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ABSTRACT

The fourth of four volumes, this report documents the implementation, evolution, and institutionalization of the Individualized Study by Telecommunications (IST) Program, a microcomputer-based system developed by the Educational Telecommunications for Alaska (ETA) Project to provide instruction and a set of core courses for rural high school students in Alaska. Following an overview of the context of educational needs in Alaska and a discussion of educational needs assessment in Alaska prior to ETA is a detailed account of IST development, with particular attention to project design principles, the formalization of the IST Instructional Needs and Implementation Plan (including user needs assessment and instructional alternatives analysis), the IST developmental configuration, the IST courseware development process, field testing of courseware (both exploratory and pilot testing), special courses developed for teaching general mathematics and developmental reading, operational testing, and the institutionalization of IST. Appended to the text are a set of review sheets for use in developing IST courses, cost models for field testing the system, information on the LEARN/Alaska network, and a list of new courses sponsored by the ETA project. A list of abbreviations and a bibliography are also attached. (JL)

EDUCATIONAL TELECOMMUNICATIONS FOR ALASKA

VOLUME IV

INDIVIDUALIZED STUDY BY TELECOMMUNICATIONS

Prepared for:

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The foundation of every state is the education of its youth.

Dionysius

FOREWORD

It was with considerable excitement and some trepidation that the Department of Education undertook the Educational Telecommunications for Alaska Project in 1977. The Project was viewed with excitement since technology appeared to offer great potential for solving some very difficult problems facing public education in the State. It was viewed with some anxiety because the solutions posed involved complicated and relatively untried technologies which presented educators with strategies that were in part unfamiliar and mysterious.

No other state education agencies were investing such a large amount of funding in what some regarded as a very risky venture in modern technology. However, the State took the position that the Project offered possible solutions to educational problems where no alternative solutions were known to exist. It was regarded as a capital investment that could pay large dividends for years to come. The systems developed by the Project were to be thoroughly evaluated. Only those that were judged to be successful and to hold long-term potential for improving education in the State were to be maintained beyond the term of the Project.

In retrospect it is interesting that there was such a high degree of caution at the onset of the Project. The systems developed by the Project are now an integral part of the educational delivery system in the State. They are used by a wide variety of educators --State and local administrators, teachers, local support staffs, and, most importantly, students in many, many communities.

The Project was designed to address three basic needs. These were as follows:

- The need for faster, more efficient communication in support of the administration of schools in the State.
- The need for quick access to information about educational resources.
- The need for instructional support for rural high school students.

Three systems were designed to address these needs:

- An administrative communication network (electronic mail system) that interconnects the Department of Education with the 52 local school districts and other educational agencies in the State.
- A computerized "Alaska Knowledge Base" containing information about a variety of educational resources and accessible via the electronic mail system.
- A microcomputer-based method for providing instruction to rural high school students and a set of core courses for ninth and tenth graders.

Today much of the time-critical written communication associated with the statewide administration and support of local school districts is transmitted via the Administrative Communications Network. Teachers and administrators regularly consult the Alaska Knowledge Base to locate educational resources to apply to problems they encounter. Virtually all school districts in the State utilize microcomputers for a portion of their instructional program and students in small rural high schools have available to them a greater variety of high school courses because of the Project.

The Project has had a major impact on the nature of education in the State. In fact, largely through the impetus provided by the Educational Telecommunications for Alaska Project, Alaska is regarded as a leading state in the application of educational technology. The Department is very pleased to have received the support provided by the National Institute of Education and the State of Alaska. We anticipate continued work in educational technology in the years to come.

Successful institutionalization of the Educational Telecommunications for Alaska Project is documented in a set of four final reports; one covering each of the three educational systems and an Executive Summary. This volume contains one of those reports.

In fulfillment of its commitment to the National Institute of Education, this set of documents is submitted in the sincere hope that the reports will also provide insights and information useful to others in their efforts to improve the quality of public education in the future.

MARSHALL LIND
Commissioner
Alaska Department of Education

ACKNOWLEDGEMENTS

The Educational Telecommunications for Alaska (ETA) Project has effected a number of significant changes in educational administration and instruction in Alaska. These changes represent improvements in the quality of public education in the State. The Project involved highly complex applications of modern technology to identified educational needs. However, the complexity of coordinating the efforts of many individuals and groups was by far the most difficult problem addressed by the Project. The success of this Project was due, therefore, to the contributions and willingness to cooperate on the part of a large number of persons.

Throughout the term of the Project the support of the State Board of Education, the Governor's Office, the Alaska Legislature, and the National Institute of Education has been paramount. Without this support and the endorsement of the Commissioner of Education, Marshall Lind, the Project would not have been possible.

The design of the Project was developed in 1976-1977 by a team of individuals led by Ernest Polley, then Coordinator of Planning and Research for the Department of Education. Polley's continued support during the term of this Project was essential.

The Educational Telecommunications for Alaska Project was managed by a core staff of Alaska Department of Education personnel. The staff were located first in the office of Planning and Research and later in a new Office of Educational Technology and Telecommunications which came into being largely as an outcome of the Project. The ETA Project director in DOE was William Bramble who in July, 1981, became director of the Office of Educational Technology and Telecommunications. Ed Obie served as assistant Project director until July, 1981, when he was appointed Project director for the remainder of the Project term. Professional staff at DOE assigned to the ETA Project included Paul Berg, Rosemary Hagevig, and Bee Tindell. Other individuals in DOE who contributed to the overall success of various components of the Project included Alexander Hazelton, Eula Ruby, Sandra Berry, and Dan Boone.

Assistance in the development of the Project design was provided by the Northwest Regional Educational Laboratory (NWREL). Upon approval of the initial grant award from NIE in September, 1977, and, with the commitment of NIE and the Alaska Legislature to support the multi-year effort, NWREL became the Design and Implementation Contractor for the Project. NWREL designed, developed, and pilot-tested the major technological systems included in the Project, In addition, NWREL produced the computer-based courseware for rural high schools. The overall NWREL effort was administered by Tom Olson and, later, Ethel Simon-McWilliams. NWREL staff who contributed to basic systems design and development included Judy Edwards, Hal Wilson, Stuart Brown, and Ralph Van Dusseldorp. Ann Murphy, Kathy Busick, Craig Copley and many others from NWREL contributed to the development of computer-based courseware.

Key support for the installation of the data communications network was provided by two other State agencies. The Division of Data Processing, Department of Administration, provided for the procurement, installation, and operation of data processing elements required for the electronic mail system and educational data bases developed by the Project. The contributions of David Riccio and Stan Hamlin were critical in this regard. The data communications network established for this system was implemented by the Division of Communications, Department

of Transportation and Public Facilities, with considerable input from Walt Pierce of that agency.

Two intermediate education agencies performed important functions related to pilot testing and implementing the systems developed by the Project. These were the South East Regional Resource Center in Juneau and the South Central Regional Resource Center in Anchorage. The contributions of Alan Barnes, Luanne Packer, Linnel McCrumb, and Jane Harrington were especially noteworthy.

Other individuals or agencies contracting to DOE or related State agencies made substantial contributions to the success of the Project. Transalaska Data Systems installed and maintained microcomputers at sixty locations in the State. Karen Parr developed instructional materials and provided training for the computer-based education courses developed by the Project. Glenn Cowan and Janelle Cowan contributed additional training and support for these courses. Computer programming support was provided to the Department by Mike Noel and Charles Dockery. The evaluation of the computer-based instruction courses was conducted by Education Skills Development of Lexington, Kentucky, with contributions from Emanuel Mason, Timothy Smith, and Frank Gohs.

Extremely important to the success of the systems and the particular products developed by the Project were the many contributions of administrators, teachers, and other staff of local school districts in Alaska. These individuals served to keep the Project on track in design and development through participation on numerous design and advisory teams that existed during all phases of the Project. Additional individuals too numerous to include assisted with pilot testing and implementation of the Project components. By the conclusion of the Project every one of the 52 school districts in Alaska had participated. Noteworthy too was the involvement of several hundred students in Alaska schools who participated in pilot tests of instructional materials. Students in public schools, of course, are the ultimare beneficiaries of the Project. It is fitting, therefore, that the participation of these students should result in educational gains for all the children of Alaska for years to come.

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PREFACE

The Educational Telecommunications for Alaska Project addresses the needs of three distinct user groups: superintendents/administrators, school staffs, and students. As such, there are three tracks that at times coincide but, in the main, follow their own evolutionary course. Thus, each of the components, Administrative Communications Network, Alaska Knowledge Base System, and Individualized Study by Telecommunications, has been developed as a stand-alone volume for those who are particularly interested in one but perhaps not the other components. The Executive Summary ties the entire Project together by providing an overview of all components.

Included in each volume is a historical perspective detailing Alaska's prior experience with satellite technology and the Alaskan educational and geographic contexts -- all of which shaped the Project as it was proposed to the National Institute of Education in 1977. Without this perspective, a great deal of understanding of the driving forces involved would be lost. Thus, the reader will find that several introductory sections are repeated in each volume.

HISTORY OF ALASKAN INVOLVEMENT WITH SATELLITE COMMUNICATIONS

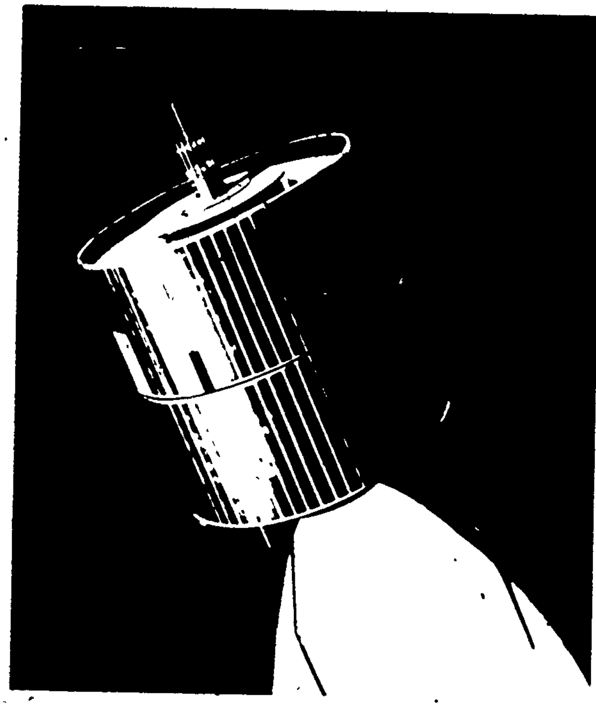
The Educational Telecommunications for Alaska (ETA) Project is the result of years of planning and experimentation with communication satellites by the State of Alaska. The first cautious probings were conducted with the National Aeronautics and Space Administration's (NASA) Advanced Technology Satellites, ATS-1 and -6, beginning in 1970 and continuing through 1975. The experiments included both voice and full-motion video for education, in support of health care, and for reaching out to all people with a need for information that affected their lives. Experimentation with the new technology was driven by the necessity to provide a large variety of services to all Alaskans, whether they lived in cities or in the most isolated areas. These tentative explorations demonstrated to the State that communication satellites were an essential element in meeting future needs for education and other public services.

The process began in 1968 with the establishment of a Satellite Task Force whose objective was to determine the total requirements for all communications services existing and projected.

In late 1969, a formal proposal was submitted to NASA for two-way audio experimentation on the ATS-1 satellite. The first demonstrations began in 1970, transmitting public radio programming between KUAC in Fairbanks and stations in the lower 48 states.

A joint United Nations Educational, Scientific and Cultural Organization (UNESCO)-Alaska National Education Association (NEA) team in 1970 investigated the feasibility of using satellites to alleviate educational problems of the State. The team concluded, in part, "Satellite communications for Alaska, as part of an overall long-range educational communications system, are not only feasible, but necessary for improved communications in the State."

In mid-1971 an Alaska Educational Telecommunications Consortium (AETC) was created to guide ATS-1 projects (two-way voice) and to identify technical solutions to help solve rural educational problems. Over the succeeding two years, more than 25 villages with no existing telephone or television service were involved in the interactive project. Programming was varied, ranging from health-aide training to Native legends; teacher, administrator, and classroom exchanges; and direct village contact with library services. As with many innovative approaches, this project was initially plagued with many problems involving technical factors and frequent schedule changes. The weakest link, however, was the lack of direct teacher involvement in designing programs for classroom use. The most successful applications were in villages where someone, usually a teacher, took responsibility for involving the community. The study concluded that experiments should continue with more emphasis on evaluation of impact between participating schools and non-satellite schools.



Educational experimentation became very infrequent but continued through 1975. Emphasis during this period shifted to detailed studies of educational needs. The Teleconsult study, submitted to the Department of Health, Education and Welfare (DHEW) and NASA, included exploration of persistent educational needs, suggestions of specific programming areas, and establishment of priorities to meet those needs. The focus remained on audio and visual materials distributed via a variety of means, including commercial satellites. Priority programming areas included Native culture, bilingual news programs, and on-going teacher in-service training.

In 1972, the Alaska Educational Broadcasting Commission (AEBC) submitted to the U.S. DHEW "A Proposal to Develop a Plan for Alaska's Unique and Innovative Education Demonstration Employing ATS-F." (The letter designator is assigned to NASA experimental satellites prior to launch; in orbit the satellite became ATS-6.) This satellite, the most powerful ever to be launched at that time, could relay video as well as audio to small, inexpensive earth stations. The proposal was subsequently funded.

While attention focused on satellite-supported educational needs experimentation, an Executive Order created the Office of Telecommunications (OT) within the Governor's Office in 1973. OT was created to provide the State with a focal point for communications policy development and to ensure adequate development of cost-effective communications techniques to serve all State residents. In March of that year, OT assumed responsibility for Alaska's ATS-F Demonstration Plan. In August, 1973, Federal supervision of the national educational ATS-F demonstration program, the Education Satellite Communication Demonstration (ESCD), became the responsibility of the National Institute of Education (NIE). Planning objectives for the Alaskan educational portion of the ATS-F demonstration were:

- to gain operational experience with communication satellites;
- to apply the experience gained on ATS-1 and to extend that experience so that the users themselves would generate service requirements. (It was felt that it was better to obtain knowledge through experience before planning was completed rather than after a system was installed.)

From the earliest planning stage, close cooperation between OT and the Alaska Department of Education (DOE) resulted in project focus on two instructional concerns: first, the desire to establish two-way communications between participating educators that approximated face-to-face communications as closely as possible; and, second, the opportunity for "hands-on" experience with live video/audio communication, by a variety of users, to be utilized to make sound planning decisions.

In 1974, with a portion of the funding received from NIE, 15 communities whose average population was less than 250, were equipped with small satellite earth stations. Consumer committees were formed from persons nominated by the participating villages and Native regional corporations. They met regularly and were responsible for input to and approval of all program designs. Programs in health education and language development were designed and produced. Each program included teacher manuals and was followed on-air with an interaction session as well as on-camera teachers to reinforce the lessons. Teacher in-service training, coordinated and developed by DOE, was broadcast weekly.

Other aspects of the $1.7 million project resulted in 100 hours of original television programming being designed, produced, and broadcast. Instructional programs were made available to 1,200 K-5th Grade rural school children and 150 rural educators. Additional programming was accessible to 9,000 Alaskan village residents, young and old, as well as thousands of students in Fairbanks. At the end of one year the Demonstration came to an end. ATS-6 was moved in its orbit out of sight of Alaskan earth stations and toward India for their use. However, the results of the NIE-sponsored evaluation of ESCD had a strong influence on the direction that the ETA Project would eventually take. Key recommendations were:

- Undertake telecommunications demonstrations in rural Alaska only when there are resources and commitment for putting aspects of the demonstrations which users deem successful directly into operation.
- Undertake satellite television operations only when they can be justified on the basis of cost-effective, timely access to programming.
- Use audio interaction without video programming as soon as there is satellite telephone.
- Decide separately commitment to broadcast material and commitment of resources to new programming. The commitment to new programming must be preceded by a survey of available programming.
- Take as the mandate for telecommunications in rural Alaska: solution to the "high school problem." Three alternatives for augmenting the village high school curriculum are: materials distribution of already existing programming; teacher-sharing via audio presentations and supervised interaction; and new programming on Alaska Native history.

The momemtum generated by the ATS-6 experiments convinced Alaska educators and OT to make an in-depth assessment of an operational communications-supported system to meet the identified needs of Alaskan education. The result was a planning grant application submitted to NIE in March, 1975 the goal of which was a cost-effective model for technological application integrated with educational needs. The grant was received from NIE in November, 1975.

It was at this juncture that the Alaska DOE accepted lead responsibility for the planning grant and future activities growing out of it.

Concurrently, commercial satellite technology was emerging as a viable means for meeting Alaska's telecommunications needs. In 1975, the State and RCA Alascom (the Alaska communications carrier) reworked RCA's original plan for facilities and services to serve Alaska through 1980. The State Legislature appropriated $5 million to procure 100 small (15-foot) earth stations for rural communities and, in July of that year, it was agreed that Alascom would install and operate them. In early 1976, RCA launched its second satellite (F-2) which would carry Alaska's long-distance intra- and interstate traffic.

By early 1976, therefore, an excellent base had been established from which to launch an earnest assault on the problems that had continually plagued rural Alaskan educators: the DOE had practical experience with the techniques associated with telecommunications-supported education; OT had hands-on experience with satellite telecommunications hardware and operations; rural Alaskan villages had participated in "learning at a distance" and were supportive of further experimentation; and RCA Alascom was beginning to install rural earth stations subsequent to the launching of F-2.

In 1976, decentralization of rural education through disbanding the Alaska State-Operated School System (ASOSS) gave a sense of urgency to DOE's plans to implement innovative and cost-effective means for educating all Alaskan children. Dissolution of ASOSS resulted in the creation of 21 new rural school districts with elected local school boards and community advisory committees. Supervisory fragmentation, so long a fact of educational life in Alaska, was ending, and DOE became the key administrative and technical assistance office to support the State's 52 separate school districts.

In May, 1976, the sense of urgency was further heightened when the State Board of Education adopted new regulations that stated that school districts must provide an elementary school in each community which had eight or more children available to attend and, unless the local school committee requested otherwise, must establish a secondary school in every community with one or more available secondary students. The implications of this ruling were staggering --the DOE was required to provide a full and meaningful educational experience for students where they lived. To do so by conventional means could not be economically supported, even if there were a sufficient number of qualified teachers. It was imperative that new and innovative mechanisms be explored to provide quality education to rural Alaska.

A DOE-led task force began preparation of a proposal in July, 1976, to be submitted to NIE. It was made possible by an $85,000 grant from the Alaska Legislature. The essential outcome of the proposed effort was to be an operational, user-supported system. The intensive planning effort by the DOE task force was to develop two major documents: (1) a determination of needs; and (2) an analysis of technical alternatives to meet the specifically defined needs. The participants included:

- *DOE* - responsible for management and development of the overall proposal and determination of needs;
- *Design Team* - a working group responsible for providing design parameters, direction, and pertinent information to the design subcontractor;
- *User's Group* - a representative group of Alaskan educators responsible for reacting to the proposal as it was developed and for paying particular attention to consumer-control mechanisms;
- *Proposal Development Contractor (Northwest Regional Educational Laboratory)* - responsible for producing the required drafts of the proposal.

Based on this intensive effort, the proposal that initiated this Project, entitled, "Educational Telecommunications for Alaska," was prepared and submitted to NIE in January, 1977.

THE CONTEXT OF EDUCATIONAL NEEDS

The Educational Telecommunications for Alaska (ETA) model has been shaped by identified needs. The needs themselves were the result of the Alaskan environment and the philosophy of the Alaska Department of Education. An understanding of the background and context in which the Project functions is essential to understanding the value of ETA itself. The following narrative has been adapted from two DOE documents: "Educational Telecommunications for Alaska Project Proposal," January, 1977; and "Operational Plan Educational Telecommunications for Alaska Project," 1979.

DEMOGRAPHIC CONTEXT

Alaska is the largest state yet contains the smallest total population. More than 280 communities are widely scattered over 586,412 square miles (16 percent of the total area of the United States). The population in 1977 was estimated to be 411,211 (less than 0.5 percent of that of the United States).

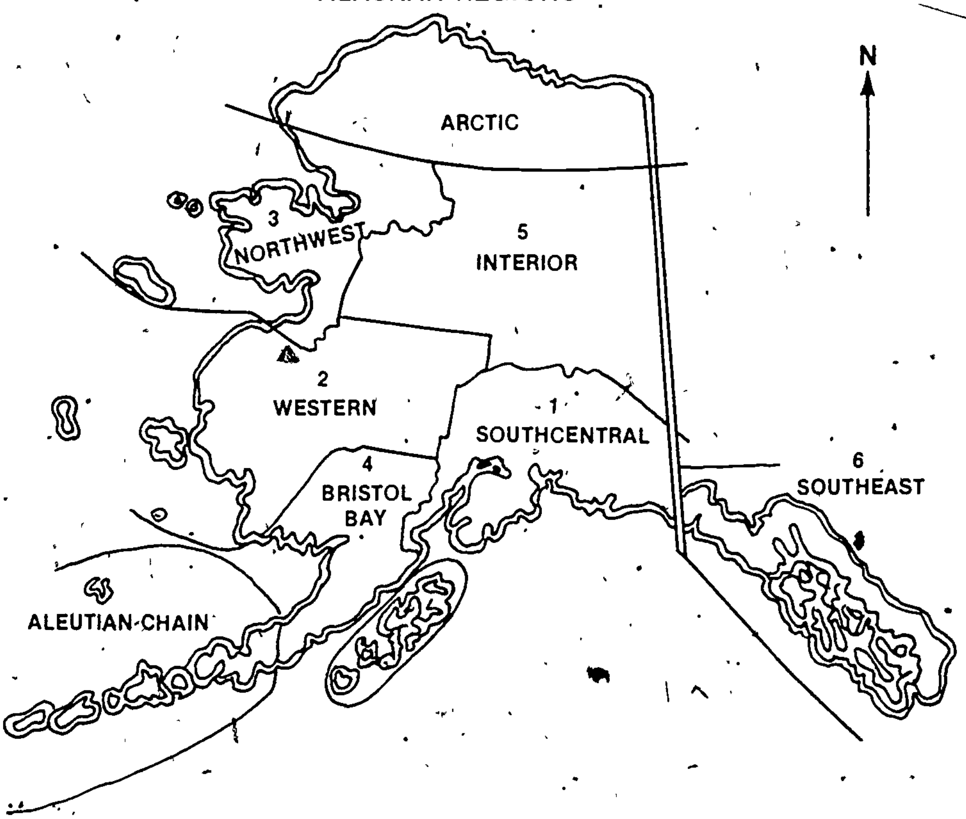
Population density statewide is less than one person per square mile with 60 percent of the inhabitants living in or near three cities (Anchorage, Fairbanks, and Juneau) that are in boroughs that contain 2 percent of the State's total land. An adjusted density ratio indicates that outside these three urban areas, the density approaches one person per four square miles.

The State is regionally divided as shown in Figure 1. The most populated region is Southcentral, which includes the largest community, Anchorage. Forty-four percent of all Alaskans live within the Anchorage Borough. The Interior region ranks second with 21 percent. The population of this region is reduced to only 7 percent of the State's total when the second largest city, Fairbanks, is excluded. The Aleutian Chain and Kodiak together contain 5 percent of the population. One-third of all Southeasterners live in the State's third largest city, Juneau, the capital. The remainder of the State's people live in 150 communities (ranging in number from fewer than 25 to more than 5,000) distributed throughout the Southeast, Western coastal and Interior areas, and Arctic North.

About one-sixth of the inhabitants are Eskimo, Indian or Aleut. The major cultural groups are Inupiat Eskimo in the Arctic and Northwest; Yupik Eskimo in the Western and Bristol Bay region; Aleuts in the Aleutian Chain and Kodiak; Athapascan Indians in the Interior; and Tlingit, Haida, and Tsimshian Indians in the Southeast. Alaska has six major languages other than English, with more than 50 significantly different dialects.

Figure 1

ALASKAN REGIONS



The total population has grown more than 34 percent since the census count in 1970, due mainly to heavy migration related to pipeline and construction-industry activity. Since total school enrollment during the 1975-76 period increased only 18.5 percent over the 1969-70 period, it is concluded that the population growth due to pipeline activity has not impacted on the vast majority of the schools in the State.

GEOGRAPHIC CONTEXT

Forty percent of all Alaskans, and 60 percent of all schools, are located in communities of fewer than 1,000 people. Isolation is often a fact of life, frequently by choice. The major factors contributing to isolation are geography, weather, the distances between communities --factors that create consistent problems in providing educational services and support.

