential to an adequate condition of life--many hover throughout their lives on the margin of survival. All of this despite the fact that more resources are being dedicated to education and other forms of human resource development than ever before in man's history.

A persuasive argument can be made that "little solutions" in education have not been solutions at all. The world desperately needs now the means of making orders of magnitude improvements in its educational accomplishments and this end must be attainable with human and material resources presently available and affordable. The processes and products of technology must be included among the inventory of resources which can contribute to quickening the pace of educational improvement.

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Educational Technology

What is encompassed in the concept of "educational technology"? It is possible to think of technologies for education which may range from analysis and planning techniques to highly sophisticated hardware systems such as the space satellite. It is equally important to think in terms of a technology of education. At Florida State University educational technology is regarded as the convergence of three other basic disciplines: (1) behavioral science; (2) management science; and (3) communications technology. Focusing the tools and knowledge of the relevant portions of these disciplines on the complex problems of education is the raison d'etre for educational technology.

Henri Dieuzeide (1971) has suggested that for developing countries forms of "intermediate educational technology" are the most appropriate means of technological application. Intermediate technology, originally an economic concept, ". . . is based on the idea that intermediate levels of technology should correspond to intermediate levels of development" (Dieuzeide, 1971). While the concept of intermediate technology is obviously most applicable to developing nations, it is also of importance to more developed nations. Education, only one of many sectors of national activity, has barely passed the level of intermediate development, even in the United States, the world's most technologically advanced nation. When one compares education in any given nation to almost any other class of activity imaginable--medicine, industrial production, transportation, even advertising--it is evident that education is in a comparatively primitive state. And quite apart from the present low state of technological sophistication of the educational sector it probably has one of the slowest change rates of any of the major sectors of the nation.

Educational researchers have been engaged in the study of the uses of technology ranging from the very basic to that which is quite sophisticated. Studies involving nations at different levels of socio-economic development have examined the use in education of resources ranging from low-cost print media to geostationary space satellites (Coombs, 1973; McAnany, 1973; Schramm, 1973; Polcyn, 1973). From these studies a number of tentative conclusions may be reached and some hypotheses developed for future courses of action.

The first, and most important of these conclusions is that there is much greater potential for impact on educational reform when the use of the things of educational technology is determined in the context of the application of the principles of educational technology. Dieuzeide (1971) and others have emphasized this point. In fact, the Commission on Instructional Technology in its report, To Improve Learning (Tickton, 1970), gave two definitions for instructional technology. One related to the equipment and things of technology and the other related to the processes. The Commission seemed to prefer the latter definition of educational technology as a body of technical knowledge about systematic design and conduct of education based upon scientific research (Gagné, 1974).

A second conclusion is that these principles of instructional technology have been applied in a number of instances where the resulting increased instructional power of programs has been clearly evident (Briggs, 1967; Bloom, 1968; Kim, 1970). Other programs such as the use of instructional television in American Samoa and El Salvador (Schramm, 1973) have also experienced a measure of success in terms of what they were intended to accomplish. The same could be said for Project PLAN (Flanagan, 1968; Flanagan, et. al., 1975), Individually Prescribed Instruction (Glaser, 1968) and a variety of individualized school programs of the last decade (Ohanian, 1971; Esbensen, 1968). The aims of these programs were relatively modest and their accomplishments have also been modest. An effort which was not modest--indeed, which could be described as grandiose--was the "Educational Systems for the 70's" project undertaken in the late sixties (Morgan, Bushnell, 1967). Because of the wide range of development research projects undertaken under the aegis of ES'70 it is difficult to assess the success or failure of this effort. Perhaps it is sufficient to simply note that there are no schools actively involved in this effort today!

A third conclusion, perhaps more appropriately stated in the form of a hypothesis, is that while all of these educational reform efforts were primitive, and while they had many and different weaknesses, their greatest deficiency was the absence of an adequate Instructional Management Information System. Sensing mechanisms to track students progress and to survey teaching resources in order to prescribe for students needs have simply not been adequate. R. L. Bright (1974) stated that "in visiting numerous individualized programs around the country, I have become sensitive to the fact that in most of these institutions it is fairly common for a student to be making little or no progress, and no one is conscious of the fact that he is 'lost'."

In 1966-68, when Bright was in charge of the Bureau of Research in the U.S. Office of Education, it was the golden period for support of computer-assisted instruction and for various forms of individualized instruction. The level of technological development at that time suggested a number of forecasts many of which still appear to be valid eight years later. One of these was that computer-assisted instruction (CAI) did not appear to be economically viable for ordinary classroom instruction. It was much more costly than conventional forms of instruction and not greatly superior in teaching quality. Bitzer and others at the University of Illinois were predicting at that time that PLATO with its plasma terminal would eventually deliver interactive tutorial instruction to students at a competive cost. There is presently some debate as to whether this prediction has yet been fulfilled.

A second forecast of this period was that school instruction could not be truly individualized unless computers were available for storage and retrieval of student learning information. A group of systems studies were sponsored by USOE to determine the uses which a school district could make of a large-memory, time sharing computer. These studies suggested that with a balance of use for administrative and instructional purposes and where a sufficiently large number of students could be served the increment added to the per student cost was not beyond the resources of most school districts (Morgan, 1969). The job of individualizing instruction requires a big information management capacity which is expensive and can't be done piecemeal.

In many ways the communications satellite is like the educational computer. There is a certain functional capacity in terms of deliverable services and a certain number of users above which the satellite must operate in order to be programmatically and fiscally competitive with alternative communication systems already in place. Howard Hupe set forth some beginning guidelines for identifying the conditions under which the satellite could be used in delivering education services (Hupe, 1974) though these seemed largely restricted to radio or television transmission.

It isn't difficult to conceive of practical uses of the communications satellites where conditions are primitive, populations are dispersed and where ground-based communications systems are thin or non-existent. The audio experimentation in Alaska with the ATS-1 satellite and the Appalachian, Rocky Mountain and Alaska television experiments with ATS-6 are appealing and appropriate uses of this technology (Polcyn, 1973; Stone, 1976). It will take somewhat more imagination and creativity to conceive of effective uses of the satellite over densely populated areas with existing extensive means of communications, including radio, telephone and television.

The question which must be addressed by state and national planners is what, of value to education, can be done with the satellite which can't be done more easily or less expensively some other way. And perhaps this question ought not to be answered only in terms of how the current processes of education can be improved but also in terms of new and alternative processes which may more effectively serve the ends of education. If one assumes that some of the characteristics of conventional instructional delivery systems may give way to new modes of providing instruction, the range of potential uses of advanced technologies is broadened.

Instructional Systems Analysis

The development of new kinds of instructional delivery systems should not be derived in an ad hoc fashion nor from a narrow perspective. These new systems should be built on a careful analysis of the social and educational needs of the people to be served by the system. Then all resources which have potential for contributing to the satisfaction of these needs should be analyzed to determine in what combinations they can be most effectively employed. The possibility of using communications satellites for domestic educational purposes introduces a whole new dimension to this process. There are educational support activities possible over a wide geographic area which could not be affordable by single schools nor isolated school districts. Because of the cost of placing in geostationary orbit a satellite complete with communications payload the analysis of the full range of its contributions must be made. What can the satellite add to the several levels of formal education, including public schools, community colleges, trade schools and universities? What can the satellite contribute to expanding and enhancing adult, non-formal education? Of these potential contributions how can they be ordered to relate to the highest priority needs? And how can the capacity of the communications satellite be optimally used?

In 1970 the Republic of Korea undertook such a comprehensive analysis of its educational system. Korea's motivation for this undertaking was simple but urgent. The country's economic development had outstripped its national capacity for providing sufficient numbers of people well enough educated to fill future manpower requirements. Furthermore, Korea was already spending twenty percent of its national budget on education, and with its necessarily heavy defense expenditure, could not increase its recurrent educational costs. The purpose of the systems study was to determine whether new and unconventional resources might be used and whether conventional resources might be used in new ways to increase educational efficiency. Put simply, the Koreans were seeking ways of getting a better return on their annual educational investment.