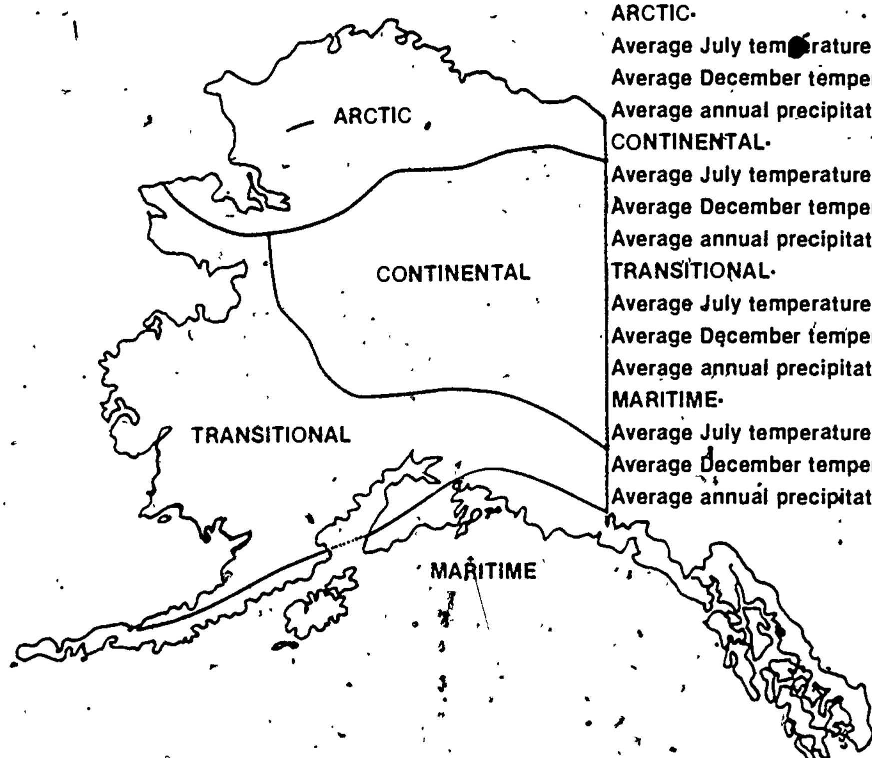
Alaska's terrain can be visually dazzling while posing formidable barriers. The fjords of Southeast and the Alaska Range in Southcentral are continuations of the coastal ranges in the northwest United States. The broad valleys and basins of the Interior are an extension of the desert plains between the Rockies and coastal mountains. The Rockies extend into the Brooks Range in northern Alaska. The Arctic coastal plain north of the Brooks is flat tundra with thousands of shallow lakes.

The State's mountains contain half the world's glaciers, with 19 peaks of more than 14,000 feet. One-third of the State is north of the Arctic Circle. Throughout Alaska there are more than three million lakes larger than 20 acres, and 10 rivers more than 300 miles long.

The climates imposed by this topography create a diversity of environments (Figure 2). Fierce, long winters have nights 24 hours long. The 2,000-mile Aleutian Chain is wet, foggy, cold, and frequently windy, year-round. Temperatures in the Interior region vary drastically from winter to summer (−50 degrees F. to +90 degrees F.). The most temperate region is Southeast, where the warming Japanese Current meets cool mountain air and results in more than 100 inches of precipitation a year in some areas.

Figure 2

CLIMATE ZONES IN ALASKA



ARCTIC
Average July temperature = 39.1°F
Average December temperature = −11.2°F
Average annual precipitation = 7 inches

CONTINENTAL
Average July temperature = 58.2°F
Average December temperature = −7.7°F
Average annual precipitation = 15 inches

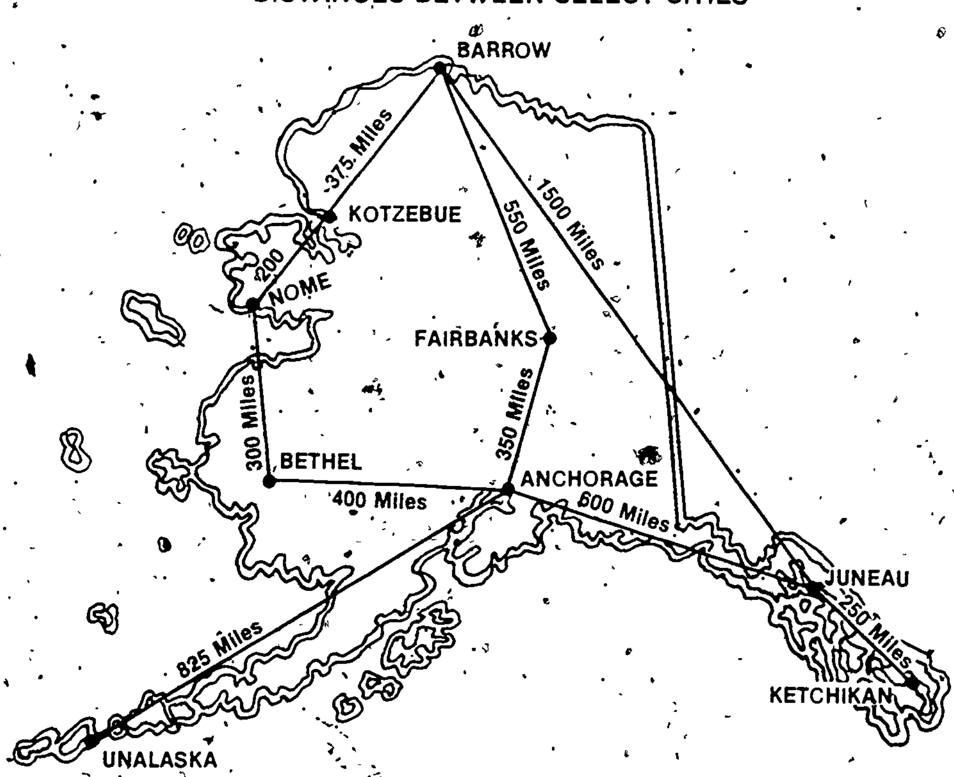
TRANSITIONAL
Average July temperature = 58.2°F
Average December temperature = 13.5°F
Average annual precipitation = 17 inches

MARITIME
Average July temperature = 52.3°F
Average December temperature = 28.4°F
Average annual precipitation = 65 inches

Distances in Alaska are vast (Figure 3). From its west to east coasts, Alaska stretches the distance from California to Florida. The northernmost community, Point Barrow, is 1,500 miles from the southernmost city, Ketchikan; Point Barrow is as far from Fairbanks as Milwaukee is from Kansas City; Bethel is 400 miles west of Anchorage approximately the same distance as San Francisco is from Los Angeles. These great distances contribute substantially to a sense of isolation and remoteness. The extremes of winter weather limit activity and contribute to Alaska's high alcoholism rate and in other ways adversely impact daily life.

Figure 3

DISTANCES BETWEEN SELECT CITIES



The effects of this isolation can be felt by Alaska's rural teachers, many of whom are not indigenous to the State. One teachers' group in a small, rural district negotiates into all contracts a yearly trip to Anchorage for an annual teachers' conference and considers the expense a worthwhile investment in mental heatlh and needed professional contacts not available in the village.

ECONOMIC CONTEXT

The environment and the variables in resources an[illegible]stry make, employment highly seasonal. Many industries -- cons[illegible] fishing, logging -- are not active in the winter, when the weather makes outdoor work and travel difficult, if not impossible. Depending on the time of the year, region, and industry, unemployment rates fluctuate by a factor of three. State and Federal unemployment insurance payments for December through March may be double, even triple, the claims paid in June through August.

Many isolated rural areas with rather depressed incomes still rely to some extent on subsistence hunting and fishing. While health, education, and other services are more readily available in large Native villages, subsistence hunters must compete for fewer available resources. The situation is succinctly described by the following passages from "2 (c) Report, Federal Programs and Alaska Natives."

> "...In recent years it has become apparent that all rural Alaska villages are in an economic trap because of the transition from subsistence to cash. They are unable to return to a complete subsistence life, nor are they able to earn enough cash to buy food, supplies, and services required to live confortably in the larger communities.
>
> "Despite this, subsistence hunting, fishing, and gathering still play a critical part in the lives of rural villagers. Of roughly 150 Native villages of less than 300 people, subsistence activity is estimated to provide at least half of the daily calorie intake.
>
> "Temporary, seasonal employment may be available to provide some income, but also takes men away from the villages at times when subsistence foods can be most easily obtained. The available cash usually goes for materials and equipment that are vital necessities today in subsistence activities: rifles and ammunition, snow machines and outboard engines, and gasoline.
>
> "As subsistence life becomes more expensive and difficult, people must increasingly depend on store-bought groceries and goods. Young people returning to the village from boarding schools who have not learned the subsistence skills must live more and more in the cash economy."

The establishment of schools in some areas of the State has been a major contributor to the growth of larger, stable, primarily Native communities. The highly nomadic Eskimos in the Brooks Range established the permanent village of Anaktuvuk Pass because of the requirement that children attend school nine months of the year. The establishment of more permanent residences has generated the need for services suited to community living. As a result, electrical power became a necessity for village residents. Virtually all schools in the State have electricity, supplied either by local utilities, school or Federally-owned generators, or the Alaskan Village Electric Co-op (AVEC). In some villages, the construction of a one- or two-room school was accompanied by the introduction of the first generator.

TRANSPORTATION CONTEXT

Power, fuel, and other goods and services are very costly because of the limited market and because of transportation costs. Whether by road, water, rail, or air, the cost of travel and freight delivery is high.

In 1970, Alaska had 7,000 miles of road, only 3,000 of which were paved. There has been no significant increase in roads since. It is interesting to compare access in Alaska with several other sparsely populated Western states:

State	Acres of Land Per Mile of Road
Alaska	52,212
Arizona	2,203
Montana	1,295
Wyoming	891

Alaska may well have more communities and schools that are not on any road system than the rest of the States combined. More than 150 rural schools are not on any connecting road system at all. The primary road network links Anchorage, Fairbanks, and Haines with connections to the Kenai Peninsula, Valdez, and many of the smaller communities in-between. But even this land link is lost for many villages in the winter when many arterial roads are not maintained and are therefore impassable.

Alaska's railroad network is even more limited. The 540-mile Alaska Railroad links Whittier, Anchorage, and Fairbanks, running daily in the summer and twice weekly in the winter. In southeast Alaska, a 110-mile narrow-gauge railroad runs from Skagway to Whitehorse in Canada's Yukon Territory.

Goods are delivered to Southeast, Southcentral, and the Interior by a combination of sea, truck, and rail. Commercial freighters and barges travel regularly between the lower 48 states, Anchorage, and some larger coastal communities. State-operated ferries carry passengers and freight among principal communities in Southeast and among communities on Prince Williams Sound, Cook Inlet, and Kodiak Island. Occasional service is provided to villages on the larger rivers by commercial freight boats. Usually an entire winter's supply of goods, ordered six months previously, is delivered in the fall.

Travel by air in Alaska is disproportionately heavy; in many areas there is no other means of transportation. Alaska ranks first in the nation in number of private pilots and planes, and in passengers and cargo tonnage flown annually. Anchorage and Fairbanks are served by several international carriers; five carriers serve most regions of the State on a regularly scheduled basis. There are numerous smaller lines, flying to virtually every village on schedule (weather permitting) or by charter. Freight to "bush" villages (meaning, generally, those inaccessible by road) is commonly delivered by small twin-engine planes in the winter, but the costs are very high.

Air travel, although the most widely used means of transportation, can be very expensive as well as time-consuming. For example, the 1,500-mile trip from Ketchikan to Point Barrow requires four stops, two changes of airlines, and takes nine hours. A comparable 1,500-mile journey between Boston and Miami is non-stop and takes less than three hours.

The difficulties and costs of travel plague Alaskan educators continually. For instance, Atka's representative on the regional school district board was chosen to represent the board at a statewide conference to be held in Juneau in June, 1976. The school board member left on a tug for the 100-mile, six-hour trip to Adak, then chartered an eight-seat, twin-engine aircraft for the 600-mile flight from Adak to Cold Bay. From Cold Bay, she then flew to Anchorage by commercial prop-jet, spent the night in Anchorage, and made connections with a commercial jet flight to Juneau the following morning. The 1,760-mile trip to Juneau took approximately 30 hours and cost $2,600, one-way (1976 dollars)!

COMMUNICATIONS CONTEXT

The geographic barriers, environment, and vast distances that contribute to isolation and the high cost of goods and transportation, have also contributed to Alaska's lack of extensive communications networks, especially in rural areas.

MAIL SERVICE

Virtually every community with a stable, year-round population (and every community with a school) has a post office and mail service. In smaller communities, deliveries may be only weekly or even monthly, almost always by small plane and barge.

Mail service has been the most relied upon means of statewide communication among educators. But weather is a major cause of unreliable bush service; if the river is freezing, or a storm hits, the mail plane cannot land. It has not been uncommon for a rural administrator or teacher to receive a request for information or notice of a meeting requesting a response, with the response due two days before the notice was received and three weeks after the notice was mailed.

TELEPHONE

In 1971, RCA purchased the Department of Defense-operated Alaska Communication System (ACS) consisting of terrestrial links in the Interior and Southcentral regions. A subsidiary corporation, RCA Alascom, was then established as Alaska's commercial long-lines carrier. RCA Alascom also began leasing portions of the U.S. Air Force-operated White Alice Communications System (WACS), using the combination of microwave troposcatter, landline, and marine cable links to provide long-line communication to some areas of the State not otherwise served. In 1973, RCA Alascom provided the first interim satellite links with landlines and microwave circuits through leased channels on the Canadian satellite Anik II, with a transfer to Western Union's Westar II two years later.

COMMERCIAL AND PUBLIC RADIO AND TELEVISION

An estimated 95 percent of all Alaskans can receive at least one radio broadcasting station. Nearly a dozen radio stations are publicly owned, operating under the auspices of the Alaska Public Broadcasting Commission (APBC) with the DOE. In 1978, a private non-profit corporation was established to interconnect all existing public stations in sharing local and national programming, legislative news, and other public affairs programming.

Some type of television service is also available to approximately 95 percent of the State's population. There are seven commercial television broadcast stations serving Anchorage, Fairbanks, Juneau, and Sitka and providing direct or translator reception to approximately 60 other communities. The State has leased a full transponder on RCA's F-II satellite to meet commercial broadcasting needs in Alaska. Satellite transmissions originating in Pennsylvania and California are received in Anchorage and Juneau for real-time broadcasting or for taping and delayed broadcast. Real-time broadcasting needs in other Alaskan cities are met through a terrestrial translator system connected to Anchorage or Juneau. The APBC receiving earth station in Anchorage tapes the interstate satellite transmissions, and re-broadcasts to non-commercial stations in the State. APBC then submits a video cassette of its programming to a State-contracted facility which dubs the cassettes and distributes them through the mail to mini-TV stations throughout Alaska.

The DOE, through its Instructional TV (ITV) Project, has used satellite time not used for affiliate and bush entertainment feeds to provide instructional television to a number of village sites. As a result of modifications of select receive-only earth stations through the Satellite Demonstration Project, sponsored by the Governor's Office of Telecommunications, instructional television has become available to a larger number of communities. This is accomplished by using a 10-watt broadcast transmitter to serve each community equipped with the earth station. A number of communities have cable television offering programs taped in Seattle and circulated throughout the State in distinct separate distribution loops. Programs are delayed from one to five weeks, and the cost of cable services ranges from $18.00 to $50.00 per month.

EDUCATIONAL CONTEXT

ELEMENTARY AND SECONDARY PUBLIC SCHOOLS

In 1978, 241 Alaskan communities had at least one school. Thirty-five percent of all schools were located within the Southcentral region and served 57 percent of all enrolled students. The Interior region contained 18 percent of all schools and students. Southeast had a substantial number of smaller "urban" communities in addition to scattered rural communities. This region contained 15 percent of the schools and 13.5 percent of the State's students. The remaining regions were primarily rural, with small school enrollments. The Western region contained 4.5 percent of total enrollment and 11 percent of the schools, followed by Northwest with 3 percent of the students and 8 percent of the schools. Bristol Bay had 2 percent of total enrollment, 7 percent of the schools.

Sixty-one percent of all elementary schools and 71 percent of all secondary schools have enrollments of fewer than 100. Of these secondary schools, 46 percent have fewer than 50 students and 36 percent have 10 or fewer.

LIBRARIES

There are approximately 300 public, school, university, and special libraries in Alaska. The State Library, within DOE, coordinates statewide services and assists individuals who lack access to a local library.

Mail service is the usual means of materials distribution and inter-Library communication. The State Library provides direct assistance and/or training to librarians and circulates close to 100,000 items by mail each year to community libraries, schools, other institutions, and individuals.

The Alaska Health Sciences Information Center services requests for information by health sciences personnel statewide. The Center operates from the University of Alaska Library in Anchorage and provides Medline computer searches of the National Library of Medicine holdings.

Material searches are facilitated by an extensive inter-library loan network. Telex and, more recently, the EMS, link major facilities in Juneau (EMS), public libraries in Anchorage (EMS) and Fairbanks, the University of Alaska libraries in both cities, and the Pacific Northwest Bibliographic Center at the University of Washington, Seattle. Service requests from outside these centers are sent to Juneau, Anchorage, or Fairbanks.

The Juneau State Library facility also contains the Educational Resources Information Center (ERIC) microfiche data bank (ED series). Fiche copies are distributed by mail. In addition, the State Library's film centers in Anchorage and Juneau are a major source of 16mm films and video tapes for Alaska's schools and public libraries. In 1978, more than 45,000 films and tapes were circulated from the 16,000 titles held. The State Library also operates a special service for blind and physically handicapped people.

HISTORICAL CONTEXT

DECENTRALIZATION.

Isolation between schools and school districts, coupled with the multiple agencies that have historically managed the State's schools, has long precluded the delivery of comprehensive and equitable support to Alaskan schools.

Until June, 1975, there were city and borough school districts governed by locally elected boards; schools outside organized city or borough boundaries were operated by the Alaska State-Operated School System; and a number of village schools were operated by the Bureau of Indian Affairs (BIA). Schools in rural, predominantly Eskimo or Indian communities, were divided between ASOSS and BIA according to no geographic or cultural design.

In June, 1975, the Alaska Legislature decentralized the ASOSS and placed governance of rural schools in the hands of regionally elected boards. Twenty-one new Regional Educational Attendance Areas (REAAs) were formed. Boundaries were drawn taking into consideration socio-economic, linguistic, and cultural similarities and natural geographic barriers. While reflecting the strong commitment of the DOE and the State to placing as much control of education in local hands, decentralization increased demands upon the Department to provide adequate technical assistance. The DOE had to assist 52 rather than 31 school districts. Further, with the creation of the new rural school districts, there was increased likelihood of the transfer of BIA schools outside an REAA to the REAA district, thus continuing the move toward a single system of education.

In May, 1976, the State Board of Education took another step toward localizing control of education. It adopted new regulations that required the governing body of the State's school districts to provide an elementary school in each community which had eight or more children available to attend and, unless the community's school committee requested otherwise, to establish a secondary school in every community which had one or more available secondary students. Dramatic changes occurred almost immediately. In 1974-75, when most villages were sending their adolescents to boarding high schools, there were 28 high school programs (not necessarily through 12th Grade) outside incorporated municipalities. In the two fiscal years ending June 30, 1979, 109 villages received funds for construction of high school facilities; nearly all of them were new buildings.

Greater local control and greatly expanded educational opportunities increased the need for DOE support services and statewide resources to address the unique needs of rural students. The DOE initially responded by drawing together all known resources under a project called Systematic Planning Around Needs (SPAN). SPAN gathered and organized information about a variety of human and information resources such as a statewide talent bank of resource persons, national and in-state validated best practices, bibliographical data and abstracts of agencies which offer services to school age populations. These materials were to be requested and then made available via the U.S. Postal Service.

To further meet the resource needs of all districts, the Legislature created six Regional Resource Centers (RRCs) in 1976. These Centers were designed to provide locally chosen means to fill locally identified gaps in essential support services. In addition, the legislation permitted school districts to work jointly to provide cooperative services which would otherwise not be available because of the high cost of establishing all educational services in a single district.

Thus, telecommunications, and its application to education in Alaska, loomed ever more promising as a tool to create management and information channels that would help DOE provide the range and diversity of services demanded by localized control and also to provide quality education to students in rural areas.

ALASKA DEPARTMENT OF EDUCATION

The Alaska Department of Education (DOE) is charged with the responsibility to:

- exercise general supervision over the public schools of the State except the University of Alaska;
- study the conditions and needs of the public schools of the State and adopt or recommend plans for their improvement; and
- establish, maintain, govern, operate, discontinue, and/or combine area, regional, and special schools.

The executive head of the Department is the State Board of Education, a seven-member body appointed by the Governor and confirmed by the Legislature. One student is selected as an eighth (non-voting) member. The Commissioner is appointed by the Board, subject to approval by the Governor.

The Department's main facilities are in Juneau. Housed there are the executive administration, including the Commissioner, Deputy, and special assistants; Planning and Research Office members who concentrate on research, systems development, and student assessment; and staff members who provide information and distribution assistance for publications prepared for virtually every section of the Department.

Three commissions have been established by State statute, regulation, or Federal law, all with operating programs, staffs, and separate annual budgets. The Alaska Public Broadcast Commission, with staff in Anchorage, regulates public radio and television stations; the Alaska Rural Teachers Training Corps, also supported by staff in Anchorage, administers a post-secondary degree program designed to prepare Native teachers living in rural Alaska who are remote from existing campuses; and the Post-Secondary Commission, with staff in Juneau and Anchorage, reviews all post-secondary institutions, program offerings, and budgets, making funding and legislative recommendations. This Commission also administers the student scholarship financial aid program.

In addition to these Commissions, the Alaska Department of Education functions through five major divisions. Each of these contains a number of sub-groupings and programs: (1) Management, Law and Finance Division; (2) The Division of Education Program Support; (3) the Division of Vocational Rehabilitation; (4) The State Library, its branch units and State Museum; and (5) the recently created (July 1, 1981) Division of Educational Design and Implementation.

EDUCATIONAL NEEDS ASSESSMENT

The components and content of the ETA Project were selected and designed to be responsive to a number of the educational needs as identified by the "Department of Education Planning and Evaluation Survey" (Spring, 1976). The basic implementation approach was consistent with the findings of the "Telecommunications Alternatives Survey" also conducted in 1976 and subsequent to the Planning and Evaluation Survey.

DEPARTMENT OF EDUCATION PLANNING AND EVALUATION SURVEY

This Survey consisted of 69 Linkert items and two open-ended queries on a questionnaire distributed to more than 2,000 Alaskan educators. Respondents were asked to rate the importance of specific areas within four categories of concern: What services should the DOE provide? How should the DOE provide services? What problems have you had in working with the DOE? What areas should DOE support? A total of 36 percent of the mailed questionnaires were returned; the majority, about 77 percent, were from teachers and the remainder from principals and principal-teachers and specialists. Although the respondents were dominantly teachers, the conclusions were generally supported by educators in other categories surveyed. The study concluded that the DOE should:

- provide leadership in establishing and maintaining statewide goals, needs, and priorities;
- identify and disseminate educational information, media resources, and Promising Practices;
- examine and improve certification procedures;
- provide in-service training, especially through regional sessions;
- investigate alternate means of funding schools;
- improve communications (with local schools, both formal and informal);
- maintain support and emphasis on the basic skills areas, especially reading;
- develop new programs and curricula and disseminate information about them (especially programs in careers, thinking skills, and special education for the gifted).

SURVEY VALIDITY

The percentage of total returns in each geographical area closely approximated the percentage of the total population of educators in those areas, except for the relatively small response from the Interior:

Area	Percent
Southcentral	61.0
Western	8.0
Northwest	4.4
Bristol Bay	3.4
Interior	3.0
Southeast	19.0
Aleutian Chain	1.0

The percentage of total returns from each of the four districts approximated the percentage of the total population of educators in those districts:

District	Percent
Anchorage	30.6
1,000-9,000 persons	39.0
400-999 persons	11.3
1-399	19.1

The percentage of total returns from each of the four occupational groups closely approximated the percentage of the total population of educators in these groups:

Occupational Group	Percent
Superintendents	4.7
Principal or Principal-Teachers	14.3
Teachers	77.7
Others	3.4

School superintendents requested that DOE:

- provide program consultation;
- provide management assistance;
- develop a student assessment program;
- provide an assessment of educational statutes;
- sponsor statewide conferences.

Principal or principal-teachers expressed a need for the DOE to:

- conduct in-service training;

- coordinate services through Regional Resource Centers;
- provide knowledge of whom to contact for services;
- develop special programs for educators.

Teachers expressed a need for the DOE to:

- design and conduct in-service training;
- regionalize its services;
- coordinate services through Regional Resource Centers;
- provide program administration guidelines;
- provide a listing of whom to contact for specific purposes in DOE;
- develop special education programs.

Persons classified as "others" (specialists, etc.) encountered problems with:

- calendar deadline conflicts;
- inconsistent responses from DOE staff;
- reaching appropriate DOE personnel;
- lack of knowledge of legislative amendments and new laws.

A copy of the Survey instrument and a detailed analysis of results are included in Appendix A.9, to the report entitled, "Results of Department of Education Planning Survey" in the "Operational Plan: Educational Telecommunications for Alaska Project," Alaska Department of Education, December 1, 1978.

THE TELECOMMUNICATIONS ALTERNATIVES SURVEY

Two basic strategies of data collection were employed:

- A tabloid, "Telecommunications and the Future of Alaskan Education," an associated response sheet, and a video tape were mailed to 6,000 Alaskan educators. The tabloid and video tape explained the telecommunications alternatives available presented some possible telecommunications solutions to educational problems and asked the educators to rate and comment upon the importance of telecommunications in providing solutions to educational problems they encountered.
- Presentations were made before local boards of education and at a number of meetings of Alaskan educators. The tabloid and response sheet were distributed for later comment while remarks made at the meetings were recorded for immediate analysis.

Because the information content of the distribution material was high, requiring heavy concentration and appreciable time, and since the subject matter was new to many, few responses were anticipated. (The main intent of the mailing was informational.) Seventy-five responses were received, however, and the data culled from these are summarized in Table 1. The percentage of responses is noted in each of the five categories (from high to low priority). The items receiving the highest ratings were those concerning individually initiated instructional resources (as opposed to required), staff development, informal information exchange, increasing input and information on State guidelines, and forms and computerization of reporting methods. These findings were very much in accord with the results of the "DOE Planning and Evaluation Survey."