This analysis resulted in a blueprint for dramatic educational change. Instructional television and individualized instruction became crucial elements in the new system--not as add-ons to the traditional program but as integral deliverers of portions of the curriculum. The role of the teacher has changed and school management and administrative practices have been modified. The new system is presently in the final stages of development and the work of nation wide implementation is nearly ready to begin. The logistical problems inherent in an educational reform of this magnitude are large and could not have been managed without systems planning.

The development and implementation costs of the Korean reform will reach a total of nearly $30 million and will take nearly eight years from conception to operational readiness. The quality and cost efficiency of the new program will, in the estimation of the Korean government, justify this large front end investment.

The application of the principles of instructional design to the building of this new educational program has led to predictable and verifiable levels of academic achievement for Korean school children.

As American educators seek new ways of improving their educational systems and attempt to discover uses for new resources such as the space satellite the Korean experience exemplifies the value of comprehensive systems analysis and planning. Tools such as television, the computer or the satellite may be out of reach financially, no matter how valuable their contribution might be to education, if their use is narrowly conceived. If, on the other hand, their potential is examined across a broad range of human development activities, their costs so widely amortized may be quite manageable.

Domestic Uses of the Communication Sattellite

While careful analysis and planning is necessary to define the real world range and combination of uses of the communication satellite it may be useful to examine some possible applications. The ultimate specification of applications will depend upon the unique characteristics of the region in which the applications are to be made. Such factors as population density, geographic location, the nature or mix of the industrial base, the educational level and aspirations of the targ. ' . .pulation are all important variables. Whether or not the satellite is to be used solely within a single state or to serve several states simultaneously will be a major determinant in use planning. The degree to which various programs of human resource development within a state or region either are or could be coordinated and articulated with one another is also of relevance.

It should also be noted that satellites can be designed to maximize different communications configurations. The ATS-6, for example, has maximized the communications power built into the satellite itself in order to permit signal transmission to widely distributed and relatively inexpensive ground receiving stations. The INTELSAT satellites, in contrast, have less transmitting power, sending the signal only point-to-point--say London to New York--where the signal is picked up by very large and expensive ground receiving stations. The signal can then be rebroadcast over existing ground relay systems. The various trade-offs in size, power, narrow or wide band applications all have implications for cost and use.

Computer-Managed Instruction. The cost problems associated with the use of a dedicated computer for interactive tutorial instruction have already been noted. However, the use of the computer as a means of managing the information associated with individualized forms of instruction has been demonstrated to be both cost effective and instructionally efficient on a localized basis (Dick and Gallagher, 1972). In 1970, Walter Dick and a group of his students developed what may be the first operational course taught by Computer-Managed Instruction (CMI). The functional arrangement between the learner and the resources critical to the teaching-learning process are shown in Figure No. 1.

periodic and continuing basis, an individual diagnosis of learning need and an individual prescription of instructional events. The Learning Resource Center where the CMI terminals were located was open from early morning until late at night and the interaction between the student and the computer could take place at any time convenient to the student.

The prescribed instruction might be for less than an hour of work or it might be for several days. The instructional events were only limited by what was logistically available to the course. Included in these events were audio-visual lessons, such as films, slide-tape presentations and instructional television. Also available were text selections, scheduled teacher demonstrations, small group work and periodic large group presentations. The student could also be routed to the professor or an assistant for tutorial guidance. Later CAI was selectively added as an additional instructional resource.

In the early phases of this experimentation two fi ings stood out: (1) instruction by means of CMI was a great deal cheaper to deliver than conventional live instruction and (2) even at the beginning the accomplishment of course objectives by the students was done as well through CMI as through live instruction. The computer's capacity to reliably support learning activities and to store, analyze and retrieve large amounts of data on each student has been clearly demonstrated (Suckely and O'Dell, 1976; Alessi, Anderson and Biddle, 1976). Computer-managed instruction has come into fairly widespread use, with courses now being offered by industry, the military and some universities. Florida State University now routinely offers courses at both the graduate and undergraduate level by m of CMI.