TABLE 1

COMMUNICATIONS APPLICATIONS (MAIL RESPONSE)
MEAN RESPONSE (%)

	HIGH PRIORITY 5	4	3	2	LOW PRIORITY 1	MEAN
INSTRUCTIONAL RESOURCES						
For Getting Resource Material	37	19	17	17	10	(3.58)
To Expand Courses and Curriculum	39	28	14	7	12	(3.73)
For Getting Research Findings	25	19	32	13	11	(3.31)
STAFF DEVELOPMENT						
For Earning Recertification Credits	24	16	27	10	23	(3.09)
For Keeping Recertification Records	17	6	27	15	35	(2.54)
For Providing Training Opportunities	43	28	13	4	12	(3.86)
INFORMATION EXCHANGE						
To Informally Exchange Information and Ideas	21	32	37	0	10	(3.52)
To Improve School Board Communication	17	22	33	17	11	(3.16)
To Distribute Department Information In Media	12.5	12.5	50	25	0	(3.13)
To Increase Public Input to Department	16	42	26	11	5	(3.52)
MANAGEMENT						
To Arrange Meetings on Short Notice	15	16	25	16	26	(2.78)
To Increase Input and Information on State Guidelines and Forms	18	29	27	10	16	(3.22)
To Offer Computerized Reporting Methods	27	16	37	8	12	(3.39)

SELECTION OF TELECOMMUNICATIONS ALTERNATIVES FOR THE ETA PROJECT TO MATCH IDENTIFIED EDUCATIONAL NEEDS

Both the DOE Planning and Evaluation Survey and the Telecommunications Alternatives Survey provided considerable input and substantiation of the direction being taken by the ETA proposal design team. Five important needs that could be significantly supported by telecommunication and computer technologies were the foundation of the proposed Project:

- NEED #1: To establish an administrative and instructional communications network characterized by interactive capacity, minimal on-site support personnel, and cost-effectiveness.
- NEED #2: To establish a method for rapidly accessing repositories of a wide variety of instructional materials and related information.
- NEED #3: To provide individual student diagnostic services, especially in the areas of reading and computational skills, and to do so on an as-needed basis.
- NEED #4: To provide direct instructional support in those situations where limited staff required the teacher to serve in the role of facilitator rather than teacher, per se.
- NEED #5: To provide teacher in-service training and teacher support in a manner that does not always require physical relocation of the staff.

To meet these needs, the entire range of transmission alternatives from one-way audio to two-way video was considered. The telecommunications formats evaluated were:

- Audio-simplex (one-way) - (1)
- Audio-duplex (two-way) - (2)
- Radio - (3)
- Computer information and data - (4)
- Television - (6)
- Television and two-way audio - (7)
- Television and teleconferencing (interactive) - (12)

The numbers in parentheses indicate the comparative satellite earth station and satellite transponder costs. When these seven telecommunications formats were compared with the five educational needs, the two-dimensional matrix of Table 2 resulted.

The selected formats are indicated by an "X". The selections were based on the following two criteria:

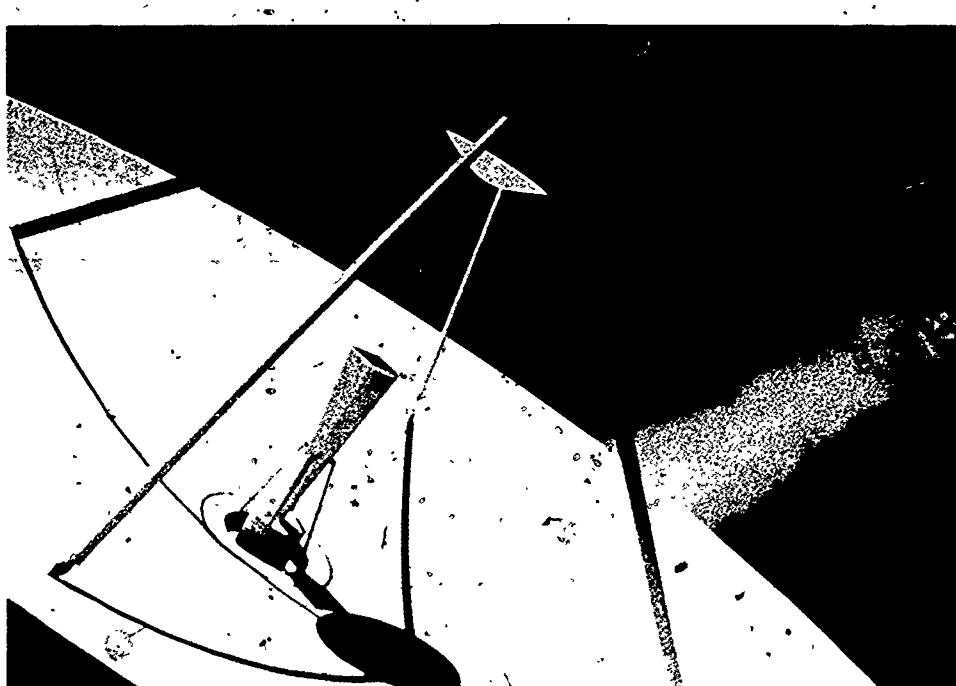
- The telecommunications medium selected to meet each need must provide a technically appropriate solution to the need and be acceptable to the ultimate users of the system; and
- Where alternative media could be brought to bear on the solution of a particular need, the most effective alternative affordable would be chosen.

TABLE 2

TELECOMMUNICATIONS FORMAT

Educational Need	Audio Simplex	Audio Duplex	Radio	Computer Information and Data	Television	Television and Two Way Audio	Television and Teleconferencing
1 Administrative Communications		X		X			
2. Resource Identification and Transmission		X		X			
3. Student Diagnosis		X		X			
4 Classroom Instructional Support		X	X	X			
5 Staff Training and Support		X	X	X			

The selected transmission formats were all narrowband (requiring small amounts of frequency spectrum). Each was widely used and took maximum advantage of what was already in place. None of the last three telecommunications formats was selected. The reason was economic -- it was too expensive to upgrade the earth stations, pay the yearly cost of a transponder, and purchase, install, and maintain the necessary television-associated equipment for full-motion video.



INDIVIDUALIZED STUDY BY TELECOMMUNICATIONS

FEDERAL AND STATE COMMITMENT

The Educational Telecommunications for Alaska (ETA) Project was designed to address several of Alaska's critical educational needs through the judicious application of telecommunication and computer technologies. The educational needs were determined by the Alaska Department of Education in its comprehensive survey conducted in 1976.

Recognizing that to develop, test, and begin to institutionalize a technologically supported educational system was a long-term effort, both NIE and the Alaska DOE agreed on a four-and-one-half year Project. To ensure continuity, Letters of Agreement were exchanged between the two organizations committing resources over that period of time. The funding was to be heavily Federally supported at the onset with the burden shifting to Alaska during the later years. By the end of the Project, two-thirds was to be supported by DOE. Beginning in January, 1982, total responsibility would be borne by the State.

In July, 1977, DOE formally submitted a letter to the NIE Contracting Officer stating that the Commissioner was committed to seeking funds to support the ETA Project according to the following schedule. Federal and State support by Project Year is shown.

Project Year	Federal Support	State Support
9/77 - 12/78	$ 1,600,000	$ 225,000
1/79 - 12/79	900,000	583,000
1/80 - 12/80	600,000	958,000
1/81 - 12/81	300,000	945,000
1/82 - 6/82	- 0 -	345,000

Federal support officially terminated on December 31, 1981. The $345,000 shown commencing in January, 1982 is estimated to be the yearly State-supported maintenance level cost. Other costs will be covered by the user communities.

INDIVIDUALIZED STUDY BY TELECOMMUNICATIONS PURPOSE

ETA PROJECT GOAL AND OBJECTIVE

The educational needs are a direct outgrowth of problems associated with distance, isolation, climate, and sparse population. Modern telecommunications, primarily satellite communications, recognizes no geographic or weather barriers. It is relatively inexpensive and experience has shown that interaction via telecommunications can well substitute for many business and social exchanges, even many where it is deemed desirable to have face-to-face meetings.

The recommendations of the DOE "Planning and Evaluation Survey" and the OT's "Telecommunications Alternatives Survey" were analyzed and resulted in three fundamental needs that could be addressed by the technology:

- to establish an administrative and instructional support communications network characterized by interactive capacity, minimal on-site support personnel, and cost effectiveness;
- to establish a method for rapidly accessing repositories of a wide variety of instructional materials, resources, and related information;
- to provide direct instructional and teacher support to rural secondary schools in those situations where limited staff requires the teacher to serve in the role of facilitator of learning rather than to provide direct instruction in the conventional sense.

Based on these needs, the Project established as its overall Goal, "An educational telecommunications network installed and operating statewide which is responsive to Alaskan needs and provides equality of access to quality educational programs and support services."

The Project's immediate Objective, to be achieved in the four-and-one-half years of Federal and State joint sponsorship, was: "A model educational telecommunications network developed and implemented containing user accepted, proven, affordable, and effective components." The three components comprising the Project which directly support this Objective are:

- Administrative Communications Network;
- Resource Identification and Retrieval System (later renamed the "Alaska Knowledge Base System"); and
- Individualized Study by Telecommunications.

This report documents the implementation, evolution, and institutionalization process for the Individualized Study by Telecommunications.

IST EXPECTED RESULT

Policy statements by the Alaska State Board of Education required that clearly stated goals, with regularly reported progress toward specific objectives, be incorporated at all educational levels. The increased emphasis placed on educational management by objectives created a greater demand on the time and resources of the classroom teacher and school staff in the areas of student diagnosis and record keeping. This increased demand was accentuated in small rural-school settings because of their limited staffs. Further, the emphasis of pre-service training for secondary teachers is focused on group instruction which often leaves the rural teacher unprepared for individualized instruction. Assistance in student diagnosis and individualized instruction then becomes critical. Poor communications, long distances, restricted means of travel, and a lack of readily available resources hinder teacher attempts to acquire that assistance. Thus, ETA's emphasis on telecommunications and educational technology was ideally suited to support school personnel in the areas of student diagnosis and instruction.

Prior to 1976, high school students were sent to boarding schools both within and outside Alaska because it was not possible to provide adequate housing for the number of teachers required to provide a full curriculum, nor was it cost-effective to do so. It was further maintained that the centralization achieved by moving students to boarding schools would result in greater efficiencies and economies of operation. With the sparseness of population, distances involved, and difficulties of communications and transportation, this model proved to be inappropriate for Alaska. The negative social and personal consequences of the separation of secondary students from their families and communities were tremendous. Based on years of experience and the desire of Alaskans for equality and local control of education, legislation was passed which decentralized the State-operated system of rural schools. Though implementation of rural secondary programs varied throughout the State, the problems of providing a comprehensive secondary program with limited staff and facilities in rural and isolated communities were similar. Therefore, the need for a cost-affordable means to provide quality education, regardless of student location, became a priority of the ETA Project.

COURTESY OF ALASCOM

Like the other two components of the Project (the Administrative Communications Network and the Alaska Knowledge Base System), IST was designed to be a microcosm of an eventual statewide system. The purpose was to test and evaluate the elements of the model so that expansion throughout the State could proceed, based on a testbed of proven performance. The following Expected Result was established for the IST:

"Equal educational opportunity will be achieved in the pilot villages for 9th and 10th grade students through a comprehensive telecommunications-mediated instructional program."

Associated with this Expected Result were a series of Verifiable Indicators to be used as measures of the model's success. These Indicators were graduated by year in ascending order of accomplishment. Thus, they formed the basis for periodic formative evaluations designed to identify for management the problem areas to be rectified and strengths to be emphasized for the succeeding phase. Successful accomplishment of all Indicators marked achievement of the Expected Result and the end of the NIE-State supported experiment. At that time, the State/user-supported operational system would begin. Verifiable Indicators specified were, by year of expected accomplishment:

- <u>BY 1980</u>
  - audio materials in two subject areas available to schools;
  - Computer-Assisted/Computer Managed (CAI/CMI) materials in two subject areas available to schools;
  - computerized and prescriptive testing in two subject areas available to schools;
  - a telecommunications-based in-service workshop for managing IST instruction available to Alaskan teachers.
- <u>BY 1981</u>
  - audio materials in seven subject areas available to schools;
  - CAI/CMI materials in seven subject areas available to schools;
  - audio and/or CAI materials used in at least 15 schools;
  - computerized diagnostic and prescriptive testing in seven subject areas available to schools;
  - 80 percent of teachers completing the IST workshop adequately trained to manage IST in the classroom;
  - 75 percent of teachers completing the IST workshop satisfied with the training they received during the workshop.
- <u>BY 1982</u>
  - audio materials in 12 subject areas available to schools;
  - CAI/CMI materials in 12 subject areas available to schools;
  - audio and/or CAI materials used in at least 22 schools;
  - at least 75 percent of the teachers using audio and/or CAI materials express satisfaction with them;
  - computerized diagnostic and prescriptive testing in 12 subject areas available to schools;

- student achievement for rural Alaskan students under IST instruction comparable to that expected from rural students under the conventional urban model of instruction;
- local administrators devoting local resources to ensure the continuance of IST instruction in at least 25 rural high schools;
- the IST courses completely operated by State, regional, and local agencies; and
- teacher IST workshops carrying college credit carried out on a self-supporting basis by colleges and/or Regional Resource Centers.

It is important to note here that the extensive testing of the IST from the time of its introduction resulted in a vastly different implementation from that originally envisioned. Therefore, the VIs were, in practice, met or exceeded, although with major change in format. Specifically:

- Full-year core curricula courses were developed for 9th and 10th Graders rather than radio-delivered audio and/or CAI stand-alone components of courses. CAI and audio became integral parts of each course.
- Diagnostic and prescriptive testing was integrated into core courses where appropriate. Separate testing was determined to be of little or no value over the pencil-and-paper test being given.
- Training was conducted on-site in the main, and video tapes were employed for the introduction on use and maintenance of the computer.
- Eight full-year courses were developed instead of select audio/CAI modules for 12 courses.

It was recognized from the outset, however, that there were factors beyond the control of the Project that could adversely impact achievable performance. Therefore, selected "Assumptions" were tracked along with accomplishments in order to evaluate performance. This is an essential element in the judgment of the introduction of any innovation. The "Assumptions" associated with the IST were:

- critical personnel can be recruited and retained in Juneau;
- local and long-distance intrastate line quality is sufficient for the development of required telecommunications links;
- RCA Alascom tariff rate structure does not exceed budget limitations;
- equipment is rugged enough to operate reliably in the Alaskan environment;
- the telecommunications program at the National Institute of Education or alternate Federal agency is viable for the term of the Project;

- Federal funding is available at the designated level and on schedule;
- the comprehensive secondary school program envisioned for the Project is perceived by others as contributing to equal educational opportunity;
- teachers accept an instructional support system which calls for a changed role and reduces the necessity for outside travel;
- existing school physical plants and power systems are adequate for the technological delivery system;
- the use of the technology as it is implemented is acceptable to local administrators and staff, parents, and others.
- users reach consensus on the definition of a comprehensive program; and
- the Project can develop cost feasible instructional systems and materials.

To assist management in tracking and providing direction for this component of the ETA, detailed performance networks were developed similar to PERT charting. A simplified (key events) performance network suitable for use by the NIE Program Manager is shown in Figure IV-1 (fold-out at back of Volume). This network, as well as the one for the Administrative Communications Network component, was designed to display key events leading toward educational objective achievement. Thus, the performance network and the Expected Result and its Verifiable Indicators provided the basis for integrated Project management, i.e., evaluation and manpower and financial resources were developed to meet the educational objective as enunciated by the Expected Result and its performance network.

EVOLUTION OF THE IST

INITIAL CONCEPTS

The introduction of the IST into the educational life of Alaska represented a large gamble on the part of the DOE - a gamble which, if it paid off, would make equality of educational access a reality at an affordable price. However, the concept was such a departure from the normal way of doing business that the risk of failure was high. Therefore, introduction of this innovation and its proper nurturing throughout the four-and-one-half year period of its evolution is worthy of detailed study. This report, then, is a record of the introduction of an educational innovation. It is presented for others to learn from and adapt what has been learned to their own situations and circumstances.

PROJECT DESIGN PRINCIPLES

From the outset, the philosophy, not only for the IST but also for the entire ETA Poject, was to accommodate to both the educational and political realities of the Alaskan environment. Therefore, certain guiding principles were established. When viewed objectively, it will be noted that they are independent of any particular project and provide excellent guidance for projects concerned with the introduction of an innovation. These guiding principles were succinctly expressed by Dr. William Bramble in his paper, "The Educational Telecommunications for Alaska Project," published in January, 1980:

> "The probability of success with innovation requiring behavioral changes is inversely proportional to the amount of change required. A strategy involving relatively small incremental steps is optimal;
>
> "In implementing a change in behavior of a given magnitude, a reward of relatively equal magnitude must be provided or innovative behavior will not be sustained after the novelty wears off;
>
> "Successful changes in 'process' or techniques in education are more probable than in 'content'. Attempts to change both simultaneously significantly diminishes the overall probability of success;
>
> "Any technologically based system must be as failsafe and user-oriented as possible. Also, the technological sub-systems should not be so interdependent that the failure of one sub-system causes the whole system to fail. Technical training requirements for the use of the technology should be held to an absolute minimum;

"The probability of continued use of educational technology is directly related to the degree of compatibility and support of the environment in which the technology is to be used. In the design of systems and training procedures, the environmental factors need to be taken into account."

INITIAL ORGANIZATION

First steps toward development of the Project were taken in 1976 when school personnel at all levels responded to the detailed questionnaire issued by the Alaska Department of Education. In addition, a number of face-to-face presentations were given to administrative and other school personnel to elicit their advice on specific needs. Thus, from the very beginning, concerned field personnel were involved in the conceptual process -- an essential step toward gaining acceptance of the innovation.

The Project management structure was established for purposes of implementing the three components of the ETA Project: Administrative Communications Network, Alaska Knowledge Base System, and Individualized Study by Telecommunications. Policy, utilization, and implementation decisions were vested in the established operating user agencies: State Board of Education, State Department of Education, and the 52 school districts. Technical support for design, production, and installation were the responsibility of two types of agencies:

- a Design and Implementation (D & I) Contractor under supervision of the DOE; and

• Regional Resource Centers (governed by participating districts).

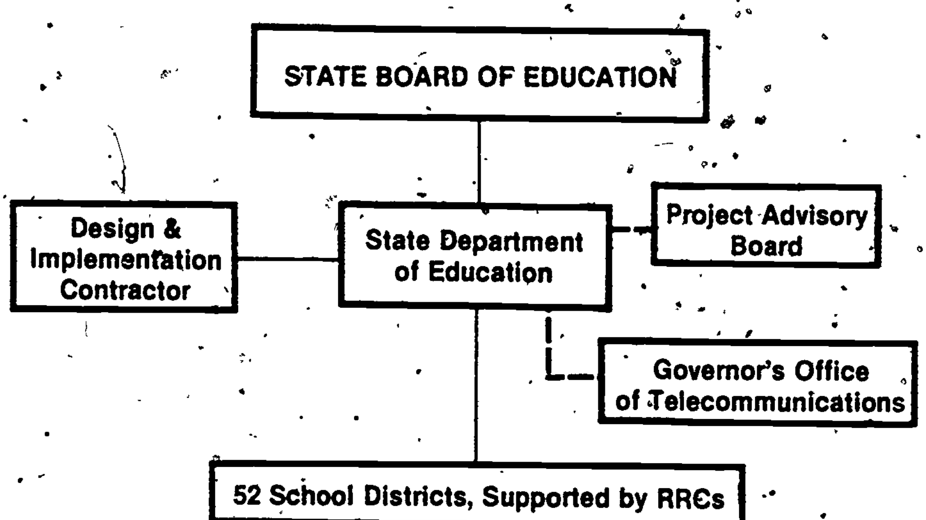
(As the Project matured, more and more organizations with specialized expertise were brought in, considerably diminishing the roles of both the D & I Contractor and the Regional Resource Centers.)

It is important to differentiate between the policy, utilization, and implementation decision-making factors and the technical aspects in order to maintain the concept of "user-driven" development and utilization, thus forcing responsiveness of the technology to priority user needs.

The overall structure is shown in Figure IV-2.

Figure IV - 2

OVERALL STRUCTURE



• *State Board of Education* - ensured that Project policies and procedures were consistent with statewide policy and priorities and approved annual and long-range scope of work plans.

• *State Department of Education* - responsible for overall Project planning, monitoring, and system evaluation. Based upon advice from a Project Advisory Board, the Governor's Office of Telecommunications, and the school districts, the DOE set priorities for: types of utilization and implementation modes, development of annual and long-range scope of work plans for State Board approval, and evaluation. Design of the evaluation was through interaction with the D & I Contractor and district personnel. Data acquisition was the responsibility of the D & I

Contractor and analysis, a joint responsibility with the DOE. In addition, DOE was responsible for maintaining statewide interagency coordination, communications and support mechanisms, and legislative liaison.

- *Local School Districts* - responsible for the following activities: provide to DOE input regarding types and modes of utilization, provide system protocols for determining levels of utilization, determine levels of supplementary local support to maintain the system, determine the role of the RRCs in system utilization, and provide formative and summative evaluation data to the D & I Contractor.

  The local school districts involved in the IST were responsible for providing decisions regarding content priorities and secondary education programming efforts, for utilizing the Student Diagnostic module, and making staff available to support testing in the field.

- *Design and Implementation Contractor* (Northwest Regional Educational Laboratory) - responsible for design, development, and testing ETA components and products as well as conducting evaluations in the field.

The ETA Project was comprised of three components with differing requirements for expertise to properly supervise and control their development. Thus, it was decided at the outset to staff the Project Office with a small complement of personnel with key specialties. The special knowledge was to include management expertise, project design and evaluation, and the Alaskan school system. It was also deemed important that key project management be known and respected by the school district administrators and teachers.

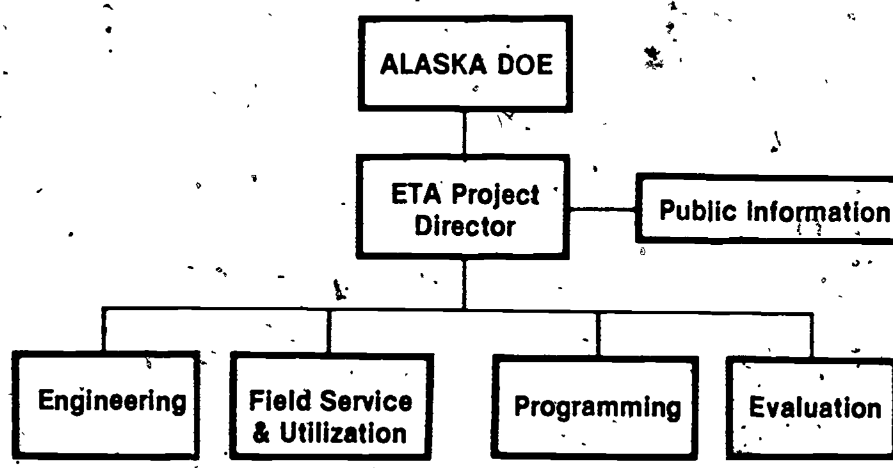
Because of this small specialized staff, the Project was organized along functional lines. This management structure was selected because functional goals could be clearly defined, the DOE is organized along functional lines, and the D & I Contractor tasks could be well defined and subject to standard Management by Objectives techniques. The structure is shown in Figure IV-3. The D & I Contractor responsibilities are listed along the bottom row.

The Contractor was to be equipped with system components similar to those at user sites and was to remain in constant contact with all participating sites. Thus, problems would be detected immediately.

Part of the management-decision process involved forming advisory boards made up of professional staff, school board members, community members, and students. Programs produced would be developed using script review so that user input to program production would begin with conceptualization of need and continue through the technical aspects of program development. All courseware produced would be subject to quality standards set by professionals and ratified by users. A detailed procedure was to be set up for testing in the field and for evaluating effectiveness.

Figure IV - 3

FUNCTIONAL ORGANIZATIONAL STRUCTURE



EVALUATION DESIGN

Although the formal evaluation documents were issued in September, 1978, portions had been used as the guiding instruments from the beginning of the Project, approximately a year earlier. Two documents formed the basis for all evaluation designs, data collection, and analysis throughout the four-and-one-half-year life of the Project for all three components. These documents, the "Evaluation Design for the Educational Telecommunications for Alaska Project" and "Summative Evaluation Design for the Educational Telecommunications Alaskan Project" were both prepared by the Alaska Department of Education and the Northwest Regional Educational Laboratory. The portions applying to the IST are summarized here.

FORMATIVE EVALUATION DESIGN

The "Evaluation Design for the Educational Telecommunications for Alaska Project" set forth the guidelines for continuing formative evaluation; i.e., its purpose was to provide adequate and appropriate information in a timely manner in order to assist management in informed decision making. The three primary elements of the conceptual evaluation plan were:

- documentation of program activities, events, incidents, and progress to serve as a data base for evaluation activities;
- identification/prioritization of program issues and needs requiring intensive analysis;
- studies of high priority items deemed important by Project management.

An operational evaluation design was constructed each year, based on the global conceptual design presented here. The operational evaluation design was subject to ongoing review by Project management to ensure that it was continuing to provide useful information. If it did not meet management's needs, it was modified and a revised plan constructed.