Once a course has been developed, its use by students is only limited by the availability to the student of a terminal connected to the main computer and access to the associated instructional materials. The initial cost of developing such courses is relatively high. Dick and others estimate that for a typical college course, where mostly off-the-shelf materials are used, the development costs may range from $8,000 to $12,000. Also, the acquisition and set up costs of a large time-sharing computer is very high--though the total costs per student for computer time in a single course is low. Cost data from FSU's several CMI courses suggests a total cost of $12.00 to $20.00 per student per course is a reasonable expectation.

By means of the communication satellite CMI courses offered at one institution could be delivered, at the same time to many others. Cooperating institutions--community colleges, other universities, and even high schools--could lease terminals and buy or rent the packaged instructional resources. The terminals could be linked to the remote computer via satellite and the teaching materials located at each cooperating school. Local course offerings--particularly for smaller colleges--could be significantly expanded and enriched, and for comparatively low cost. Since the terminal-computer linkage is a narrow-band use of communications satellite, the functional capacity of the satellite at any given time is not significantly diminished.

Performance Assessment for Instructional Improvement. A variation on CMI has been developed recently, making it possible to take advantage of the feedback to the learner component of CMI without the development of the special inventory of instructional resources (Oosterhof, 1977). Also, rather than using individual student terminals for testing the learner a series of tests over the course objectives are developed which the student can request for whatever objectives he feels he is ready to be tested upon. The test is then scored on the spot by an optical scanner and the central computer prints out for the student a record of his successes and deficiencies in attaining the course objectives. This process differs from CMI in that the computer does not prescribe any instruction for the student. The student's learning follows the conventional pattern of hearing the teacher lecture, of getting reading and work assignments and engaging in the kinds of behavior associated with usual classroom instruction. The major difference is that all the learning objectives for the course have been specified and sequenced and criterion-referenced test items have been developed for each objective and stored in the computer. The student is given the objectives at the beginning of the course and advised that he can go to a campus testing center at any time and ask to be examined on any of the objectives wh. . he feels he is ready

The process contributes to learning effectiveness in several important ways. The student can know where he stands in his progress with respect to the course expectations on a continuous basis. And even though the students in a particular course are being tested at variable intervals the computer periodically aggregates the data for the professor. This allows the teacher to closely monitor the progress of his class and each of the individual students. He can know on a weekly, or even daily basis which objectives or parts of the course are giving the students difficulty and to which more instructional time should be allotted. Guidance to individual students who need special instruction is also facilitated. While at this point no special instructional materials, as in CMI, are being developed, if their need becomes evident the accumulated test data will identify those areas where the nee's are most pressing.

The student can submit to retesting one or more times on those objectives he failed in the first pass. Also, objectives from the early parts of the course are retested, on a sampling basis, when the student takes subsequent tests to insure retention of the objectives throughout the course. This process serves both a formative and summative testing function and has greatly reduced the amount of in-class testing time needed while increasing the overall performance assessment for each student. While uniform mastery achievement has not yet been attained, course failure and near failures have been virtually eliminated.

Test-taking and scoring can be remote from the central computer if an optical scanner and terminal can be linked to the computer. This means of improving instruction has the advantages of being inexpensive, technically uncomplicated, and instructionally non-disruptive. Its utility among a group of cooperating schools is limited only to the degree of agreement among faculties and departments on common course content and objectives. If course content and objectives can be developed by inter-institutional committees their acceptance should be assured.

The space satellite is an efficient potential means of making available to many schools in a region the capacity for continuous student performance assessment designed to improve learning. Widely dispersed schools could operate sophisticated assessment resource centers by linking, via satellite, to a centralized computerized assessment capability. While more research is needed on this approach, early findings suggest many potential benefits to students and teachers which will not be realized if each institution or local educational agency must design, develop, and implement the entire apparatus by itself. This appears to be an instructional innovation dependent for any rapid generalizability upon the communications satellite.

Centralizing Media Storage and Distribution. In rudimentary ways the centralization of print and audio-visual media has been customary in education for some years. There are regional film libraries, the ERIC system and inter-library loan agreements. The use of these resources, particularly by public shcools, has not been very encouraging. There are probably several reasons for this. First, and perhaps most important, is that most of these instructional resources are only marginally related to teaching any real course objectives, having been designed as adjunctive or enrichment materials. They are also rarely designed to teach but rather to inform. With the spread among educators of knowledge of the principles of Instructional Systems Development more is coming to be expected from instructional media. It has been demonstrated that appropriately integrated media when properly developed can effectively carry a part of the instructional load, and in some cases more effectively and reliably than a live teacher.