Six areas were used as the model for the yearly operational evaluation designs:

- *CONSIDERATIONS IN THE DEVELOPMENT OF THE EVALUATION*
  - Policies and Constraints
  - Expected Results
  - Activities and Verifiable Indicators
  - Suggested Areas to be Assessed
    - User Acceptance
    - User Needs
    - Timeliness
    - Cost
    - Technical Systems
    - Training
    - Performance of Involved Agencies
  - Groups to be Served by the Evaluation
  - Criteria for Decision-making
- *COLLECTION OF INFORMATION*
  - Sources of Information
    - Written Synopses
    - Records
    - Questionnaires
    - Interviews
    - Financial Records
    - Observations
    - Performance Indicators
    - Studies on Specific Activities

- Design of Instruments and Methods for Data Collection
- Sampling Procedures for Collection of Information
- Conditions and Schedule for Information Collection

- *ORGANIZATION OF INFORMATION*
- *ANALYSIS OF INFORMATION*
- *REPORTING OF INFORMATION*
  - Audience to Receive Information
  - Means of Providing Information
  - Format for Information Dispersal
    - -- Weekly Newsletters via the EMS
    - -- Quarterly Newsletters or Brochures
    - -- Documentation Reports
    - -- Executive Summary/Final Report
  - Schedule for Reporting
- *ADMINISTRATION OF THE EVALUATION*
  - Evaluation Schedule
  - Staff Requirements and Roles
  - Budget Requirements
  - Scope of Work

SUMMATIVE EVALUATION DESIGN

The summative evaluation design, as presented in "Summative Evaluation Design for the Educational Telecommunications Alaskan Project," followed the same outline as that of the formative evaluation. However, its purpose was to determine the overall effectiveness of the Project and its component parts.

INITIAL IMPLEMENTATION CONCEPT

From the outset, the concept was to design the IST model with as many of the elements of the eventual statewide system as possible. The purpose was to test the model and to expand it as new knowledge was gained through periodic formative evaluations, retaining those that passed the test of user acceptability, expansion potential, and cost effectivity. Initially the IST had two primary goals: (1) to design and test a computerized diagnostic system for Grades 1-8; and (2) to design and test a 9th and 10th Grade rural secondary education curriculum and delivery system.

INTENSIVE PILOT REGION

In the original proposal to the National Institute of Education (1977) the Bristol Bay Region was selected as the statewide microcosm. It was selected on the basis of having met seven criteria that were significant in the makeup of the State itself:

- First, there was strong evidence of interest and support from the superintendents and boards whose four districts form Region 4.

They represented a diversity in background and opinion and had the respect of their peers in other districts. The latter is important to any statewide diffusion effort.

- Second, the four districts represented the total universe in terms of variety of forms of local government. The Bristol Bay Borough School District was based on a borough form of government controlled by a borough assembly elected areawide. The Dillingham City School District had a city-council form of government. The Southwest Region School District and the Lake and Peninsula School District were two of the newly created (July 1, 1976) school districts which had their origins in the dissolution of the State-Operated School System. There was no local contribution to funding as was the case in borough or city schools. Each had an elected areawide board which was backed by community committees which supplied local village input to questions of governance and policy.

- Third, the four districts -- while basically rural -- represented a fairly broad range of social environments. As a consequence, there was a wide range of students' backgrounds, from small village Native youngsters to middle-class white children who may have spent a number of years in larger cities in other states.

- Fourth, Region 4 had elected to form a Regional Resource Center (RRC) designed to support cooperating districts. The RRC included a variety of educational experts whose functions were to provide educational services to their sponsors covering a wide variety of management and instructional efforts. Telecommunications could have a significant impact on the variety and manner of delivery of these educational services.

- Fifth, Region 4 offered a wide range of communications and power-source alternatives. These variations were important in terms of gaining field-based data on the environmental sensitivity of various uses of the technology itself. As an example, village power systems are notoriously undependable in terms of reliability and consistency of output. Factors such as these play a significant role in determining the telecommunications software and hardware mixes suitable for different operating environments.

- Sixth, the four district offices were located in two areas which were, in turn, close to one another in terms of relatively inexpensive flights by charter or regularly scheduled aircraft.

- Seventh, Region 4 met the criteria of need, both in terms of existing communications systems and educational programs. The provision of a comprehensive secondary education program within the village school was difficult because some schools had only one or two teachers. It was extremely unlikely, therefore, that there was the range of educational knowledge and skills necessary to provide the variety of quality offerings required. Further, needed materials and resources were likely to be unavailable.

Of the 32 locations to be involved, links to nine locations could be provided by local telephone companies. Earth stations, already in place or tentatively scheduled for installation prior to December, 1977, allowed for line installations to 16 locations. The last seven locations were linked to the outside world via VHF radio.

The communication links involved for the IST were to be two new networks. These were (1) a dedicated-line network and (2) the "mail drop" and computer-access network developed for the Administrative Communications Network and the Alaska Knowledge Base System, the other components of the ETA Project. The dedicated-line network was to consist of a voice/data line primarily using the Bristol Bay Area earth stations and the RCA communications satellite. A variety of one-way and interactive instructional programming was to be made possible by the system. The second communication network, the "mail drop" and computer-access network, was to link the 28 Bristol Bay Area schools with the Regional Resource Center in Dillingham, the four district offices located in the Bristol Bay Region, and DOE/Juneau.

OPERATING CONCEPTS

COMPUTERIZED DIAGNOSTIC SYSTEMS FOR GRADES ONE THROUGH EIGHT

As initially envisioned, this element of the IST, when fully implemented, would operate as follows:

- At the beginning of the year, the teacher submits status-related numbers from each student folder into the computer and requests the basic skills profile for each student.

- The printout reveals that four of the students have never been evaluated and three others have not been evaluated in more than six months. For these students, the teacher requests a "canned" diagnostic instrument covering a wide range of objectives and the microcomputer prints copies for immediate use. Post-instructional testing will be done with each student interactive with the micro, thereby ensuring a file up-date.

- Via the terminal, the teacher requests a student grouping report by skill objective in terms of failure to achieve on an objective. In addition, the teacher also receives a printout referencing local materials for each objective.

- Each student is given a copy of the skill objectives (in modified form) which he or she is expected to work toward during that school year.

- Whenever they desire, teachers provide narrative input making suggestions for improvement of the system. This input is placed in the "mail drop" file belonging to the Department of Education manager for student assessment. Of particular interest would be validated instructional modules focused on specific objectives.

NINTH AND TENTH GRADE RURAL SECONDARY EDUCATION CURRICULUM AND DELIVERY SYSTEM

Conceptually, the scenario presented below describes how this element would function in the operational mode:

- Pre-taped one-way audio segments for critical course areas would be broadcast. These would be selected from commercially available products in some content areas but, more often, would be constructed by curriculum and production specialists to fit the needs of Alaska's rural secondary students (reflecting local input from the educators of the region).

- Interactive audio sessions would follow which allowed students enrolled in a particular course region-wide access to outstanding local instructors in secondary course areas.

- Computer-assisted instruction would be provided in areas where rote learning of materials is emphasized and where individualization of instruction can be provided in its most complete form.

- In addition, a wide variety of self-instructional correspondence materials adapted to the system being implemented would be made available, thus providing access to other educational areas not addressed by the project.

- One-way and two-way instructional programming and seminars for the rural teachers of the area to assist them in implementation of the project at the classroom level would also be provided.

USER INVOLVEMENT

The central principle governing the design was that of a "user-driven" development model. Representatives of the four districts in the Bristol Bay Region were to be full partners in the development process. The mechanism for this partnership was to be a subcontract with the Regional Resource Center. This subcontract would provide support to the four districts by providing staff materials required to implement a series of decision processes related to the development effort.

The first step in this process was for user representatives to assess existing program offerings and to prioritize the ninth and tenth grade program areas requiring initial development and testing. Based upon these user-defined priorities, a component of one program area would then be selected for initial prototype development.

A design contractor, working with staff representatives of the four districts, would define specifications for the prototype instructional module. These specifications would include the desired learning outcomes, learning activities, mode of delivery and evaluation questions and procedures. Technical staff working with user representatives would design and test an initial prototype with teachers in the remote villages in the Bristol Bay Region. A review session would be held upon completion of the prototype test. Purpose of this session would be to determine revisions needed in the prototype as well as effectiveness of the development process.

This sequence in designing and testing a prototype would achieve two purposes. First, it would afford user representatives initial "hands-on," heavy but low risk involvement in a systematic development process. Second, it would result in a visible curriculum product which had been mutually designed by local users and "experts" from the Design and Implementation Contractor's staff. The end result would be an identification of needed revisions in the development procedures, skill development needs on the part of the users, and a set of decisions and a plan for revision of the prototype.

Technical project staff would assist the users' representatives in analyzing proposed areas for development in terms of cost, development time required, amount of teacher retraining, and availability of existing resources. Based upon this analysis, decisions would be made by the users regarding an overall plan with developmental priorities, event sequences, and responsibilities of technical staff and user representatives delineated.

INSTITUTIONALIZATION CONCEPTS

An essential element of institutionalization is early dissemination of information about the program and its intended purpose. The Electronic Mail System component of the ETA Project was the ideal vehicle for providing continuing communications about the Project's progress to all district administrators, the DOE and others, and for providing an efficient and continuing user feedback mechanism.

A second feature was to be a "capacity building" effort. The initial site for this effort was to be in the Bristol Bay pilot region. This capacity building was to have two dimensions. First, staff of the four districts and the Regional Resource Center in the Bristol Bay Region would be full partners in the design, development, and testing of the student diagnostic system and the rural ninth and tenth grade curriculum and delivery systems. Through this effort, local skills in curriculum and instructional development would continue beyond the four-and-one-half years of Federal/State Project support. The second dimension of the "capacity-building" effort was the briefing of representatives of the other Regional Resource Centers during the first two years of the Project, followed by Project-supported preparation of staff from the Alaska Center for Staff Development (CSD) and the South Central Regional Resource Center (Anchorage).

The Alaska Center for Staff Development is located in Anchorage. Its primary responsibility is to offer short-term, highly intensive skill training to professional educators. Workshops are organized on the basis of local, regional, or statewide demand and often involve local funding.

During the third and/or fourth years of the Project a staff member from CSD and the South Central RRC would be located at the Dillingham Regional Resource Center (Bristol Bay). The South Central RRC was selected because it served the region in which initial replication and diffusion was most likely to occur. As such, it was important that this RRC have as much contextual background as possible. By working with the Dillingham RRC and Project team the Anchorage staff member could provide valuable input on the issue of exportability of products.

As product development occurred, the CSD staff member would, within specifications established by the State and under the supervision of the Contractor, develop user training packages for each major product or utilization module. These packages could involve training for board members, administrators, teachers and students. Except for students, the focus would be on the validation of need vis-a-vis the appropriateness of a telecommunications alternative, specific user protocols and expectations (the focus of student training), and internal management and evaluation.

On a continuing basis:

- The State would establish policy and provide funds for product development.
- The CSD would design, with external contractor assistance when required, training for telecommunications systems installations

and serve as a trainer of trainers and install and maintain the capacity for training in one or more Regional Resource Centers.

- RRC staff would train local districts and gather user information and, as a general staff skill, have the capacity for assisting districts in product adaptation. In the instance of a need for significant modification, the training package would be cycled back to the CSD. Should there be a complete absence of an appropriate package, the request for development resources would be made to the State.
- Districts which had already experienced installation would serve as a talent-bank resource for those contemplating installation.

Because the Project was aimed at avoiding highly expensive uses of telecommunications, the products selected for diffusion would be well within the capacity of local and State resources to cover the costs of implementation and maintenance.

A third key feature would involve Project demonstrations and conferences involving users from across Alaska -- providing "hands-on" experience in system utilization.

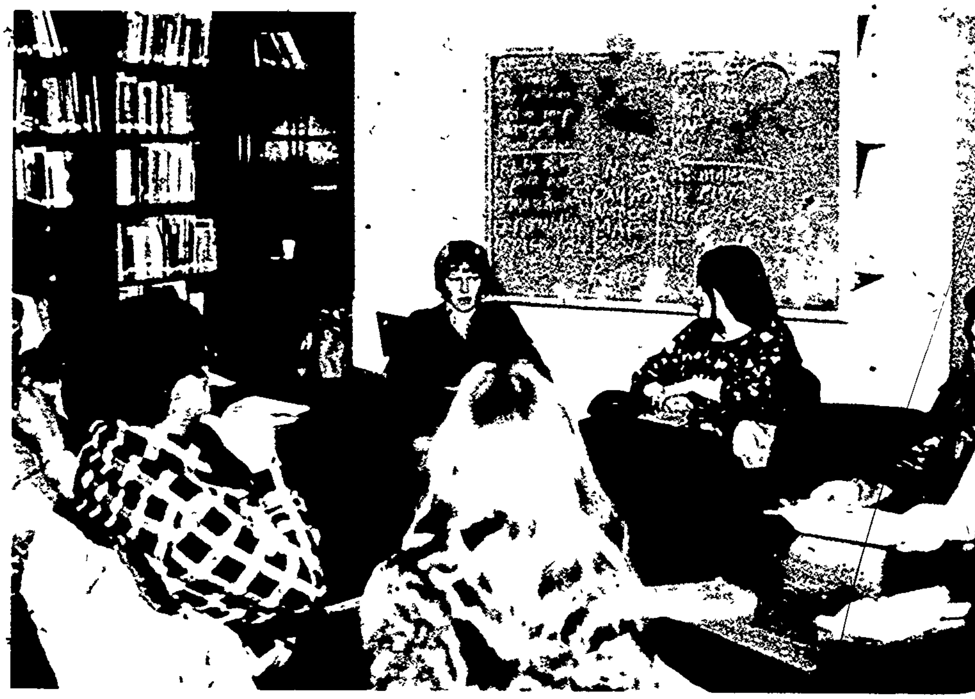
Finally, evaluation of each of the IST elements would result in a detailed analysis of cost-utility and plan and policy recommendations for State and local financial funding beyond the period of NIE support.

FORMALIZING IST INSTRUCTIONAL NEEDS AND IMPLEMENTATION PLAN

The initial needs assessment by the DOE two years earlier did not delve into the specific curriculum courses most needed to support secondary education. Further, the initial IST implementation concept was based on the *maximum use* of the selected technology. In early 1978, therefore, a series of conferences and studies were undertaken to pinpoint precisely the courses to be developed and the specific ways the technology should be used in support of students and of the teachers in their roles as managers of education.

USER NEEDS ASSESSMENT

Instructional needs to be met by telecommunications and associated technologies were the subject of a user needs assessment conducted in March and April of 1978. On-site interviews were carried out at 14 schools which were chosen as representative of Alaska's ethnic and geographic milieu and school size. Among core course areas, English received the highest priority rating for early development. In addition, several non-core subjects were identified as areas of need. Career/vocational education and drug- and alcohol-abuse education were perceived as the high priority areas. Since the decision was made early on that ETA would concentrate primarily on core courseware, the English course was identified as among the first to be developed.



PLANNING CONFERENCE

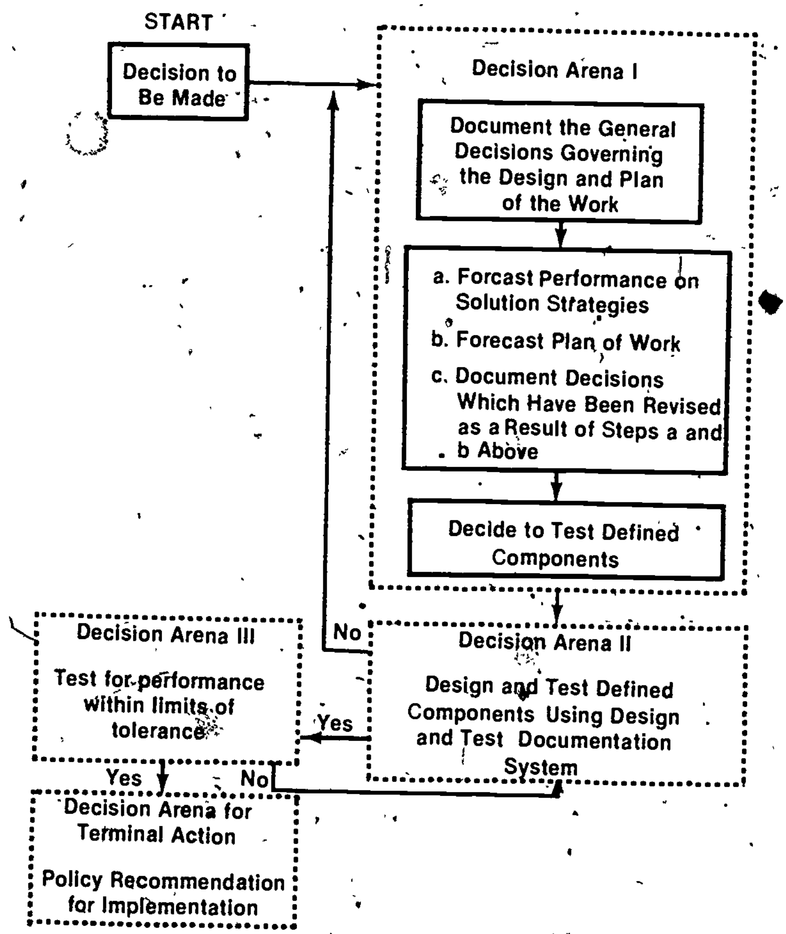
Concurrent with activities designed to select specific courseware for development and appropriate technology applications, ETA Project management, along with the NIE Program Manager and the Implementation Contractor (Northwest Regional Educational Laboratory), met to define the decision-making model to be used throughout the life of the Project. This was a key conference for it established the basis for the detailed evaluation methodology to be used to implement the formative and summative evaluation designs developed earlier. The model adopted, and presented below, was used in conducting analysis of: instructional alternatives; performing cost comparison among technological and other alternatives; feasibility; user acceptance; effectiveness; and methods for choosing between state-of-the-art techniques and instruction modes.

Figure IV-4, "Generic Decision-Making Model," views three major areas for Project decision-making. It covers the strategy involved in the use of both formative and summative evaluations. Key decisions, identified during initial Project design and generated by management as the Project progressed, were fed into the model. Each decision first entered Decision Arena I which involved the initial contextual analysis in terms of the critical needs facing the IST and documentation of the initial Project design, i.e., documentation included in the original proposal.

The second stage of Decision Arena I involved systematic analysis and forecasting of intended performance based on the Expected Result, Verifiable Indicators, Assumptions, and schedule. Based on this input analysis, the decision was made as to what elements were to be tested in the field, i.e., passed on to Decision Arena II.

Figure IV - 4

GENERIC DECISION MAKING MODEL



In Decision Arena II, the design and test phase was initiated. Detailed design and test documentation was developed which allowed for a tracking of performance forecasts, limits of tolerance for acceptable performance, and constraints and conditions throughout the developmental cycles. Design and test was envisioned as five major developmental stages. (The number of stages employed depended upon Project management's assessment of the amount of evaluation information needed to mold the element into its operational configuration.) The five stages were:

- Design
- Exploratory Test
- Pilot Test
- Field Test
- Summative Reporting

The Exploratory and Pilot Tests represented the basis for formative evaluations, i.e., relatively short trials to gather information about the workings of the components under development to determine changes necessary to form the operational configuration. By the time the Field Test was run, the vast majority of bugs had been corrected and the elements under test were very nearly that of the operational configuration, i.e., the form taken when the IST was turned over to users and user-support agencies for management and funding.

Decision Arena III entailed the actual testing. At any point, if a component failed to meet the established criteria, it was recycled to Arena II for reformulation and thence further testing. When the component met pre-specified intended outcomes, it was at the stage where the Project Manager could make policy recommendations regarding its institutionalization into the statewide educational system.

STUDENT DIAGNOSTIC TESTING CONFERENCE

One of the two major focii of the IST was to be diagnostic testing of students in Grades 1-8. Therefore, in June, 1978, a group of experts was gathered in Juneau to discuss and shape the form this element should take. Specifically, the subject was how the Alaska Objectives and Item Bank (AOIB) could best be handled by computers and accessed by teachers. The AOIB includes objectives and items in Reading and Computational Skills for Grades 1-8. Individual items could be selected by teachers to construct customized tests particularly suited to the needs of their students.

After intensive discussion, conference participants concluded that administration of AOIB test items by computer would produce *little or no gain in efficiency or utility over the pencil and paper version.* Conferees expressed some concern that there would be, in fact, a danger of information loss because of the graphic and audio limitations imposed by those computer terminals or microcomputer systems that could be obtained at a reasonable cost. It was concluded, however, that diagnostic testing should be incorporated as an integral part of the overall design of the instructional (ninth and tenth grades) portion of the IST. Thus, although diagnostic testing was *dropped* as a stand-alone element, the conference (decision) resulted in *incorporation of a diagnostic aspect in the testing component of the 9th-10th Grade support element.*

STATE-OF-THE-ART STUDIES

The conceptual student instructional component of the ETA depended very heavily on the use of audio and the computer to realize the individualization of student learning. Thus, it was important that an extensive literature search be conducted in order to identify how these techniques could be most effectively used. Specifically, two studies were conducted; the audio study and report were produced by Dr. Lorne Parker, University of Wisconsin, and the CAI/CMI study was conducted and produced by Dr. David Thomas of the University of Iowa. Each report addressed whether there was existing evidence of how, and under what conditions, instruction delivered by the technique under study was at least as effective or more effective than traditional instruction.

EFFECTIVENESS OF COMPUTER-ASSISTED INSTRUCTION

This section details the important findings of the study, "The Effectiveness of Computer-Assisted Instruction," as it applies to high school students. Emphasis was on the use of computer-assisted instruction in five ways: (1) drill; (2) practice; (3) tutorial programs; (4) simulations; and (5) problem-solving programs. Evidence of effectiveness was categorized according to achievement, attitude toward the computer and CAI, time reduction, retention, and cost. No attempt is made here to describe the situation or location, or to credit the authors of the numerous studies that contributed to those findings. This is found in the body and bibliography of Dr. Thomas' report.

ACHIEVEMENT

- Students who use the computer in language arts, reading, and mathematics have been shown to realize greater achievement gains than students who are more conventionally taught.
- Computer simulations of various careers resulted in enhanced cognitive achievement and awareness of careers on the part of students.
- The use of CAI in a biology program showed, on the basis of post-test scores, a significantly higher level of achievement for CAI students.
- Physics laboratory simulations which supplemented laboratory sessions resulted in a high level of problem-solving skills and higher content examination scores. This study also showed, and was borne out by others, that _supplementary CAI_ is valuable, whereas stand-alone CAI may not be.

- Use of CAI in a beginning typing course showed that CAI led to higher "production" typing scores, but to lower scores in a "five-minute timed typing test."

In conclusion, rarely did controlled testing show that CAI-supported learning was inferior to the more traditional teaching mode. The evidence overwhelmingly supported CAI as a viable instructional alternative.

ATTITUDE

- CAI-exposed students have been shown to have the same or higher levels of good feelings toward their instructional situation than non-exposed students.
- Student attitudes have been shown to be more favorable when measured by increased motivation and interest in mathematics.
- One study found no difference in study habits, study attitudes, or study orientation between students in a CAI class and a non-CAI class.
- It was found that CAI students had higher attitudes toward CAI and mathematics, but lower attitudes toward self and school.

TIME REDUCTION

- In a time-trial-related unit in mathematics, it was found that high and medium ability students were able to complete the unit quickly, whereas low ability students were not.
- In a typewriting program, a significant reduction in time for completion was attributed to CAI.
- In a particular training unit within an industrial arts program, a significant reduction in time for completion was attributed to CAI.
- Time reductions were reported by several investigators for courses in accounting and biology.

In conclusion, the literature showed conclusively that CAI study reduced the time needed for students to complete a unit. In the worst case reported, students took somewhat longer, but had more data to work with. Even so, the difference was not statistically significant.

RETENTION

There was little in the literature on this subject and that available dealt almost exclusively with grades below the secondary level. On the basis of available evidence, however, it appears that retention levels for students are comparable for CAI- and non-CAI-taught courses.

COST

This is an extremely difficult measure since the cost varies with the type of equipment used, courseware selected, maintenance associated with the particular machine (and this does vary considerably between machines), local situational variables, and a host of other things. However, a number of examples showed CAI used in the proper situation, was equal to or less costly than conventional teaching methods. In a particular Title I program the cost was approximately half that for other remedial programs. (As the cost of microcomputers comes down, and the number of students per machine increases, the relative cost effectiveness of CAI will increase.)

EFFECTIVENESS OF BROADCAST AUDIO AND TWO-WAY AUDIO INSTRUCTION

This section details the important findings of the study, "The Effectiveness of Broadcast Audio and Two-way Audio Instruction for Distant Learning," by Dr. Parker *et al.* As in the summary of the CAI/CMI report, no attempt is made to be comprehensive or to credit the authors of the numerous studies that contributed to these findings. This is covered in the body and bibliography of the report.

In the report, Dr. Parker analyzed two aspects of the use of audio techniques; radio instruction and teleconferencing. To clarify the terms relative to radio instruction, the National Association of Educational Broadcasters' Radio Task Force adopted certain definitions that are useful in the study of adaptation of this technique to the Alaskan context:

- *Instructional Radio* - systematically presents materials for the benefit of a student who is working to achieve a specific learning objective.
- *Direct Teaching* - refers to an instructional presentation that specifies lesson plans, conducts drills, and gives tests. This format generally follows local curricula.
- *Supplementary Radio Programs* - covers only a portion of the curriculum and is adapted by the teacher/instructor of individual students for select learning applications.
- *Enrichment* - uses radio instruction to bring resources to the classroom that would not otherwise be available.

The authors found sufficient supporting evidence to conclude that there are numerous advantages to radio instruction for students. Specifically:

- Comparison studies indicated that students learn as much as students by other instructional modes.
- Radio instruction motivated students to learn by bringing in special, outside resources.
- Radio instruction allowed personalized communications between students and teachers.

- Radio, coupled with a telephone link, or through use of another radio link, allowed interaction among students or between students and their instructor.
- Radio created an efficacy of its own, transmitting a sense of immediacy and involvement in the programming.

Advantages to the instructors were also found:

- A comprehensive radio instruction program could make sharing among educational institutions possible and economical. Instructor-sharing allows schools to offer more complete education and permits outstanding teachers to reach out to students attending different schools around the State.
- With minimal training, radio programming could be used in conjunction with or instead of classroom instruction.
- Radio could be supplemented with other media.
- Radio programming could be adapted to a wide variety of educational needs.

It was concluded that the special benefits that would accrue to the Alaskan situation by the use of radio instruction were:

- Economies would be realized since participants or faculty would not have to travel significant distances or spend inordinate time away from occupational or teaching responsibilities.
- It provided the ability to reach isolated professionals who would otherwise be in an educational vacuum.
- It would offer tangible evidence that the Educational Administration is vitally concerned with the problems of students and professionals.

The teleconferencing portion of the report considered several modes of interaction in reaching its conclusions. The interactive modes studied are defined as:

- *Telelecture* - is a pre-arranged contact (usually telephone) from a classroom to a resource person to enrich regular classroom instruction. It provides students the opportunity to ask questions and to comment on topics under discussion.
- *Teleteaching* - enables a sick or handicapped student at home to participate in class activities through use of two-way telephone. The disadvantaged student indicates by a signal when he or she wishes to speak or answer a question.
- *Teletutoring* - gives a student or students the means for getting in touch with a teacher or tutor for individual help. It is used mainly in correspondence education or other types of independent study.

- *Telephone-based Instruction* - uses a system that acts as a huge "party line" where all groups and individuals can hear and interact with each other.
- *Telewriting* - enables an instructor to transmit hand-drawn graphics to participants. This is used to supplement audio teleconferencing. (Since this report was undertaken, devices have been perfected that permit transmission of pictures over telephone lines.)

The advantages, enumerated by the authors, of two-way interactive teleconferencing and instruction were:

- It was shown to motivate students to learn; it also proved to be ego-satisfying.
- It provided a means to meet the needs of students in remote locations.
- Comparison studies indicated students learned as much via a teleconferencing instructional system as by other modes of instruction.
- It allowed personalized communication between teacher and student.
- It allowed student-to-student communication -- an essential ingredient to learning.

The advantages that would accrue to instructors were:

- The technique enabled faculty-sharing, thus making it possible to offer a more complete educational program.
- After initial training, teleconferencing instruction did not impose any additional workload on instructors.
- The technique could be used as a break-in medium to help student instructors overcome nervousness during initial training experiences.

Special benefits that could accrue from teleconferencing to schools in the Alaskan environment were:

- It offered flexibility in planning and scheduling by accommodating taped programs as well as live lectures.
- It provided access from any point in the network and thus permitted coping with emergencies.
- It allowed class offerings for limited numbers of students in many remote locations simultaneously.
- It eliminated the need for many trips and saved instructors' time.

- It permitted institutions to share costs and thus to offer high quality educational programs to all students.
- It could be used for administrative purposes when not being used for instructional purposes.

AUDIO INSTRUCTION CONFERENCE

Because of the important role planned for audio instruction in the conceptual design of the IST and the encouraging results from the state-of-the-art report, a conference of leading experts in the field was convened in August. The purpose was to discuss all aspects of audio instruction in the light of experiences and successes of the attendees, and to define specific applications of that information to the development of audio courseware within the Alaska context. Two major questions were addressed by the conferees. These were:

- *HOW COULD AUDIO TELECOMMUNICATIONS BEST BE UTILIZED?*
  - to provide instruction for entire courses?
  - to provide instruction for specific course units?
  - to supplement regular courses?
  - to support extracurricular activities?
- *WHAT MEANS OF AUDIO TELECOMMUNICATIONS FOR INSTRUCTION WOULD BE MOST EFFECTIVE AND FEASIBLE?*
  - one-way radio?
  - two-way radio?
  - one-way telephone?
  - two-way telephone?
  - a mix of radio and telephone?

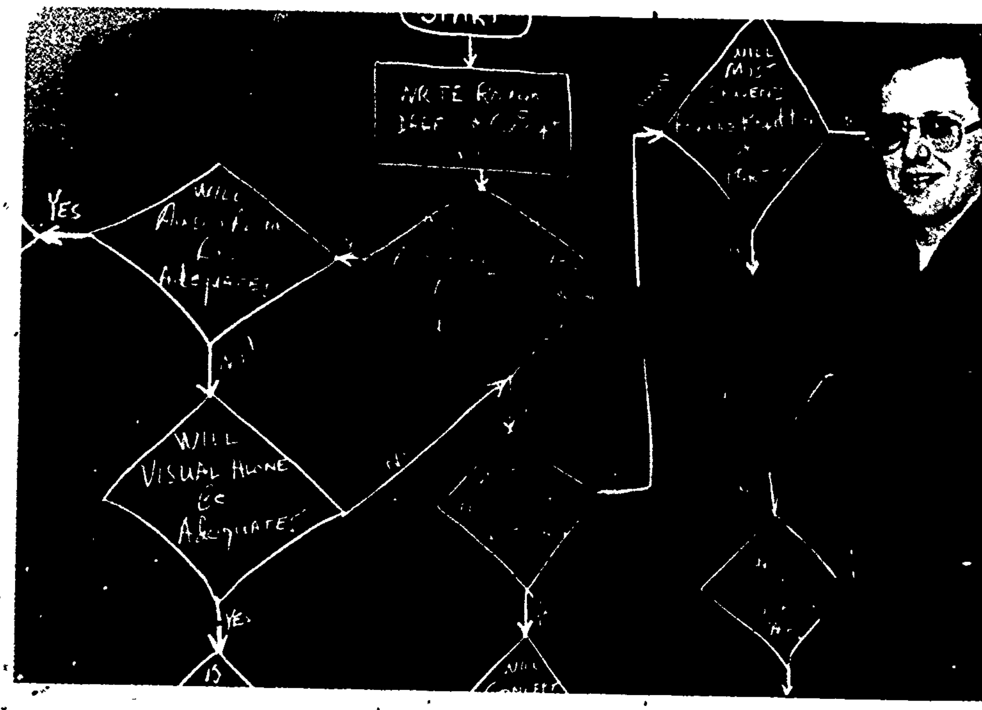
The major conclusion reached was that *it was not feasible to produce full-length audio courses in core curriculum areas within the time frame, scope, and budget of the Project*. It was recommended, however, that *short audio modules be produced to supplement other forms of instruction.*

INSTRUCTIONAL ALTERNATIVES ANALYSIS

The purpose of the conferences, state-of-the-art reports, visits to major CAI/CMI sites, interviews with school administrators and teachers, and extensive literature searches was to amass the basic information necessary to perform an instructional alternatives analysis. This document provided guidance for installation of the initial IST (now dedicated totally to the support of 9th-10th Grade curriculum) in the field. The study considered the cost/benefit of several technological and methodological approaches to fulfilling the IST objective within the constraints of rural educational realities. The major elements addressed in the analysis were:

- the best use of the media;
- the time frame for development;

- availability of "shelf" materials for feasible adaptation;
- hardware requirements;
- total cost of development;
- staff expertise required;
- identification of user capabilities for participation in development; and
- degree of user ownership.



Ground rules for the analysis were that cost figures generated were for 94 secondary schools with a population of 100 or fewer students and for one complete course of 120 hours of instruction to be delivered to all 94 schools. (There are 140 secondary schools with 100 or fewer students if K-12 schools are included.) The fundamental techniques investigated were radio instruction, CAI, and CMI. Four variations of each of these basic techniques were analyzed: (1) use of off-the-shelf materials and/or programs that could easily be adapted; (2) in-house development of programs by ETA staff and consultants; (3) mutual adaptation which included development of programs by ETA staff in cooperation with Alaskan teachers, etc., and; (4) local development of programs by Alaskan school personnel with some technical assistance by ETA staff.

It should be noted that actual costs are of little importance to the reader contemplating implementation of any such modes. Rather, the factors considered in the analysis and the relative costs are of significance.

Conclusions are detailed here with explanatory notes sufficient only to ensure understanding of the figures and conclusions reached. Full explanations are detailed in the "Instructional Alternatives Analysis" by H.A. Wilson, September 1, 1978.

RADIO INSTRUCTION

It will be noted in the accompanying tables, IV-1, IV-2 and IV-3, that provisions were included for commercial radio broadcasts even though costs were high. The reason was that only 38 of the target schools were able to receive Alaska Public Radio (APR) broadcasts. Of the remaining schools, 50 were not able even to receive commercial broadcasts. A possible solution considered was the use of satellite transmission, but this was prohibitively expensive. An alternative for schools beyond both APR and commercial broadcast reach was the use of audio cassettes. *The full course delivered to all 94 schools would cost only $21,600.* In light of the data shown under "Radio: Total Costs of Development Plus Five Years of Implementation," it was determined that interactive modes would be viable alternatives to cassettes followed by classroom discussion *only if very large cognitive and affective differences were found during actual field testing.*

Table IV - 1

DEVELOPMENT COSTS FOR FOUR MODES OF DEVELOPMENT: RADIO INSTRUCTION

	Off-The-Shelf	In-House	Mutual Adaptation	Local** (Probably Unrealistic)
Staff Expertise Required	·Administrative ·Curriculum Specialist	·Administrative ·Curriculum Specialist ·Radio Production Specialist	·Administrative ·Curriculum Specialist ·Radio Production Specialist	·Administrative ·Curriculum Specialist ·Radio Production Specialist
Hardware Dollars	None (1)	None (1)	None (1)	None (1)
Staff Dollars	0 – $21,600 (2)	$216,000 (3)	$ 65,700	$3,600 – $9,000 (6)
Travel & Other Dollars	None	$ 12,000 (4)	$ 91,250 (5)	$1,000 – $2,000
TOTAL DEVELOPMENT COSTS	0 – $21,600*	$228,000	$156,95[illegible]	$4,600 – $11,000

NOTES:

1. No hardware costs.
2. Requires a curriculum specialist to develop or adapt teacher guides. The range is related to the amount & quality of material accompanying program tapes.
3. Lesson objectives, scripts, teacher guides & program production for each 15 minute segment completed in 2 weeks on the average.
4. Talent & production costs are $100 per segment.
5. Travel for teacher orientation conferences; EMS messages; teachers' time; talent & production.
6. ETA instructional staff in an advisory & minor editorial role.

* Program acquistion costs not included.
** Not of comparable quality to other alternatives.

Table IV - 2

IMPLEMENTATION COSTS FOR THREE MODES OF INTERACTION: RADIO INSTRUCTION

	No Interaction	2-Way Telephone Interaction	EMS Interaction
Expert Instructors		$67,200 (3)	$25,000 (6)
Hardware	$9,400 (1)	$47.000 (4)	$282,000 (7)
Delivery (Communication)	0 – $72,000 (2)	$184,880 (5)	$33,840 - $105,840 (8)
Maintenance	....	....	....
Site Modification	....	....	....
Software	....	....	....
TOTAL IMPLEMENTATION COSTS	$ 9,400 - $81,400	$299,000	$340,840 - $412,840

NOTES:

1. 94 radios.
2. Range due to difference between delivery by Alaska Public Radio, APR, (no charge) & 6 commerical stations for 120 segments.
3. Assumes maximum size for a discussion group is 25 students, 700 students requires 28 groups and teachers.
4. Darom Model 610 (speaker + 2 microphones) at each of 94 schools.
5. Average RCA daytime rate to nodal city (location of message concentrator equipment) plus commercical broadcast cost.
6. One instructor full-time to respond to questions from 94 schools.
7. One microcomputer with disk & printer at each school.
8. EMS communication cost to EMS plus commerical broadcast cost.

* Assumes all micros only used for this purpose (worst case).

Table IV - 3

RADIO: TOTAL COSTS OF DEVELOPMENT PLUS FIVE YEARS OF IMPLEMENTATION*
(x $1,000)

	Off-The-Shelf	In-House	Mutual Adaptation	Local
No Interaction	9 – 391	231 – 597	166 – 526	14 – 380
2—Way Telephone	947 – 1,329	1,175 – 1,535	1,104 – 1,464	...
EMS	571 – 937	799 – 1,165	728 – 1,094	...

NOTES:

*Five years was selected because it was assumed that this was the normal life of an instructional program before revisions became necessary.

Considering the four modes of development (Table IV-1), the "in-house" mode was very expensive; the "off-the-shelf" mode, although less expensive, suffered from unavailability of sufficient suitable materials. "Local" development did _not_ include costs at the district or school levels -- they were considered prohibitive for a full 120-segment course. It was more realistic to consider this mode for development of smaller units to meet local interests. Thus, the _"mutual adaptation" mode was considered the most viable alternative for large-scale audio-instruction production._

Turning to the question of the desirability of a full 120-segment audio course, it was found that the compelling arguments advanced for broadcast audio instruction were low cost, immediacy of the medium, and widespread reception. It has already been noted that widespread reception in this instance was impossible. Immediacy has limited value in the normal curriculum, being confined to such things as current events in social studies, for example. Finally, experience has shown that full-length course lectures via tape are inappropriate at the grade levels under consideration. Rather, short dramatic episodes, music, quiz shows, etc. have been found to better maintain motivation and attention over extended periods.

In conclusion, the analysis conducted indicated that _audio cassettes containing short units of material should be used in conjunction with other media_, CAI/CMI for example. This type of usage would minimize the rigidity of any broadcast schedule and allow the teacher flexibility in usage and scheduling.

CAI

It is clear from Table IV-4 that cost alone eliminated the "in-house" development of full CAI courses. Although somewhat cheaper, the "mutual adaptation" mode was still extremely expensive and, therefore, not worth consideration unless a compelling need was identified at target schools that could not be met with existing CAI programs or other media. On the other hand, the "off-the-shelf" mode was found viable if implemented on a less elaborate basis than PLATO.

Some large courses and many smaller modules were found to be readily available. It was also noted that small units of drill and practice as well as simulations could be developed in either the "in-house" or "mutual adaptation" mode at reasonable cost where there was existing material. The small-module approach had the advantage of allowing flexibility of choice for teachers to meet their individualized needs.

Cost estimates for implementation, Table IV-5, were based on vendor prices. The high-end prices represented the fully interactive PLATO system. The low-end price represented downloading appropriate curriculum segments on a daily basis to microcomputer systems in the schools. It was evident from Table IV-6 that use of _micros and downloading was the only affordable alternative_. ("Downloading on a daily basis" refers to the technique whereby all programs are contained in a central computer and each day the portions to be used are transmitted to the local schools.)

Table IV. 4

CAI DEVELOPMENT COSTS FOR FOUR MODES OF DEVELOPMENT

	Off-The Shelf	In-House	Mutual Adaptation	Local
Staff Expertise Required	1-Administrator (1/8 time) 1-Programer	1-Administrator(1/4 time) 1-Team Leader (design) Full Time 1-Subject Matter Expert 6-Writers 2-Programmers	1-Administrator (1/4) 1-Team Leader 2-Programmers	Local Development Not Expected for Full CAI Courses
Hardware Dollars	ETA Data Processing System	ETA Data Processing System	ETA Data Processing System	
Staff Dollars	$3,600 (1)	$540,000 (3)	$241,920 (5)	
Travel & Other Dollars	$0 - 7,000 per mo. (2)	$15,000 (4)	$116,800 (6)	
TOTAL DEVELOPMENT COSTS	$3,600 (one-time)-$7,000 per month	$555,000	$358,720	

NOTES:

1. Four weeks of programmer time to adapt an average CAI package.
2. Cost range is due to the fact that many CAI programs are available for only the cost of tape reproduction. At the high end of the scale, some programs can cost $75 per month per terminal.
3. Assumes 200 hours of development for each hour of instruction.
4. Assumes consultants brought in for design & review conferences.
5. Assumes 3 staff for two years.
6. Assumes 4 FTE teachers, 32 trips for 16 teachers & EMS messages.

Table IV - 5

CAI IMPLEMENTATION COSTS

Hardware (1)	$188,000 Purchase - $1,000,000 Per Year Lease
Delivery (2) (communication)	$33,840 - $1,353,600
Maintenance	$88,704
Site Modification	None
Software	None
TOTAL IMPLEMENTATION COSTS:	$221,840 - $2,353,600

NOTES:

1. The low estimate is for one microcomputer with disk in each of 94 schools The high estimate is for PLATO terminals.
2. The low estimate is for EMS communications. The high estimate assumes on-line communication with PLATO.

Table IV-6

DEVELOPMENT AND FIVE YEAR IMPLEMENTATION COSTS
(x $1,000)

	Off-The-Shelf	In-House	Mutual Adaptation
Full Interactive (PLATO)	12,025	12,577	12,381
Distributed (micro with downloading)	360	913	716

CMI

The costs shown in the accompanying tables (IV-7, IV-8, and IV-9) considered that the microcomputer was used for only CMI and for only one CMI course because the development-cost was based, as the other courseware, on producing a single 120-segment full-length course. It should be noted that the CMI development cost compared favorably with audio and was only 23 percent of the cost of developing a full CAI course.

In summary, then, the following mix of courses and methods was recommended for IST:

- audio cassettes and broadcast for short courses and modules;
- CAI for use
  - in drill and practice to accompany a computerized version of upper level diagnostic testing and remediation;
  - in full courses for basic subjects such as English and mathematics;
  - in a large array of short drills and simulations to be delivered upon teacher request.
- CMI for use
  - as a model and a process for remote teacher interaction in the production and monitoring of CMI courses;
  - as a teacher training course for new roles as an instructional manager;
  - in conjunction with other courseware developed for the ETA Project.

Table IV - 7

CMI COSTS OF DEVELOPMENT

	Off-The-Shelf	In-House	Mutual Adaptation	Local
Staff Expertise Required	Not Applicable (1)	1-Administrator (1/4) 1-Team Leader 4-Subject Matter Experts 1-Programmer	1-Administrator (1/4) 1-Team Leader (1/2) 1-Programmer (1/2)	Not Applicable (5)
Elapsed Days		175	365	
Staff Days		750	350	
Hardware Dollars		ETA System	ETA System	
Staff Dollars		$135,000 (2)	$ 63,000 (3)	
Travel & Other Dollars		....	49,040 (4)	
TOTAL DEVELOPMENT COSTS		$135,000	$112,040	

NOTES:

1. Existing CMI courses are specifically tailored to their local curriculum & text & other media resourses used at the particular location.
2. Assumes 50 hours per hour of instruction.
3. Includes only ETA project staff & not local district & school personnel.
4. Covers a 12-week summer workshop for four teachers.
5. Unlikely that local schools & districts have the resources to produce full CMI courses.

Table IV - 8

CMI COSTS OF IMPLEMENTATION*

Hardware	$282,000 (1)
Delivery (Communications)	33,840 (2)
Maintenance	88,704 (3)
Site Modification	None
Software	10,000 (4)
TOTAL IMPLEMENTATION COSTS:	$325,840

NOTES:

1. Assumes a microcomputer with disk for each of 94 schools.
2. Assumes same costs as for CAI case.
3. Assumes same costs as for CAI case.
4. It was found that purchase from some vendors cost the same as a year's lease from others.

*PLATO has not been considered because of the excessive costs associated with it.

Table IV - 9

CMI: COSTS OF DEVELOPMENT AND FIRST YEAR IMPLEMENTATION VS FIVE YEARS OF IMPLEMENTATION (x $1,000)

Implementation	DEVELOPMENT MODE	
	In-House	Mutual Adaptation
First Year	461	438
Five Years	596	573

READER CONSIDERATIONS

What is of great importance to the reader are the conclusions that may be drawn from this study as it relates to his/her own plans for the use of the media:

MODES OF DEVELOPMENT

- User acceptance must be a strong criterion in considering development modes.
- Target users (in this case, teachers) should be involved in product development.
- Off-the-shelf materials should be carefully reviewed by a panel of users to maximize acceptance.
- In-house development should be used only when absolutely necessary, and reviewed by a user panel. This is indicated by cost analysis.
- Names and affiliations of members of the development team and review panels should be prominantly displayed with any product to be placed in the field.

METHODS OF DELIVERY

- Cassettes should be considered as an alternative to lengthy broadcasts.
- Time constraints of broadcasting on teacher scheduling must be a strong input factor when considering this mode.
- Short broadcast segments on important topics should be the rule.

CAI

- Dedicated, fully interactive CAI systems and large-scale CAI course development are usually not cost effective.
- Microcomputers with curriculum downloading is an attractive concept that can be affordable.
- Off-the-shelf courseware was plentiful for the larger computers (mainframes) but was not yet available in quantity or quality for the small microcomputers required in rural Alaska. However, since publishing houses and others were entering the field, it was believed that, in a reasonable time, sufficient courseware would be available in quantity, cost effective, and affordable.
- The advantages of short modules over full-length courses are availability, ease of adaptability to teaching styles, and the flexibility afforded teachers in selection and use within larger courses.
- Higher user acceptance can be anticipated if a large selection is offered which allows teachers to select programs as needed.
- Acceptance may be greatly aided by teachers' review of courseware modules so that they can recommend those to be offered to the schools.

CMI

- Its greatest virtue is providing teachers a tool for management of individualized instructional programs.
- It utilizes *all* instructional media to meet the desires and requirements of educational institutions using common criteria and therefore, in the main, is *not* transferable elsewhere.
- It does *not* involve design of materials, but rather the detailed design for *utilizing* materials in the instructional process.
- The use of familiar materials usually makes this attractive to a wide range of teacher tastes.
- Maximum advantage is realized when the CMI is used to meet the *individual needs* of a wide range of student abilities rather than the average needs of the class.
- Optimum use of CMI demands serious involvement of the teacher.
- Cost of generating a CMI course is, in most cases, equal to or less than the cost of other media.

IST MODEL

The results of the alternatives study very clearly showed that no single technique would be cost effective in realizing ETA's instructional goals The major roadblock in achieving cost effective production would be to design courses totally "from the ground up." Therefore, a search was made of courses already designed for "long distance education."

For the initial courses, Alaska History and English, correspondence courses met the need for thorough design, having been tested and tailored to Alaskan needs. Further, they were in use and accepted by the Alaskan educational community. The IST model that was fielded initially, therefore, combined proven audio and computer technology, a telecommunications network, and existing printed materials. It also provided teachers with maximum flexibility in helping them to meet their individual needs. (It was found for the remaining six courses, however, that commercially available texts provided the basis for more comprehensive study than did correspondence courses. Accordingly, texts became the core of succeeding courseware.)

The time, effort, and monies devoted to studies and conferences more than paid for themselves. The initial conceptual model contained two elements: diagnostic testing for Grades 1-8 and support of 9th and 10th Grade curricula with maximum use of broadcast radio and telecommunications and computer technologies. What survived the Alaskan environmental filter was a single-element IST and a mix of various technologies with reduced emphasis on broadcast radio but heightened focus on audio cassette and computer. This change of emphasis resulted in a "new look" to the field model. The new IST consisted of five major components:

- basic course materials;
- audio;
- CAI/CMI;
- supervising teacher (local); and
- master teacher.

Telecommunications was to provide the glue tying together the five components.

- *BASIC COURSE MATERIALS*

The basic course materials were to be drawn from the Alaska State Department of Education Centralized Correspondence Studies and the University of Nebraska-Lincoln Independent Study High School in the Division of Continuing Studies. These materials were to be modified to meet Project requirements where necessary. (As noted earlier, texts were found to be more satisfactory for later courses.)

- *AUDIO*

The audio component was to consist of a set of recorded weekly lectures by the master teacher, based on the basic course materials. Dramatic segments were to be included where appropriate. The audio component concept was altered to allow for delivery either by radio broadcast; radio broadcast followed by two-way telephone or Electronic Mail System interaction; or by a set of pre-recorded audio cassettes (new element) delivered at the beginning of the school year. When delivered by radio broadcast, the audio component would reduce the supervising teacher's flexibility.

- *CAI/CMI*

The CAI/CMI component was to direct each student's progress through the course according to the syllabus and assignments from the basic course materials. Tests would be administered individually by the computer in a computer-assisted mode. Criteria for each test were to be set such that, if the criteria were met on the first pass through the test, the student would be assigned the next study unit. If criteria were not met on the first pass, the student would be given a review assignment followed by a second test. This second test could serve as a tutorial, with the program either displaying correct responses to items missed or providing the reason that an incorrect response was unacceptable and an opportunity to try again.

Drill and practice modules were to be developed to support the learning tasks of the basic course materials by providing drill in necessary facts and skills. Simulations and games were also to be delivered at appropriate points to reinforce and enrich the learning experience.

Finally, reports of student progress and test scores were to be produced by CMI and delivered on-site to the supervising teacher and over the EMS to the master teacher.

- *SUPERVISING TEACHER*

The supervising teacher was to be furnished by the participating local school and would be directly responsible for the daily instruction of participating students.

The role of the supervising teacher, although given a little more flexibility in class format, was still basically one of instructional manager rather than traditional supervisor in normal correspondence study courses, since a major function, that of test administrator, was to be carried out by the computer. The supervising teacher would focus primarily on providing student psychological and emotional support and on expediting the flow of communication between the student and the master teacher.

• *MASTER TEACHER*

Master teachers were to be selected based on their high level of knowledge and expertise in the subject matter addressed and, in addition, would have several years of experience in teaching the same or similar courses at the secondary level.