Some materials of excellent quality have been developed by state and regional educational agencies but its use is, with only a few exceptions, locally confined. Because of copyright, manufacturing and marketing complications educational publishers have been understandably slow in accepting these new integrated media.

Another reason for less than optimum use of centralized media sources is the problem of communication. Teachers, and even supervisors, not knowing what materials are available, how they may be ordered and what costs are involved must be major deterrents. Also, the fairly common time delay following a teachers awareness of the need for some material and its eventual availability must discourage use.

The creation or expansion of such regional media centers and their direct linkage to consumer schools via satellite should be useful. These centers could serve as depositories for integrated materials which do not lend themselves to commercial distribution. Two way communications by means of telephone or computer, where the user and supplier are linked by means of the space satellite should be quicker, less expensive and generally more efficient than the postal communications most often used at the present time.

A new technological development, operationally demonstrated, but not yet commercially available, could considerably enlarge the concept of centralized media libraries in the near future. This technology, invented by the Westinghouse Corporation, is called VIDAC (Video Audio Compressed). VIDAC is based upon non-real-time transmission of audio-visual information by means of conventional television systems, and permits time compression during storage and transmission of the aural component of a still visual-narrative audio presentation by a factor of up to 480:1. Prototype equipment has been developed which permits conversion of televised programs, their storage and high speed transmission utilizing standard television facilities. A terminal buffer has been developed which allows remote program selection, storage and real time display of the compressed information at viewer/user locations. This concept when considered together with the communications satellite has some important implications for educators. At the price of motion, eight hours of conventional television can be compressed and transmitted in a single minute. It can be stored in this compressed form until needed, at which time it can be decompressed and displayed or recorded with conventional television equipment. Effectively, this process changes the regular television program into a visual presentation which compares to a slide/tape presentation with the sound portion the same as before compression. VIDAC - A New Technology for Increasing the Effectiveness of Television Distribution Networks gives a more complete description of the technical aspects of this process (Diambra, et. al, 1975).

In late 1974 through early 1975, FSU, Westinghouse and the Veterans Administration collaborated in study of the field use of this system. Twenty-six requested medical training programs from the VIDAC "central library" were transmitted in compressed form to the Dublin, Georgia VA. hospital for staff training over a ten week period. These transmissions were made weekly via the ATS-6 satellite during two minute time intervals made available at station breaks. Westinghouse assumed responsibility for conducting the experiment and evaluating the technical aspects. FSU evaluated the delivery syst m/ user interactions, the system functional performance and user attitudinal responses (Diambra, Gulliford, Horowitz and Wiltshire, 1975).

Logs kept during the experiment indicated that about twenty percent of the estimated target population used the VIDAC library during the ten week period. These students generally reflected highly positive reactions to learning via VIDAC and the loss of motion did not appear to reduce viewer interest nor impair learning. The study team made a number of observations regarding the feasibility of a VIDAC type central library of integrated media linked with a satellite delivery system.

1. Since DAC allows the equivalent of some 900 fifteen-minute programs to be stored on a standard one-hour video tape, there

is potential for large savings in tape and storage costs of central library inventory.

2. VIDAC technology permits normal dubbing on conventional equipment, thereby avoiding the cost of extra equipment for each manipulation of the tape.
3. VIDAC equipment may be "plugged in" to existing local TV networks, thereby eliminating the cost of major modifications to existing facilities.
4. The ability to send textual material as hard copy, together with audio-visual information, eliminates the costs associated with separately printing and distributing hard copy from a single central location. Production of hard copy as required at the user location can be achieved with slight modifications to the present prototype hardware configurations within the system.
5. Stored information can be updated solely at the central library, thus simultaneously affecting all users. This may have significant effect on inventory control, markedly reducing inventories of non-current material.
6. A VIDAC system can be modularly planned and scaled for large or small applications to fit user needs; it may achieve greater and greater cost advantages as both the library and audience grow.
7. VIDAC central libraries could serve an area approximately one-third the size of the earth by utilizing a single dedicated satellite channel. Cost sharing based upon channel usage would permit many smaller agencies to enhance their public

services to a larger number of users.