Master teachers were to be drawn from the pool of Alaska's secondary teachers and could reside anywhere in the State that was served by an earth station and a reliable telephone link. Identification of master teachers would be made through nominations by the DOE, district superintendents, building principals, and the Alaska National Education Association. In addition to subject-matter expertise and teaching experience, it was desirable that the master teachers have considerable experience with education in rural Alaska.

The role of the telecommunications network was to provide a rapid and easily accessible communication link between the students and the supervising and master teachers. Reports and test results were to be transmitted over the EMS. Students' written assignments were to be forwarded by a combination of EMS and facsimile devices. This feature would minimize the time lag between assignment completion and the master teacher's feedback. The time lag in correspondence study, using the postal services, was usually measured in weeks.

Questions and problems encountered during the course of study by either the student or the supervising teacher were to be communicated to the master teacher at any time over the EMS. This would serve to strengthen the interactive bond between the three parties involved in the instructional process.

By utilizing the existing body of correspondence study courses developed by the Central Correspondence Studies of the DOE and the University of Nebraska-Lincoln Division of Continuing Studies, the number of courses made available could be substantially expanded within the lifetime of the Project. Twelve IST courses were to be produced and tested by 1982. It would be impossible to produce this quantity of course material within the limitation of Project time and resources if each course had to be designed and developed *in toto*.

An advisory panel of superintendents, principals, teachers, and local school board members from a representative sample of target schools was to determine priorities for developing IST programs, making selections from existing audio materials and recommending modes of delivery. Separate advisory panels of teachers, skilled in particular subject areas and drawn from the target schools, were to be established to assist in the development of each separate IST course.

The IST model, as conceived, would produce highly reliable courseware. Temporary equipment failure in either the audio, CAI/CMI, or EMS components would not have a catastrophic effect on student progress. It would be possible as a backup strategy for a student to complete a course even if all technological components failed completely. A fail-safe design is essential in any rural area where equipment failures are common and can extend over considerable periods of time.

Finally, the IST model provided a mechanism for further course development and delivery by the State and local districts at an affordable cost after Federal support of ETA was ended. The University of Nebraska-Lincoln catalogue listed approximately 150 semester-length courses; many more were available through other university extension divisions. Once the development and delivery systems for IST had been designed, tested, and refined by ETA, their continued application by the State and local districts would be a fairly routine process.

AUDIO EXPLORATORY TEST

A field trial was planned to explore some of the concepts about the use of audio and broadcast radio which had such central roles in the conceptual design of the IST. Specifically, three methods of instruction were to be investigated:

- radio broadcast, followed by classroom discussion;
- radio broadcast, followed by two-way telephone interaction between students and a master teacher; and
- radio broadcast, followed by interaction between a class and a master teacher by means of facsimile equipment, i.e., worksheets and tests would be sent for correction and returned.

It had been originally intended to use the EMS, not facsimile. However, site surveys conducted prior to the test showed that although local radio reception was excellent, but limited, the telephone links in many rural communities were marginal. Thus, it was felt that the signal format transmitted by facsimile would retain its integrity better than the EMS signal. It was concluded, therefore, that facsimile transceivers should be substituted. Since the end results were similar either via facsimile or EMS, it was decided that the substitution would have little effect on the exploratory test's validity in this area.

The variables of interest were student cognitive gain, affective rating of the three methods, and student and teacher reactions to a variety of audio formats including narrative, quiz shows, drama, etc.

The subject selected for the field trial was fire prevention. It was pertinent, because Alaska has the highest number of deaths from fire per capita in the nation. Further, it was generally not included in the curriculum, and considerable support could be gained from the villages themselves as well as from the Fire Marshal's Office. This was an excellent vehicle for introducing the ETA Project into communities upon whose acceptance the survival of the Project depended.

GUIDELINES

Guidelines for the Audio Exploratory Test were developed from the numerous studies performed and, especially, from recommendations of the Audio Conference held in August. Specifically, the following items were included:

- Multimedia were used for the instructional tasks.
- Materials were designed in modules of one-week - each day's segment could stand alone as an instructional unit.
- Audio segments were kept short, less than 30 minutes, in order to retain student interest.
- Professionals were used, e.g., actors, to achieve maximum student motivation and retain their interest.
- Materials for teachers were easy to use and consistent with their roles as instructional managers.
- Materials from the Fire Marshal's Office were used to the maximum extent to ensure a realistic experience in the Alaskan context.
- Different segments of the community and teachers within each region were heavily involved during the course development.
- Programs were carefully designed to increase cross-cultural awareness and to be sensitive to cultural and sex stereotypes. Native reviewers were used to ensure compliance.
- High-quality equipment and production techniques were used to ensure that these extraneous elements did not interefere with the message.
- Interaction was designed via dial-in to local radio stations.
- Tight management control was exercised in order to ensure a high-quality product and to resolve production/instruction conflicts. This role was assigned to the instructional designer to be sure educational qualities held highest priorities.

TRAINING

Training was designed primarily to be conducted on-site and to involve the participating supervising teachers and students in the test.. However, following the concept of keeping everyone informed, prior to on-site training, the principals from the involved schools were visited and the Audio Exploratory Test explained to them.

A manual was developed containing detailed instructions for the teachers. It was structured to provide timely information in a weekly format:

- *General Section* - contained information to be used throughout the three-week period including:
  - the three instructional modes to be tested;
  - procedures to be followed during the four days of instruction;
  - procedures for sending and receiving facsimile documents;
  - simple troubleshooting procedures.
- *Weekly Sessions* - contained:
  - directions covering follow-up activities after broadcast;
  - daily log of activities conducted;
  - evaluation packet containing weekly quiz and attitude-assessment and teacher-survey instruments.

The teacher training was intensive and in great detail, covering the items listed above. Although training was successful, it was difficult to contend with the fact that teachers could only be "worked" for 15-20 minutes at a time because of other duties. In addition, time had to be found at each site to give classroom presentations of about 20 minutes' duration to students who would be involved. Student topics covered included a general overview of the Audio Exploratory Test, sample segments of the broadcasts, and an explanation of equipment to be used. Then the students were given hands-on experience to become familiar with the facsimile and the telephone teleconferencing equipment (convener).

AUDIO EXPLORATORY TEST METHODOLOGY

Three test sites were chosen so that in any week all three instructional methods were used. Each week the instructional mode was changed so that, at the end of the test, all sites had experienced each of the methods to be evaluated.

The format followed was a radio broadcast of a short (usually 15 minutes) segment followed by three methods of student/supervising teacher/master teacher interaction: classroom discussion; teleconferencing; and facsimile transmission. This was done for four days of each week; the fifth day was devoted to testing cognitive achievement and affective reaction. Thus, at the end of the three-week exploratory, testing and affective reaction were obtained from all sites.

Test items were developed concurrent with the program-writing process and were organized by week of instruction. This resulted in selection of three weekly 20-item tests. Along with the test items, attitude survey instruments were developed. The test population was 60 students from the 9th and 10th Grades chosen by high school administrators as representing a heterogeneous sample.

LESSONS TO BE LEARNED

Problems encountered during administration of the Test involved missed radio broadcast schedules, difficulties in establishing suitable times for classes to "meet" with the master teachers, and local site scheduling. Further, because of the small sample sizes, both of students and teachers involved, the results obtained should be used by the reader as good indicators of potential problem and success areas and thus, as guidance within their own contexts:

- Caution must be exercised in producing courses that have different meanings to different groups, either because of culture or location (e.g., urban vs. rural). In rural villages, for example, many houses are heated with wood stoves; also, there are no fire departments. To resolve such problems, persons with broad experience must be used to assist in the instructional design.
- Committing too short a time frame in the production of courseware containing material subject to differing interpretations may be harmful to the project.
- Scheduling at participating schools may be a difficult problem when the broadcast times are rigidly set. Because of other commitments, a number of students and teachers may miss parts or all of certain sessions.
- More time (perhaps even days) should be allowed for teacher training than the actual subject matter would require. This is particularly pertinent in small schools and communities where

teachers are called on to perform in a number of different roles. Removal to a more formal setting may be one answer.

- The technology already in place that must be used in conjunction with the innovation to be introduced may present a problem. Existing equipment, e.g., local telephone, especially in rural areas, may be notoriously unreliable or inadequate in ways such as audio quality.

- Where the communications links are adequate, facsimile can be more attractive to the master teacher than teleconferencing, in that it provides the opportunity to obtain additional information, making the responses to student problems more complete and well thought out.

- Teleconferencing, like facsimile, can suffer from poor telephone links. It appears to be popular, however, with both students and teachers when working properly. The master teacher may find it less satisfactory than facsimile because of the lack of time to prepare answers to questions.

- Students will probably be more favorably inclined toward teleconferencing than either facsimile or classroom discussion.

- Indications gained from achievement data collected are that teleconferencing could be somewhat more effective than classroom discussion or facsimile transmission, perhaps because of a motivational factor.

- Teachers can be very positively inclined towards audio instruction if the content is relevant and is presented objectively and in a variety of formats. Audio programming must be carefully tailored in areas of "localness" and if it is desired to hold student attention for periods beyond 15 minutes.

- Students tend to be favorably inclined towards audio instruction.

- For well-produced segments, students appear not to have heavy preference for one presentation format over another (quizzes, dramas, documentaries, etc.). However, a variety of formats may be necessary to hold students' attention.

- Students prefer segments to which they can experientially relate rather than segments dealing with more abstract concepts (e.g., how to escape from your burning home was preferred to the "classes of fires").

- No major differences in mean achievement scores should be anticipated as the result of radio broadcasts followed by any of the three interactive modes tested.

The major conclusion drawn from the Audio Exploratory Test was that audio is an effective instructional medium if carefully designed and well produced. *Large budgetary expenditures for two-way teleconferencing were not warranted, in terms of student results achieved or the potential sacrifice of reliably reaching all remote* *schools with the complete course materials.* Audio cassettes can achieve almost equivalent results. Thus, in this instance, audio-cassette delivery was incorporated into the IST model early in 1979. Again, the reader is cautioned to look carefully at the interface with existing technology before finalizing on the instructional model to be used.

IST DEVELOPMENTAL CONFIGURATION

With the completion of the Audio Exploratory Test, all major questions relative to configuration, instructional formats, and delivery mechanisms were sufficiently in-hand to begin the next phase of IST development. That phase consisted of developing the actual courseware and computer software so that the entire IST concept, its hardware, implementation, and courseware could be evaluated as a system in the schools of rural Alaska. At the threshold of the experimental phase, all major components were in place; managerial and technical.

PROJECT STAFFING

Since the major activities to be accomplished in the experimental phase required large commitments to content development, software programming, and field evaluation, it was advantageous to basically continue the ETA staffing pattern established at the Project outset. The staff, therefore, consisted of a small number of individuals highly knowledgeable in courseware production, rural school concerns, operations, training, and evaluation. Their major tasks were to oversee the activities of competent contractors engaged in development of the actual materials and software; to participate closely with the contractors in developing field test design, evaluation, and training; and to maintain constant contact with the districts and schools. It was important to ensure that the "field" was fully aware of and participated in major decisions concerning the courseware and operating procedures. The staff was also committed to early-on involvement of those agencies of the State with operational missions so that handover of the proven elements would be as smooth as possible.

Toward that end, the Division of Data Processing, Department of Administration, was brought in to provide oversight of those activities involving data processing, i.e., procurement, installation and maintenance of the microcomputers and their associated software. In addition, the staff was supported by a variety of agencies and organizations acting in an advisory capacity including:

- local school districts to assist in review and development of courseware; and
- User Advisory Committees to participate in course selection and developmental specifications.

IST COMPONENTS

THE MICROCOMPUTER

Certain criteria were established for the selection of the microcomputer to be used at each school site. These criteria included:

- affordability by the schools;
- durability;
- proven record of customer satisfaction;
- ease of use and maintainability;
- quality of the software, and at this stage language capability was most important;
- availability of instructional programs from other sources (important for cost containment); and
- the ability to be up-graded.

The microcomputer selected was the Apple II with 48K RAM (random access memory) using three disk drives for storage of programs and management information, a black and white television monitor, and an internal clock associated with drill and practice functions.

INSTRUCTIONAL COMPONENTS

Based on results of the Audio Exploratory Test, certain changes were necessary to the IST model that was developed as a result of the state-of-the-art studies and conferences. Therefore, the developmental phase was begun with the same instructional components but with a somewhat different allocation of duties to each.

AUDIO COMPONENT

The audio component consisted of cassette tapes to fulfill specific instructional needs for lessons within each course. It was determined that the audio would be used to fulfill many of the functions usually performed by the supervising teacher for other courses. Hence, they were used to:

- motivate and provide background information;
- introduce vocabulary and terminology;
- indicate key questions which serve as advance organizers to guide reading of text materials;
- introduce and provide primary instruction on concepts and skills;
- give directions for activities;
- provide answers and explanations for activities;
- provide enrichment and extension of concepts;
- repeat in oral form information which students might find difficult to read.

CAI/CMI COMPONENT

The CAI portion of each course contained activities developed for the following purposes:

- drill on facts;
- application of concepts;
- presentation and drill on vocabulary;
- development of problem-solving skills;
- review of facts and concepts;
- testing;
- provision of "help screens" containing information directly related to specific questions, e.g., instructional text or problem-solving steps;
- motivation.

The CMI portion used student records to control the sequence of computer activities specifically for each student by:

- providing access to the complete record of student computer activity (CAI) progress;
- making available to teachers information on test scores, mastery of objectives, and portion of the course completed;
- managing student CAI sessions and ensuring that when the student returned at a subsequent time, he/she would restart at the proper place.

From the information provided, the supervising teacher was able to modify individual progress through the course material.

WRITTEN COMPONENT

This component was comprised of printed material from revised correspondence study courses and/or commercially obtained materials as well as IST-developed student and teacher materials. The written materials:

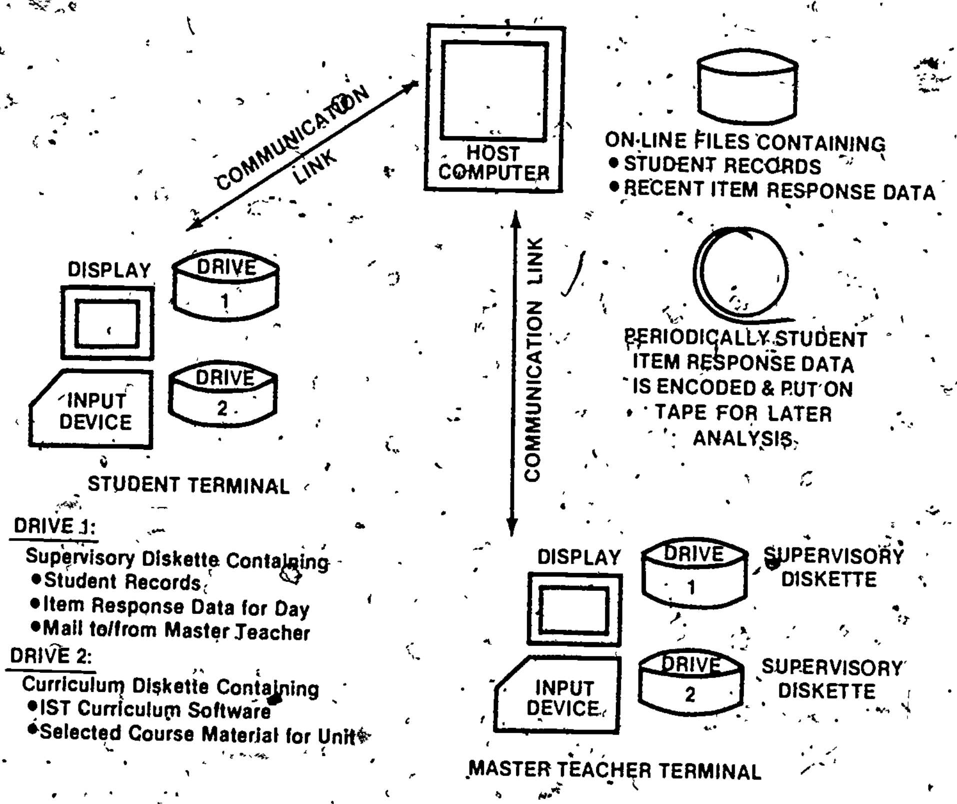
- served as the core of IST courses;
- included student worksheets, guides for audio and hands-on activities, and readings to accompany computer activities;
- provided teachers with detailed course explanation and rationale, instructions for use of the course, teaching strategies, optional activities, and copies of all student materials.

DEVELOPMENTAL IST SCENARIO

Prior to the Exploratory Test (first level of testing in the field), the operating elements of the IST were considered the student and his/her microcomputer (terminal), the master teacher and his/her microcomputer (terminal), and the host computer at the DOE in Juneau. These elements are schematically shown in Figure IV-5.

Figure IV - 5

INFORMATION FLOW



The IST micro at the student site would perform CAI and CMI functions. With each drill, simulation, test, and review, the student response data would be accumulated. Unit test scores and course completion records would be maintained at the local site and used to control the sequence of progress through a course by each student. In addition, reports and comments generated during the day would be stored and later sent to the master teacher via his/her EMS mailbox located in the host computer. Thus, the master teacher would observe students' performance by monitoring their progress. Conversely, comments and reports from the master teacher to particular classes would be sent by the EMS to the school sites via their own mailboxes.

CAI functions could involve substantial periods of communications time if provided from a central host computer on student demand. Therefore, it was decided that simulations, drills, tests, and reviews should be stored locally on diskettes that could be put into the second disk drive (the curriculum floppy) as shown in Figure IV-5. This represented an even more cost-effective change of concept than was proposed for the earlier IST model. At that time, downloading to local microcomputers from the host was considered a cost-affordable approach as opposed to direct student interaction with a central CAI computer.

An additional step considered to make use of the IST model simpler and more cost effective was to fix the courseware format so that it was compatible with a standardized management software package contained on-site. Thus the student microcomputer would work with any course properly constructed. Each course would be divided into modules, each containing one or more units of instruction small enough to be stored on one diskette. When the student "signed on," the student management system (part of the CMI) would specify the course/unit/lesson and sub-lesson to be performed based on the student's history thus far.

COURSEWARE DEVELOPMENT PROCESS

Concurrent with the IST model development was the design and production of courseware to take advantage of that model. Development of a full-year course is a long-term process requiring several years from concept to final acceptance in classroom curricula. Early in 1978 as the ETA Project got underway, the process began with a needs assessment conducted to determine the most critical courses to be developed over the life of the Project. At that time, there were 140 rural high schools with enrollments of fewer than 100 students. Of the 140, approximately 60 had enrollments of 10 students or fewer. In many of these schools, almost any addition to their curriculum would have been welcomed. It was decided, therefore, to develop both full entry-level courses as well as elective courses in core areas. Guidance as to the courses to be developed was obtained from the needs assessment which, in part, concluded:

- Math courses were not uniformly available to students at all sites.
- A great disparity existed between the number of science offerings and the availability of such offerings to 9th and 10th Grade students.
- School staff members most frequently indicated that English and vocational education were not covered well in high school.
- Students indicated that English, history, science, physical education/health, and mathematics were not covered well.
- Community representatives most frequently indicated English and mathematics as subjects not covered well by high schools.

It was decided, therefore, to begin course development with English and Alaska History. English was the obvious selection since it was the course perceived by school staff members, students, and community representatives as being not covered well in high schools and sorely in need of upgrading. Alaska History was chosen as the elective subject because it was strongly recommended by an advisory committee of Alaskan teachers, administrators, and school board members.

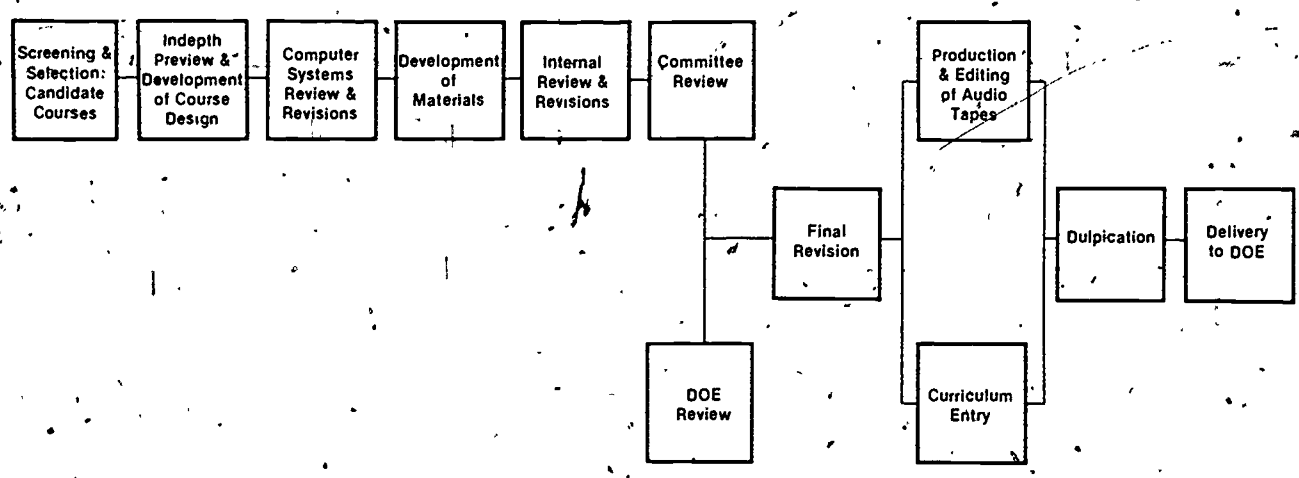
Courseware was based primarily on existing correspondence courses (Alaska History and English) and text books (subsequent courses) with the CAI/CMI, audio materials, and teacher guides built around them. Further, courseware was aimed at a reading level two years below that expected in 9th and 10th Grades, an important decision that experience has shown was a good one. The process through which each course evolved to its final form and then offered to the Alaskan school system was the following:

- Early in the course development, select units were tested for a short period of time at a small number of rural schools (Exploratory Test). Based on the results, modifications were incorporated.
- A second field trial (the Pilot Test) lasting a full year was then conducted at a larger number of schools (20 or more) with the fully developed course.
- Where necessary, Project management instituted a Field Test in which any school wishing to participate was involved.
- Successful completion of the Field Test resulted in a course being offered for <u>sale</u> to any school desiring its use, rural or urban.

It was discovered shortly after development began of the first course that the written materials were not totally appropriate for the intended audience. This was surprising since the correspondence courses had been successfully used in Alaska for many years. This illustrated an important lesson. It should not be taken for granted that courseware, even with a proven track record, will meet the needs of specific audiences without some revision. From this experience and over the period of the production of Alaska History and English, a development and adaptation process evolved, as shown in the flow chart in Figure IV-6, that has remained essentially unchanged.

Figure IV - 6

INDIVIDUALIZED STUDY BY TELECOMMUNICATIONS
COURSE DEVELOPMENT PROCESS



Most of the courseware developed was constructed by NWREL. The following description of the Development and Adaptation Process is taken from their report, "Individualized Study by Telecommunications Model and Procedures Documentation Report," October 31, 1980, and follows the boxed events in Figure IV-6. This is of importance to the reader because it is a presentation that reduces trial and error to a minimum by giving step-by-step instructions of a methodology that has evolved over four years and proven very successful. Although written for the Alaskan context, it is easily transposed to the reader's situation.

SCREENING AND SELECTION OF COURSES

This step consists of intensive screening of commercially published materials, correspondence study materials, and suggested locally developed courses by a Review and Nomination Committee comprised of developers, staff, and subject-area consultants selected for their familiarity with the target population and their knowledge of the content field. Course materials are screened in light of the differences in the audience and the format for presentation. The following preliminary criteria should be met:

- The course should be a standard course offered in secondary schools in the U.S.A.
- The course should cover two complete semesters.
- The course should contain textual materials, an identifiable scope and sequence, a student workbook (or equivalent materials), and a teacher guide.
- Course materials should be available in large quantities from a commercial publisher or other curriculum development project.
- The copyright date of the course should be current.

Eligible course materials are then reviewed in detail by the Committee. A Course Summary which addresses the following criteria is generated for each set of course materials:

- reading level of materials is at or below 8th Grade (one to two years below the level of the intended target group);
- sufficient quantities of supplementary materials are readily available;
- defined scope and sequence and a complete teacher's guide containing suggested class/student activities and projects are available;
- copyright release license requirements are assured;
- course is organized and complete;
- course is adaptable for unique requirements of Alaska;
- course exhibits usability and flexibility;
- course content is complete and of high quality;
- course avoids stereotyping or bias; and
- course is compatible with JST software.

After review, a summary, across sets of course materials, is generated for each subject area under consideration. The ratings for each set of materials are compiled and candidate courses are ranked in order of recommendation within subject areas. Ratings and descriptions of candidate courses are sent to DOE (the sponsor) along with copies of the course materials as potential candidate courses. DOE makes the final decision on course materials to be adapted for IST.

IN-DEPTH REVIEW AND DEVELOPMENT OF COURSE DESIGN

The Preliminary Course Design is developed by a committee comprised of development staff and two subject-area consultants. The committee analyzes the selected course materials lesson-by-lesson. During this process, essential concepts and objectives are determined and potential problems and solutions are identified. Suggestions are made for the appropriate use of audio tapes, computer activities, worksheets, and projects. Effective teaching strategies are also recommended. Areas in which supplementary materials would be appropriate are identified and, when possible, specific materials are suggested. A bias and content review is conducted by advisory groups as the committee proceeds through the materials. All decisions and recommendations made by the committee are recorded in chart format; these detailed charts and an accompanying narrative serve as the Development Plan for the IST course.

COMPUTER SYSTEM REVIEW AND REVISION

Working from the Preliminary Course Design, the instructional development team identifies the types of computer activities most appropriate to meet lesson objectives. Sample computer activities are drafted by the instructional development staff incorporating any recent software enhancements. The sample activities are checked by the computer system specialist (an essential step) for appropriateness and feasibility. It is at this point that the most effective uses of the computer for a particular course are determined in terms of available time, fiscal, and human resources. Unrealistic uses are deleted from the Development Plan.

DEVELOPMENT OF MATERIALS

During this phase, decisions are made as to how best to implement the recommendations delineated in the Course Development Plan.

SECURE COPYRIGHT RELEASES

Copyright permission is obtained, as needed, for use of published materials in alternate format (such as audio tape or computer activity). In some cases, a fee is charged for use of materials; usually permission is granted without charge because of the educational use of the material within a specific state.

COURSE GOALS AND OBJECTIVES

Course goals and objectives developed in the in-depth review phase are emphasized in the IST course version. During development, objectives are put into a form requiring specific student behaviors so that mastery can be determined. The objectives also identify for the student the information which will serve as the basis for each skills test. Tests and supplementary materials are tied to these objectives.

DRAFT OF STUDENT AND TEACHER MATERIALS

The drafting of student and teacher materials occurs simultaneously. Much of the emphasis is on filling gaps identified in the commercial or correspondence-course materials in skill and concept instruction. In addition, materials are adapted in such a way that they are relevant to the target student population.

COMPUTER ACTIVITIES AND TESTS

Many computer activities, particularly those which provide drill and practice of skills, are adapted from exercises in the student text or workbook. Others are created from suggestions in the teacher guide. A number are created to fill gaps. Questions on the computer generally take the form of multiple choice or fill-in; some make use of graphics such as maps or timelines. Modification to exercises or activities in the commercial or correspondence-course materials is generally needed to accomplish a match with the computer format.

Instructional computer activities contain synopsis screens which summarize the skill or content area covered in the activity, directions screens, and "help" screens. These are adapted from the text or developed to meet the requirements of the particular activity.

Tests on the computer are created or adapted from existing materials but have no help screens or examples. Objective screens are developed for each test; these identify skills not mastered and direct the student to appropriate supplementary materials, some of which may have been developed specifically for the IST course. The objectives are those identified earlier as being essential to the course.

The system developed for the computer permits the supervising teacher to check both test scores and specific objectives missed by each student. This "Student Management System" is consistent in all IST courses.

AUDIO SCRIPTS

The general purposes of the tapes are, once again, to provide initial instruction, review information, guide reading of selections, add variety and stimulate interest, and repeat in oral form the information which students might have difficulty understanding in reading. Various formats are used in developing audio scripts. The suggested format and purpose for each tape is recommended during the Course Development Planning Process. The majority of tape scripts are newly created. Where appropriate, copyright permission is obtained for published selections. Experience has shown that commercially developed cassette tapes are usable in only a few instances.

Listening Guides are developed as tape scripts are written. They are interactive worksheets which require student response to the taped material. Some Guides are adapted from existing course materials; created to fulfill a specific purpose for the particular lesson.

WORKSHEETS

Six major types of worksheets are developed for use with IST course materials: Listening Guides, Lab Guides, Challenge Worksheets, Application Worksheets, Review Worksheets, and written tests.

Decisions regarding inclusion of worksheets in lessons and the type of worksheet appropriate for a particular lesson are made by the Review Committee during the Course Development Planning Process. Each worksheet is designed to provide students with written application and/or practice in a particular set of skills or concepts. Format decisions, therefore, are influenced by the most effective presentation of the skill or concept.

Listening Guides are created for use with the audio tapes; answers to all items are given on the tapes. A Key for each Listening Guide is also created for inclusion in the Teacher Guide.

Lab Guides are created so that they provide enrichment and application experiences which parallel regular course activities. As appropriate, an audio tape is developed to accompany a Lab Guide. Lab Guides provide opportunity for hands-on experience. Materials needed are either listed (if readily available on-site) or provided through the IST course.

Challenge Worksheets are optional worksheets which are designed to provide stimulation and enrichment for students of high ability. Keys are provided for the Teacher Guide.

Application Worksheets, designed to provide drill and practice for skills emphasized in the IST course, are adapted from text or workbook materials or are created to parallel computer drill and practice activities. Worksheets may refer to text page numbers for student reference. Keys are developed for each worksheet. IST teacher materials include a suggestion that teachers keep informal track of student activities and any self-checked worksheets so that assistance or clarification can be readily provided.

Review Worksheets are provided for students who need extra practice on specific skills. Worksheets are either created or reproduced (after copyright release is obtained, if appropriate). Keys are supplied or developed as needed.

Written tests are sometimes included in addition to the computer tests. They are developed to match the instructional format of the course. Keys are provided where necessary.

PROJECTS AND TEACHING SUGGESTIONS

Projects are recommended by the Course Development Plan Committee for the purpose of providing opportunities for application of high-level thinking and writing skills. Projects suggested in existing text or correspondence study materials may be designated in IST teacher/student instructions as optional, recommended for omission, or rewritten as needed. Additional projects are created when essential concepts are not covered in other materials. Each project is identified in the Teacher Guide as to level of difficulty. On-site teachers are advised to use the stated levels of difficulty in guiding their students in project selection. Standards for written work, which apply to all projects, are delineated in both student and teacher materials. Specific criteria for projects and related suggestions for individualizing projects are included in teacher materials, but grading and weight of projects is at teacher discretion.

SUPPLEMENTARY MATERIALS

Some supplementary materials are skill-specific and can be created and/or supplied to accompany the courses. Other supplementary materials are identified and listed in the IST Teacher Guide for site purchase or optional use (such as films and video tapes available from the Alaska State Film Library). These materials generally have a content focus.

PROGRESS CHARTS AND DIRECTION CHARTS

Progress charts are developed for each unit or section of the IST courses. They list activities lesson-by-lesson and include a space for students to record the date each activity was begun and completed. Progress Charts can serve as an informal monitoring system of student progress. Each course is partitioned into lessons and follows an established format. Activities are balanced by the instructional developers within and across lessons to ensure variety. A lesson, for example, may consist of a vocabulary computer activity preparing students for a reading assignment, tape to reinforce important concepts and add information, worksheet for application of skills covered, and final computer activity drill on important facts from the reading and tape. *Computer activities are never presented consecutively within the same lesson*. This ensures adequate access by other students to the computer and provides variation in instruction.

TEACHING STRATEGIES

Effective teaching strategies for each course are recommended by the content specialists during the in-depth review process and by the instructional development team throughout the Course Development Planning Process. These suggestions, included throughout the IST Teacher Guide on color-coded pages, are provided for specific activities and topics and are also cited as general recommendations for the subject area. Where appropriate, sources of additional ideas are listed for teacher reference.

OPTIONAL ACTIVITIES

During course development, activities which will provide stimulation and enrichment for students of high ability are developed or identified for inclusion at appropriate points. In addition, activities which allow for extra drill and practice on skills and concepts are identified for students requiring additional assistance. Both enrichment and extra-practice activities come in a variety of formats: supplemental reading selections, written projects, worksheets, and tapes. Each optional activity is clearly identified as to purpose in the Teacher Guide; assignment of the activity is at teacher discretion. Where needed, suggestions on grading, instructional strategies, and level of difficulty are stated in a Teacher Note accompanying the optional activity.

TEACHER GUIDE, STUDENT MANUAL, AND COMPUTER READINGS BOOKLET

TEACHER GUIDE

Teacher Guides contain an explanation of the format of the course, copies of all student materials (readings, projects, direction sheets), scripts of audio tapes, printed copies of computer activities, tests, worksheets, Listening Guides, and Lab Guides. A full set of Answer Keys for all IST printed materials is included. For many activities, special notes are provided for the teacher. A reduced-sized copy of the student page is made and notes on grading, level of difficulty, purpose of the activity and/or teaching suggestions are typed in the margin. These pages are placed immediately before the full-sized student page and are color-coded for easy identification by the teacher.

When an IST course has a commercial text as its basis, the Teacher Guide is intended for use with the teacher edition of that text and includes detailed instructions for use of the IST course as well as additional guidelines for use of the published text.

A Teacher Folder, containing copies of consumable printed materials required by certain students only, accompanies the Teacher Guide. This folder also includes a copy of the Student Progress Charts, an extra set of Answer Keys, and many other teacher materials for the particular course which will be more easily accessible if contained in the folder rather than in the Teacher Guide.

STUDENT MANUAL

The Student Manual for each course contains all non-consumable printed material. The manual, designed to be used with the published text or with informational booklets which contain reading selections, includes the course rationale, objectives, detailed course-direction sheets (color-coded), instructions for using the textual materials, written introduction to reading selections, and instructions for completing course projects.

A Student Folder accompanies the Student Manual. This folder contains consumable printed materials required by each student and may be used to store completed work.

COMPUTER READINGS BOOKLET

Some courses utilize computer activities which are accompanied by readings too long to fit reasonably on the Apple II. In these cases, the readings are printed and bound in a non-consumable Computer Readings Booklet.

INTERNAL REVIEW AND REVISIONS

IST development staff review all drafts of materials for accuracy, thoroughness, and consistency. Materials and activities are carefully checked to ensure that course objectives are properly covered in instruction and testing. Materials are also checked to ensure compliance with the approved Course Development Plan. Problems noted during the internal review process are corrected and any necessary revisions are made in the course materials.

COMMITTEE REVIEW

In their first meeting, the Bias Review and Content Review Committees considered the available course material and determined the best method for conducting future reviews. As the courseware develops, it must be continually reviewed. Therefore, it was originally decided that this on-going process be conducted at face-to-face meetings or by mail. Because of the quantity of material, several groups were formed to review different units, with the agreement that the Chairman would review all materials. Material of particular ethnic or cultural nature was reviewed by appropriate representatives.

When this procedure was first initiated, the number of problems experienced in reviewing the materials and in reviewing comments in a timely manner mandated a different procedure. Therefore, the screening and selection of candidate courses and in-depth review referred to in the section, "In-Depth Review and Development of Course Design," was instituted early on in the Development Process. This pre-screening, carried out by Alaskan educators who are specialists in the content field, eliminated much of the objectionable material prior to review by the Committees. In its present form, the Committees receive drafts of the IST materials at regular periods throughout the Development Process. They record their comments and suggestions directly on the draft materials. Development staff then compile these notes on "comment sheets." Drafts of the materials are simultaneously reviewed by an experienced editorial consultant who is responsible for final editorial clearance of the developed materials.

DOE REVIEW

At periodic intervals established by contract, drafts of materials are delivered to the sponsor, DOE, in this instance, for review and approval prior to final revision.

FINAL REVISION

Recommended changes and suggestions of the various review committees and the sponsor are recorded and notes indicating actions to be taken are made by the Development staff based on these comments and suggestions. Revisions are made on the basis of these notes; corrections, additions, or deletions are made in IST materials wherever appropriate. Suggestions which will enhance the effectiveness of the IST model are recorded; they influence the development of subsequent courses.

PRODUCTION AND EDITING OF AUDIO TAPES

When sponsor approval for tape scripts is received, recording proceeds. The process of recording is closely monitored by Development staff to ensure accurate interpretation of scripts, instructional validity, and appropriateness of the presentation for the target population. Following recording of the narrative, tapes are edited to include sound effects and background music.

CURRICULUM ENTRY

One of the most time-consuming steps in the Development Process is the entry of computer activities onto curriculum disks. This curriculum entry overlaps many other steps in the process. To be prepared for curriculum entry, each activity, pool and question must be coded to indicate its limits and options. A course header indicating the sequential number, lesson number and activity letter, the number of pools and type of activity (pre-test, drill, review, or post-test) is prepared for each computer activity. This information is entered onto the IST system disk.

Once an activity, its pools and each question, has been coded, the coded information as well as all synopses, direction, pool help, local help, graphics, and question and answer text must be entered directly onto a curriculum floppy diskette. Each entry is logged.

The printing, proofing, and editing which follows are extremely time-consuming steps in the process. The computer is connected to a printer and hard (printed) copy of each entered activity is run. A member of the instructional development team proofs the printed copy for computer and human errors, noting any required edits. Working from this marked copy, the proofed activities are run on IST. Any additional problems are noted for editing. Typical edits include typographical errors, overly lengthy question-or-answer text, required pagination, spacing, placement of graphics, incorrect or incomplete coding.

The print, proof, and edit cycle is repeated until all edits have been made and checked on IST. As editing takes place, it is frequently necessary to compress the information on a disk in order to make maximum use of the space on each disk.

Bench testing by secondary students is another component of curriculum entry. Students check each computer activity and all of its options (pool and local help, objectives, time available, recording of goals, and answers). A bench-testing log is used for any final edits required.

Once the final round of editing has been completed and each activity has been checked on IST, a final hard copy is run and coding sheets are updated. Also the status file of the sytem disk on which the "students" have been enrolled must be cleared. At this point the system disk and curriculum disks are ready for duplication.

DUPLICATION

Multiple copies of student materials are printed and assembled. Student Manuals and Computer Readings Booklets are bound; color-coded folders of heavy paper are used for Student Folders; worksheets and Listening Guides are printed on two-copy NCR paper.

Teacher materials are printed and assembled along with copies of all student materials in Teacher Guides contained in three-ring spiral binders. Tabs are used to delineate lessons or chapters. Color-coded folders of heavy paper are used for other teacher materials. Multiple copies of other materials, i.e., audio cassettes, floppy disks, and supplementary materials, are produced.

DELIVERY TO DOE

Following duplication, all materials are delivered to the Department of Education for distribution to pilot test sites.

NOTE: Copies of some of the review sheets developed for use by the various committees that guide development of IST courses are included in Appendix A.

TESTING COURSEWARE IN THE FIELD

THE EXPLORATORY TEST

The first step in proving the courseware for operational use is to conduct series of field trials on each course. In the spring of 1979, the first of such trials, the Exploratory Test, was conducted. The core of the curriculum materials used was the Centralized Correspondence Study (CSC) test, "Alaska History," Unit 1: Geography (Weeks 1 and 2). However, since this was the first time IST courseware had ever been used, there were several basic questions to be answered which were key to the design of the courseware and not peculiar to "Alaska History." The fundamental purposes of the Exploratory Test were:

- to define an efficient response-criterion level for CAI drill items;
- to ascertain student and teacher acceptance of the instructional materials and procedures;
- to ascertain whether the hardware and software were sufficiently reliable for use in rural Alaska.

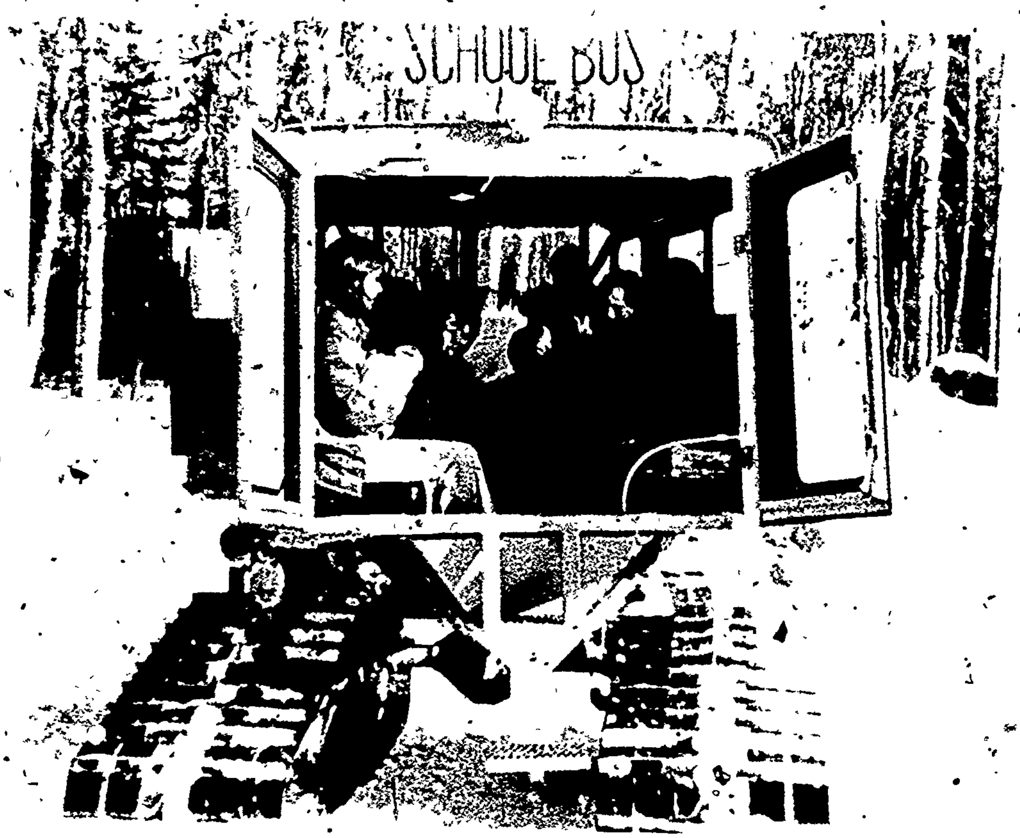
The response criterion refers to the number of successive correct answers the student must provide to any given question before the computer considers that he/she has mastered the subject of the question. The two response criteria tested were "two successive correct answers" and "four successive correct answers." Specifically:

- Does response criterion have a significant effect on post-test scores?
- Is there a significant interaction between response-criterion and reading-comprehension levels?

SITE SELECTION

The Exploratory Test involved three schools with 20 students from each school. The instructional units consisted of the first two weeks of Alaska History. The test lasted three weeks to allow slower students to complete their work.

Criteria for school selection were that there be fewer than 100 students in Grades 9-12, that they be of similar racial/ethnic distributions, and that there be reliable telephone service. Student selection was to be determined by use of a reading comprehension test. On the basis of the test results, ten students above and ten students below the mean at each school were chosen. Five of each group were assigned to the "two successively correct" response criterion and the remaining ten to the "four successively correct" criterion.



SUPERVISING TEACHER/AIDE TRAINING

Members of an instructional team visited each site before the test began to inspect the set-up and operation of all equipment, to observe student/teacher/aide reactions, and to make notes for system revisions. School board members, the superintendent, and other interested persons were briefed about the Project and the Exploratory Test.

An intensive one-day training session was held in Juneau one week before the test for supervising teachers and aides. The purposes of the training were to:

- specify clearly the skills required by the participants -- managerial as well as educational;
- present activities to develop those skills;
- give educators an understanding of the philosophy and process of course components;
- establish a strong rapport between master teacher, supervising teacher, aide, and test managers;
- identify potential problems and means for dealing with them;
- give hands-on training in unpacking and packing the equipment, equipment set-up and operation, and insight into the instructional software;
- review the student materials.

The training turned out to be a vital component of the IST model. Teachers and aides had few problems setting up equipment and making it operational on-site. Use of color-coding greatly simplified the tasks of equipment hook-up.

RESULTS AND IMPLICATIONS

The reader should note that briefing interested persons at the local sites and removing supervising teachers and aides to Juneau for training were deliberate. During the course of bringing up the Administrative Communications Network, it was found that on-site training of the primary training target audience with other interested parties in attendance was distracting. It resulted in inefficient use of time and also required continued repetition of content.

STUDENT ACHIEVEMENT

Like so many other aspects of ETA, the outcome of this Exploratory Test has significance beyond the Project. This has consistently been the case, because evaluations have dealt, to a very large extent, with how to match the innovation interface with the intended target audiences. Thus, the recommendations, as formulated in this report, are of the same value as guidance to readers as they originally were to IST management.

Before listing the recommendations, however, the results of the impact of response criterion on student performance is discussed because of the interesting results obtained and its value to readers. Table IV-10 lists the mean scores achieved by the high and low readers as groups and as differentiated by the response criterion for the computer test and the written test (essay).

Several results were anticipated and therefore, not surprising: high readers scored significantly higher on the computer test than did low readers; high readers scored better on the written test than low readers. When the effect of response criterion was taken into account, it was surprising that there was no difference on the computer test between students whose criterion was two consecutively correct answers to each question and those whose criterion was four. On the written test, criterion-two students, as a group, scored significantly better than did criterion-four students. There was a major difference between low readers (criterion two) and low readers (criterion four) on the written test; criterion-two students scored significantly higher than criterion-four students.

A possible explanation of this last phenomenon is that the low readers who were required to complete each question correctly four times, may have progressed more slowly through the computer drills. This may have interfered with their retention of some materials, perhaps the later materials.

Table IV - 10

MEAN SCORES FROM UNIT TEST

	Mean Score, Computer Test	Mean Score, Written Test	Mean Score, Total
High Readers Two Trials (N = 14)	55.14	27.71	82.86
High Readers Four Trials (N = 8)	56.75	27.19	83.94
Low Readers Two Trials (N = 15)	47.33	26.27	73.60
Low Readers Four Trials (N = 10)	47.70	19.60	67.30
High Readers (N = 22)	55.73	27.52	83.25
Low Readers (N = 25)	47.48	23.60	71.08
Two Trials (N = 29)	51.10	26.97	78.07
Four Trials (N = 18)	51.72	22.97	74.69
All Students (N = 47)	54.34	25.44	76.78
Total Possible Score	60.00	30.00	90.00

IMPLICATIONS:

- All students, low as well as high readers, can be given a two-criterion goal on computer drills without affecting potential post-test scores.
- It appears that, for low readers, a minimum-acceptable-correct-response criterion on computer drills will help them retain facts for essay-type tests that may accompany computer drills.
- It appears that too high a response criterion would be detrimental to low readers in essay-type tests covering the same subject area.
- Low criterion goals allow for more efficient use of the computer since drill sessions would be shorter; also more drill questions can be given for a set amount of time.

PARTICIPANTS' REACTIONS

The reactions of participants were garnered by having students complete a questionnaire. Teachers were interviewed by phone according to a survey instrument prepared ahead of time. The response pattern among the three schools was very similar, indicating that the responses probably can be made general to small, rural high schools like those in Angoon, Hoonah, and Yakutat.

IMPLICATIONS:

- Most students will find reading from the computer screen "easy" or "about right."
- Students will be inclined to prefer properly prepared topics studied via the use of a media mix to conventional teaching.
- Although supervising teachers play a lesser role in the actual teaching process, students will probably feel that teacher support is adequate.
- Students will probably prefer, by a large margin, the computer portion of the learning experience to audio or written materials.
- Students would probably respond "yes" to the question of whether they would like to take another course using the computer and tape recorder.
- Teachers/administrators will react positively to the enthusiasm of the students.
- It is probable that students involved in a properly constructed media course will exhibit higher attendance than in a conventionally taught class.
- It is generally a good idea to set the reading level of the instructional materials at about two years below the grade level of the paticipating students.
- The audio format must be carefully considered. It should not be taken for granted that dramatization, quiz shows, or other exotic formats are more liked or lead to retention of more information than straight narrative reading.
- Supervising teachers will probably feel that their minimal interaction with students could cause future problems.
- Supervising teachers may feel like "monitors" rather than "teachers." Means should be taken early on to prepare teachers to accept their role as manager/instructor.
- Small, teacher-led discussions included as part of the process would probably help teacher "morale" and provide guidance for the students.
- It would probably be advisable for students to have varying entry points into the lessons to prevent their having to queue up for access to the media; provision should be made for students to enter at their own level.
- Additional activities should be available for students who finish their lessons early. Finishing early will probably be less of a

problem if students are permitted to proceed through the courseware at their own rate.

- Turn-around time for worksheets forwarded to the master instructor can be a potential problem and may require a larger role in the process for the supervising teacher.
- If the master teacher is to correct worksheets, lessons should not be structured so that other work or tests must wait upon the return of said worksheets. Alternatively, such written assignments must occur early in the units so that they do not impede students' progress.

HARDWARE AND SOFTWARE ISSUES

It cannot be emphasized too often that the technology, if not in proper working order or maintained poorly, can destroy enthusiasm for the project and result in failure despite an excellent instructional design. This applies whether it is the technology being introduced or the existing technology that must be used with it.

IMPLICATIONS:

- The quality of the transmission links must be high if student-written worksheets are to be transmitted to, and returned from, the master teacher. Variations in student handwriting can result in deterioration of the items received to the point where either the master teacher's copy or that which is returned to the student, is unreadable.
- In poor, small communities, expense of transmission of large numbers of worksheets can be considered excessive.

- In a structured-lesson format when students should use the media in a prescribed sequence, it would probably be advisable to put control of access in the hands of the supervising teacher or aide in order to have the flexibility to accommodate both fast students and those who are trying to make up lessons. It would be unwise to "lock out" access to the computer, for example, at the beginning of the period in order to ensure that students follow the mandated sequence.
- When using a computer-screen format that provides the answer to a wrong question, sufficient time should be allowed for a slow reader to read both the question and the answer; or it may hinder rather than enhance the learning process.
- A manual should be provided which identifies mechanical problems and solutions in order to facilitate uninterrupted use of the system.

IMPACT ON IST

As a result of the findings of the Exploratory Test, the following changes in the IST were implemented:

- The format of the audio tapes was modified from a somewhat dramatic to a more traditional style.
- Facsimile copies of student worksheets were eliminated; automatic carbon worksheets were utilized to allow the on-site supervising teacher to correct student work while forwarding the copy to the master teacher.
- It was decided that problems identified by the master teacher or encountered by the supervising teacher were to be resolved by teleconferencing.
- In the main, the role of master teacher was changed to one of consultant on request by the supervising teacher.
- The supervising teacher assumed a greater role in content feedback to the student.
- A comprehensive hardware/software manual was developed for use on-site.