Networking of ITV and ETV. Many communities and states have a variety of television delivery systems including both instructional and educational television. The former is often closed circuit and dedicated to and accessible by a specified user group such as the students at a single university or public school district. Its programming is characterized by being most often directly related to organized course instruction or, in some cases, the principle means of delivering certain instruction. Network type relationships between ITV systems are rare with only minimum exchange of programs. Program production is usually done locally, and, while costly to its developers is cheap compared to the more sophisticated productions of the Public Broadcast System or its affiliate stations. As a result ITV programming is more often amateurish than not.

In contrast, educational television stations, especially those affiliated with PBS, have much more elaborate production facilities and support resources. Many of their locally produced programs are of commercial quality, in addition to which, they can access PBS network programming. They do not, however, devote much program time to direct instruction. This is partly due to a loose and informal division of responsibilities between ITV and ETV stations. It may also be due to the value held by many educators that instruction is a local, or at best, regional phenomenon. Programs on subjects of public events or cultural affairs are of national interest, where TV courses on civics, history or even science may need to differ from one region to another.

If such television production and broadcast resources could be linked within a region and if ITV and ETV could negotiate the sharing of responsibility for televised instruction the impact on education, both formal and nonformal, would be greatly enhanced. The communications satellite offers a means of TV networking on a state or regional basis heretofore not feasible. There could be much more flexibility in the use of locally produced programs over a wider audience of viewers. A Consortium of stations could plan and articulate production schedules so that each member could allocate its total production budget to fewer but better programs. With all stations in the consortium doing this the aggregate number of programs available to the members would be greater in number, higher in quality without any increase in overall expenditure.

Some Conclusions and Possibilities

What are the elements of commonality among individualized instruction, computer-managed instruction and other low-cost teaching resources, that give them any relationship to space satellites? Actually there are a number of linking elements. First, they all represent means by which instruction can be made more efficient and effective. Second, they all have their greatest impact when used in the context of the instructional systems approach. Third, they are optimally effective when used in conjunction with a sophisticated information management system. And last, their implementation in new sites is limited to ones where there is available--usually nearby--an equivalent information management system.

It is this last limitation which may make the satellite of interest to the educational planner in population dense and communication rich regions. Most attention, in experimental uses of the multi-purpose

Application Technology Satellite (ATS) program, has been given to one and two-way audio and television transmission. The linkage in a state or region of the various educational resources to permit more effective instructional information management could be done through digital communication using smaller portions of the satellite's transmission capacity.

States such as Florida, New York, or California with centralized and coordinate control of their public and higher education systems could conceivably link all their institutions together via satellite. Florida has already moved to a common course numbering system for all nine of its state universities. There is presently large overlap between the course offerings of the several institutions. There are, of course, a great many courses which are offered on only one of the campuses. Assuming a large centralized data processing capacity it would not strain the technology to offer one University's CMI courses on any or all of the other campuses where the campuses have been linked with one another and the central computer by satellite.

It is possible to envision formal and nonformal educational programs in a community, a state or a region of the nation, which are parallel and mutually supportive. On many college campuses there are fairly sophisticated learning-resource centers, sometimes employed to deliver supplements to regular classroom instruction and sometimes to actually provide the instruction. It may be that the computer, instructional resources and learners can be linked together by the communication capacities of the satellite in ways previously unimaginged. Indeed, by replicating the basic inventory of off-line instructional resources the placement of computer terminals in a community library or center, permits a non-university tie-in to such an educational system, by means of a transmit-receive satellite earth terminal. Thus, a network of community learning-resource centers offering courses for credit or for fun, could be developed serving potentially millions of citizens of all ages. At the public school level individualized instruction could become feasible on a statewide or even regional basis. The logistical technical and cost problems associated with such an effort can only be guessed at in the absence of a careful systems study.

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