THE PILOT TEST

The findings of the Exploratory Test had an effect on the roles of both the master and supervising teacher, on some aspects of student management, and on ways in which the media should be formatted and used, e.g., audio tapes. Those factors affecting the participants' role and student management were incoporated into the IST model immediately. The media fixes could not be accommodated in the English and Alaska History courses but were influential in structuring future courses. With the completion of the full-year English and Alaska

History courses, attention turned to testing them over an entire academic year.

The reader will recall that the Pilot Test was the mechanism for conducting a full-year test using completed courses. Therefore, in the school year 1979-1980, both English and Alaska History were introduced in seven schools and involved more than 120 students. This sample size was considerably larger than the one used for the Exploratory Test. Students were selected to represent a broad range of the Native groups of rural Alaska. In addition, sites were visited to ensure that those selected to participate were representative of the conditions, accessiblity, and geography of rural high schools. In broad terms, the purpose of the Pilot Test was to determine the effectiveness and potential usefulness of these specific courses and, in general, assess realistically the usefulness of the IST instructional model.

Preparation for the test was extensive and lasted several months. The process included choosing proper sites, selecting the proper student mix, informing administrators, training supervising teachers and course coordinators (formerly called master teachers), indoctrinating students, and ensuring that equipment and software were available and debugged. Careful preparation was essential to the successful conduct of such a long test.

The core courses of the Pilot Test are briefly described as follows:

English was designed to be a regular 9th Grade or basic skill reinforcement course for 10th to 12th Grades. The first-semester units developed student skills in grammar and reading comprehension by focusing on simple and complex sentences, punctuation, capitalization, and other grammar and syntax bases. The second-semester units focused on major topics in written expression including interpretation of literature, paragraph writing, and related skills.

Alaska History was designed as a regular course for 9th to 12th Grades. The first-semester units covered descriptions of the regions of Alaska and major physical forces that affect its development, and detailed the structure and lifestyle of the Native groups and the relationships among them. The second semester focused on the Russian heritage of Alaska, detailed events from the time of its purchase by America through statehood in 1959, and concluded by considering present-day issues (e.g., land and oil resources) and by speculating on future developments in the State.

TRAINING

Training was conducted over a period of three days in September, 1979, just prior to the beginning of the school term. It was carried out by the Course Development Contractor, NWREL, and was aimed primarily at involved supervising teachers and principals and course coordinators (one for each of the two courses). ETA Project personnel were also present. Sufficient hardware and courseware were available at the training sessions to ensure that all participants had their own equipment/software when working through a particular exercise together. Equipment consisted of the microcomputer and its associated hardware and software, courseware, audio cassette players, and a number of teleconferencing units.

Training for supervising teachers and principals consisted of:

- unpacking, assembling and repacking the IST microcomputer, cassette recorder, and the Darome teleconferencing unit;
- understanding the organization and philosophy of an IST course;
- properly operating all equipment, registering and deleting student records on the student disks, and calling up summary student records on the micro;
- troubleshooting some common hardware and software problems;
- learning names of proper DOE/ETA staff members to contact when any problems arose;
- understanding under what conditions to contact the appropriate course coordinator;
- learning the range of roles to be played by the supervising teacher from monitoring and evaluating student progress to providing guidance and motivational support and communicating with the course coordinators;
- learning about the content, organization, and student activities of the course for which they (supervising teachers) were responsible;
- playing the student's role by participating in samples of every different student activity involved in the course for which they were responsible;
- working out a teleconference schedule/format with the course coordinators.

Training for course coordinators consisted of:

- understanding the philosophy and organization of an IST course;
- demonstrating in-depth knowledge of the rationale, organization, and content of the course for which they were responsible;
- understanding the content, organization, and student activities associated with the courses for which they were responsible;
- knowing their role in evaluating student progress, providing feedback to the supervising teachers and ETA staff, correcting worksheets requiring analysis by the content specialist, and planning/conducting weekly teleconferences;
- understanding operation of the teleconferencing unit;
- becoming familiar with student products;

- developing strategies for effective communications with students via teleconferencing;
- working through samples of each type of student activity in the appropriate IST course.

HARDWARE/ SOFTWARE TRAINING MANUAL

In an attempt to avoid interference of equipment procedures with the evaluation of the IST model and courseware, a comprehensive document was prepared by the Design and Implementation (D & I) Contractor for use by supervising teachers on-site.

Like all documents prepared for use by cooperating personnel, the Manual began with a brief history and philosophy of the ETA Project and the purpose of the Pilot Test. In the belief that it was important to put everyting into its proper context, repetition of these fundamentals was important for participants who were new to the Project and reinforced the concepts for those who had been involved before. Unlike most projects, ETA management believed in involvement of not only those directly supporting student learning, but also identifying the responsibility of key administrators even though their roles did not involve the student directly. This philosophy is believed to be sufficiently important (one too often neglected) to be included in this report. The Manual states:

"The principal has a key role in the success of the IST implementation. This individual should be *supportive to the staff* in the following ways:

> "obtaining all materials, equipment, and facilities;
>
> "determining the selection and scheduling of students in cooperation with the Project staff and the DOE;
>
> "assisting the staff in problem solving;
>
> "observing regularly during the Pilot Test period in order to analyze the effectiveness of the IST model in terms of flow of students and organization of supervising teachers' work;
>
> "providing release time for the supervising teachers to observe and monitor student progress during the course of the Pilot Test. (Students were scheduled to carry out their individualized tasks, on the Apple computer or audio cassette, throughout the day rather than only during the class period. This reduced the amount of hardware required and greatly improved cost effectiveness.); and
>
> "responding to questions about the IST model during several scheduled interviews during the test period."

The Manual also laid out the revised roles of the supervising teacher for each course as it related to interaction with the student; student record management; communication with the principal, course coordinator and students; and the types of information to be entered in a weekly log (e.g., instructional problems and how they were solved).

The role of the course coordinator for the Pilot Test was also presented in detail and included establishing a schedule of weekly contact with the seven supervising teachers responsible for the courses within their (course coordinators') expertise; providing at least one presentation per semester to each Pilot Test site (content to be based on supervising teachers' suggestions); assisting evaluators in determining critical information to be gathered during interaction with teachers and/or students; and discussing specific problems and significant achievements during regularly scheduled teleconferences.

The majority of the Manual consisted of discussion, illustrated with pictures, on the microcomputer, its set-up and operation, step-by-step procedures for getting the student started, accessing and operating the student management system; the teleconferencing equipment and how to use it properly; and the audio cassette player. Also included was a short summary of student activities involved in each course. It explained the role of reading materials and the relationship of micro and audio cassette activities, worksheets, unit tests, and special projects. The Manual ended with a brief discussion of simple problems that could be remedied on-site. In short, the Manual was a reference or refresher vehicle, serving as a reminder of all the things that had to be done to successfully operate on a daily basis at the individual sites.

SITE VISITS

Sites were selected for participation in the Pilot Test based upon several simple, but important, criteria:

- school should have 100 or fewer students in the 9th to 12th Grades;
- student population should be a cross-section of ethnic and cultural groups;
- school principal must have expressed interest in using the IST courses and willingness to support the school staff;
- must be a reliable source of AC power at the site; and
- at least one reliable telephone circuit must be available for use.

The sites selected for participation were scattered throughout the State rather than concentrated in an "intensive pilot region" as suggested in the original concept proposed to NIE. The decision not to concentrate in a single region was based, primarily, on the importance the Project placed on the desire to have participating schools where administrators were committed to supporting the experiment to the fullest extent. This criterion outweighed all others. The seven participating high schools were located in Aleknagik, Angoon, Fort Yukon, Hoonah, McGrath, Nondalton, and Yakutat.

NWREL staff visited each site shortly after the training session to provide start-up support to personnel. Although one of the selection criteria was a reliable phone circuit, it was found that Nondalton could not use the Darome teleconferencing unit because it did not have the necessary telephone. In addition, three sites had telephones a short distance from the rooms; one had a phone in another building; and two had phones in the rooms where activities were to take place. Thus, an additional, but realistic, variable was interjected which would influence the use of teleconferencing by course coordinators.

One of the things the site visitors considered very carefully was the room set-up for actual student use of the IST equipment and the relative location of materials to be used with that equipment. Specifically, questions about aspects of the facility that are important to determining whether it provides a secure and proper work environment, are:

- Was the area large enough for equipment and materials storage?
- Was the area secure?
- Was the area where the computer and CRT were to be located out of direct sunlight (to prevent a glare problem)?
- Could the temperature be controlled? (Necessary both for student comfort and to keep equipment from overheating.)
- Was the electrical power adequate?
- Was the area used for other purposes?
- Was the telephone conveniently located? (Important for ease of teleconferencing or transmission of data, if used.)
- Were the supervising teachers satisfied with the facilities?

Additional items on the site visitors' checklists were:

- Had all equipment/materials arrived?
- Was the equipment properly installed?
- Were there problems in scheduling all students on the appropriate days?
- Were the supervising teachers able to operate the student management system?
- Were the students using the equipment and materials properly?
- What were the attitudes of staff, administrator, and students?
- Were there any problems?
- Did the supervising teachers understand their roles?
- Did any of the individuals involved have any suggestions?

INITIAL REACTIONS TO THE PILOT TEST

Two months after the Pilot Test was underway, a meeting was called by the ETA Project Director to review the progress of the seven sites and to identify any problems that might have surfaced. In attendance were ETA personnel, all supervising teachers, representatives from the courseware developer, and two representatives from the South East Regional Resource Center (SERRC). The findings greatly influenced the conduct of the remainder of the Pilot Test and, when generalized, are of value to the reader as well:

- The IST model had evolved to allow varying degrees of teacher intervention and modification of individualization to allow for differing amount of non-IST content and student group activities. For example, two sites changed the instructional approach from an individualized one with limited supervision/teacher intervention to one involving group activities. (It was the nature of several of the ethnic/cultural groups involved to engage in group activities and decision-making rather than in individual action.) At least five of the sites brought students together as a group on a weekly basis if not more often.
- Many teachers viewed reduced interaction with students as undesirable. They felt they were losing track in terms of progress and awareness of difficulties which students were encountering. This was not an issue where IST students met periodically as a group.
- IST was used to accommodate students with scheduling conflicts or those who had missed a subject which was scheduled on alternate years.
- The IST courses were utilized by students from the 7th to 12th Grades, across ability levels from gifted to special-education students, and with varying amounts of teacher-intervention; this, despite the fact that the reading level for the IST courses was set at the 7th Grade level.

- With regard to the highly individualized nature of the courses with limited teacher intervention, teachers felt that 9th graders and below functioned less well (below accepted standards in some cases) than students in the 10th to 12th Grades who seemed to be able to function well in this situation. (This reinforced the concept of greater teacher intervention and varying the amount of individual help as required.)
- The IST model created a greater workload for the supervising teacher where traditional group delivery and scheduled class times existed; it reduced the workload where student courses were individualized.
- It was noted that high student accountability required by IST courses enhanced teacher-student interaction in some instances by requiring students to come to teachers with content questions. (This appeared to apply mainly to the more passive students in a group classroom setting.)
- Variation in student progress, permitted by IST, was seen as allowing them to work close to their potential. However, some students appeared to be racing through the materials, in competition with their peers, possibly at the expense of internalizing the content.
- Teacher consensus was that the less teacher/aide interaction, the less well students progressed both in number of activities and quality of work.

It was at this meeting that the shortcomings of the prescribed teacher/student interaction with course coordinators came to the fore. It was generally agreed that teleconferencing in the existing environment, as a required activity integral to the learning process, was not appropriate because of the following factors:

- Communication between students and course coordinators was very limited because the coordinators were not known to them. (It is generally the case that situations requiring continued interaction via teleconferencing should be preceded by a face-to-face meeting).
- The cost of teleconferencing was very high.
- Tying up the only telephone line or one of several available ones presented problems to other users.
- Individualized schedules made it difficult to assemble a class as a group.
- Varied student progress hindered group presentations.
- Telephones were not usually located to accommodate a group.

It was agreed that from then on a change would be made from required weekly teleconferences initiated by course coordinators to pilot site contacts at the supervising teacher's discretion. It was also agreed that a technical person would handle technical problems, while the course coordinators would continue to handle course-related problems. Furthermore, course coordinators would be consulted on course content, student worksheets, and test performance as needed. Student data reporting and the ordering of required materials rounded out the major duties remaining to the course coordinators.

At the end of the first semester, problems relating to hardware reliability and course content surfaced:

- Student motivation waned when numerous disk errors occurred and microcomputers continually malfunctioned.
- Some students stated a preference for more reading in the English course; others stated that it was difficult to see the relationship between some reading assignments, associated audio tapes, and computer drills and worksheets.
- A number of students at different schools became upset when they were asked in the Alaska History course to identify their cultural background and differentiate it from others. (It was recommended that this be retained in the course but that it be introduced more slowly.)

Changes instituted at this point to remedy detected deficiencies were:

- English worksheets were redesigned to encourage self-expression and to permit lengthy essay answers which focused on development of writing skills by building on basic concepts taught about grammar.
- Supervising teachers were encouraged to institute more procedural checks to ensure that students had learned the concepts being taught, thus detecting student difficulties early.
- Kits were to be provided for history projects in order to overcome the lack of materials at isolated schools.
- Teachers were given the flexibility to spread computer tests over two periods where they found a single period too short.
- Technical problems were referred to a computer consultant for quick resolution who either told site personnel how to fix the problem or to immediately send the part to the depot for repair. The intent was to avert the frustrations that arise from chronic problems.

PILOT TEST EVALUATION

A comprehensive evaluation of the 1979-1980 school year was critical to the survival of the IST. It was the first full-scale test wherein the course materials were complete, all site equipment was available, and the supervising teachers and course coordinators were fully aware of the flexibility and restrictions imposed by the model. Mid-course corrections, implemented as a result of the first semester review, had been in place about five months. In essence, the IST model was complete. Problems, other than minor ones that could be easily corrected, could well cause the demise of this instructional concept -- little time and money remained to initiate a major overhaul.

EVALUATION PROCEDURES AND INSTRUMENTS

Evaluation information was collected from participants at training workshops, weekly Project staff meetings, site visits, numerous telephone contacts, and written communications. There were two site visits by the evaluation staff to each of the seven pilot sites where all participating staff were interviewed. In addition, students were observed using the equipment and materials, taking exams and filling out worksheets -- all within their regularly scheduled class and computer-drill periods. The data collection instruments used throughout the Pilot Test year were the following:

- Inventory for Project Professionals – These data were collected at the very start of the school year and thus provided baseline information about attitudes and perceptions of the IST; existing and anticipated roles under the IST; knowledge of the specific features incorporated into the courses; and other data.
- Training Terminology List – Assesed teacher understanding of the essential terminology associated with the equipment under their responsibility (pre-test/post-test).
- Evaluation of IST Training – Gathered participants' perceptions of the quality of the training session and its overall adequacy.
- Student Checklist – Completed by students prior to beginning the program and also at the end of the academic year. It gathered information about student attitudes regarding, primarily, school and learning.
- Student Pre-test and Post-test – Covered materials included in the courses using items drawn from computer unit tests and written tests. In addition, three sections of a standardized English test, the Sequential Test of Educational Programs (STEP), involving reading, vocabulary, and writing skills, were administered.
- Perceptions of the IST Project – Similar to the Inventory for Project Professionals but completed by site administrators and selected non-IST staff.
- Observation Schedule – Used by evaluation staff during site visits. Focus was on student behavior at the microcomputers, interaction of students with each other and with teachers, and problems encountered by students and supervising teachers.
- Comment Sheet – Provided information about equipment, scheduling of students for computer use, materials, roles, communications, and student behavior. (Completed by IST supervising teachers).
- Site Contact Record – Recorded hardware, s[illegible], content, and courseware problems and solutions proc[illegible] DOE.

- *Interview* - Used by evaluation staff with supervising teachers and aides during site visits.
- *Student Background Schedule* - Contained reports on student's general achievement, motivation, attendance, study habits, interest in school and educational goals.
- *Problem Rating Scale* - For recording problems encountered by the supervising teachers in the areas of hardware, software, courseware, and communications.
- *Cost Analysis Schedule* - Recorded data regarding direct and indirect costs of the IST.
- *Unit Evaluation* - Completed by the students for rating units and features of the English and Alaska History courses.
- *Computer Data* - Printouts of the students' disk work.
- *Supervising Teacher Survey* - Provided assessment of training with regard to competency level to operate the Apple, clarity of role definitions, recommendations for revisions and/or additions for improved training (end-of-year questionnaire).
- *IST Components and Procedures Survey* - Completed by supervising teachers at the end of the Test to indicate whether modifications to components and/or procedures were needed.

EVALUATION FINDINGS

EFFECTIVENESS OF THE COURSES IN TERMS OF COGNITIVE AND AFFECTIVE ACHIEVEMENT

Analysis of the seven Pilot Test school pre-test scores in both English and Alaska History showed no significant differences. Thus it was concluded that the IST students, regardless of site, began the Pilot Test with similar levels of baseline knowledge.

Students, regardless of site, made significant gains in the English course content. The mean for the pre-test was 7.89; the mean for the post-test was 10.16. Students, regardless of site, also made significant gains in vocabulary knowledge (STEP), $t(23) = -3.85$, $p<.05$.

Analysis of student performance in Alaska History showed that significant gains were made, across all sites, in the acquisition of first semester History facts, $t(19) = -5.12$, $p<0.5$. The mean for the Alaska History pre-test was 10.1; for the post-test it was 13.95. Unfortunately, insufficient data prevented analysis of second semester results.

No significant differences in scores occurred among sites during end-of-year testing except on STEP vocabulary. School Site 4 performed significantly higher than the other four sites that provided post-test scores, $F(4,24) = 8.165$, $p<.05$. (Two sites did not forward post-test data.) A test run to determine the proportion of variance in scores explainable by differences among schools (Eta²) did indeed show a moderately strong relationship between school differences and variations in STEP vocabulary post-test scores. The differences that accounted for the variations were not determinable from the analysis itself.

In Alaska History, two schools showed significantly higher levels of knowledge of the first semester materials than the four others who submitted data. School Sites 1 and 6 surpassed the other schools, $F(5,14) = 8.075$, $p<.05$. The Eta² of .74 showed a strong relationship between school differences and variations in post-test scores. Again, the differences which accounted for these variations could not be determined from the analysis.

No significant differences in second semester Alaska History knowledge levels were found among the four schools reporting post-test scores.

EFFECTIVENESS OF THE IST MODEL FOR EXPANDING COURSE OFFERINGS

Ninety percent of the teacher respondents to this question regarded IST as an effective alternative for expanding course offerings. None of the teachers disagreed but 10 percent were unsure. The most frequently recommended courses for the IST approach were mathematics, science, and social studies. These were the same courses that surveys taken in 1978 had shown were the least-well-covered in rural high schools. Therefore, it could be surmised that teachers believed that the IST model was appropriate for any courses for which there was a great need.

IST courses were regarded by teachers as an effective method for providing courses for students in need of a small number of credits for graduation since the credit could be acquired independently within a short period (depending on the student's ability and availability of the course).

Periodically, after completion of an individual unit of study, students were asked to express their opinions about those units. In English, at least 73 percent of the students responded that they were able to read and understand lessons; that practice exercises helped them learn; that directions were easy to understand without teacher help; and that activities helped in understanding the units. Sixty-four percent stated that worksheets aided in learning the material. Most of the remaining students were uncertain about their opinions and fewer than 10 percent disagreed with the majority in any of the five areas surveyed above.

Figure IV-7 presents student reaction to the English course format. Fifty-five percent stated they were able to use the computer enough; 87 percent were able to finish at their own speed; 61 percent had enough time to learn before taking the unit test; 55 percent had time to do the expected work; and 62 percent stated that grading for work performed was fair. Thirty percent felt they did not get to use the computer enough. When coupled with the fact that the vast majority were able to finish at their own speed, it can be concluded that students really enjoyed their time using the micro and would have preferred more. Approximately 25 percent felt they did not have enough time to learn before the test -- a situation that was later rectified by providing more frequent supervising teacher checks throughout the course.

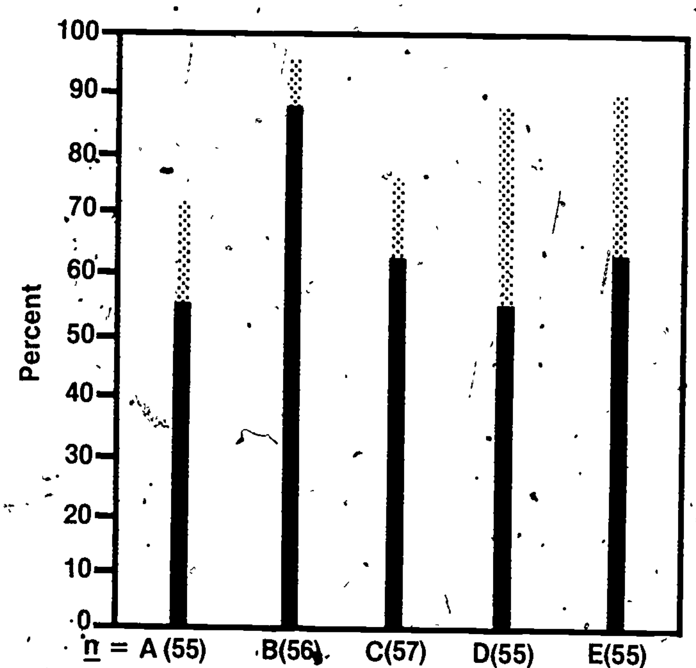
The overall student evaluation of English showed that 86 percent were able to get teacher help when requested and 60 percent indicated they would like to take other courses taught in the same way. Fewer than 10 percent felt they could not get needed help and 20 percent definitely would not like to take other IST-type courses.

In Alaska History, a total of 29 students responded to questions relative to content and format. Of these, more than 66 percent agreed that they were able to read and understand the lessons; that practice exercises helped them learn; that directions were easy to understand without teacher help; that activities helped their understanding of the units; and that worksheets aided their learning of the material. Fewer than 5 percent disagreed with the majority except relative to worksheet usefulness, where about 10 percent disagreed.

Reaction of students to the Alaska History course format is shown in Figure IV-8. Wide variations were noted in this instance. All students agreed that they were able to finish assignments at their own speed. Sixty-two percent indicated that they had enough time to learn before taking the test; approximately 25 percent were unsure; and 13 percent disagreed. Almost half, 48 percent, stated that the workload was not too heavy but 30 percent were uncertain and more than 20 percent felt the workload was too heavy. Grading was considered fair by 48 percent; the rest were unsure. Only 34 percent reported they had been able to use the computer long enough; 35 percent were unsure, and 30 percent definitely felt they did not get enough use -- again indicating a preference for the computer format.

Figure IV - 7

ENGLISH UNITS COURSE FORMAT EVALUATION
(ALL SCHOOLS RESPONDING)



Statements:

A. Get to use computer enough.
B. Able to finish at own speed.
C. Had enough time to learn before test.
D. Expected work load is not too much.
E. Grading for my work was fair.

In the overall Alaska History course evaluation, 90 percent of the students felt the supervising teachers were able to help when needed and 52 percent expressed interest in taking other courses in the same way. Twenty-eight percent were uncertain about their interest in other IST courses and 20 percent would not like to take such courses.

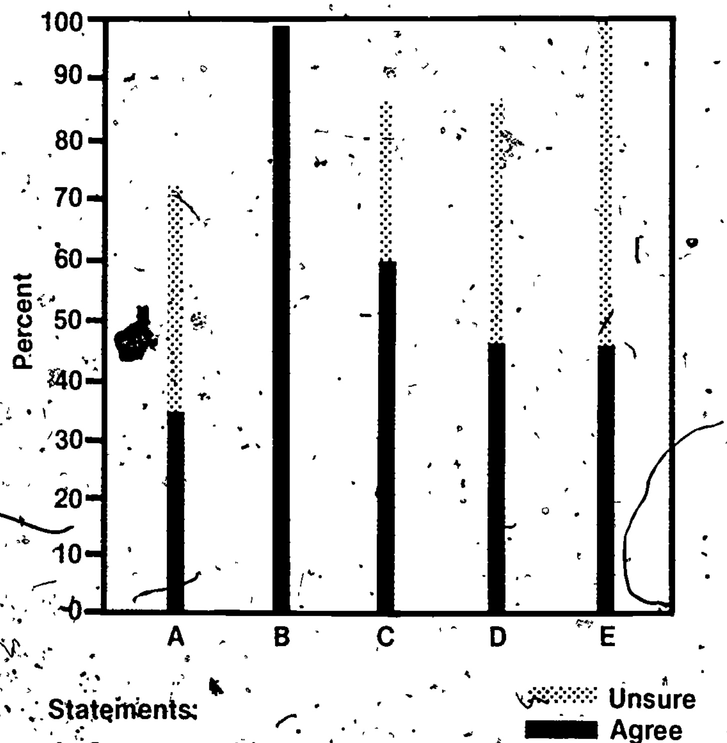
ESTIMATE OF THE PER STUDENT AND PER DISTRICT COSTS OF PROVIDING IST INSTRUCTION

The cost model and the analysis performed by SERRC based on data collected during the Pilot Test were limited. Certain assumptions were made and a limited number of cost elements assumed. A number of the assumptions required caveats to ensure that the reader understood the limitations of this analysis.

In estimating the 1980-81 (the year following the Pilot Test) per-student and per-course costs of providing IST instruction, five variables were considered. These variables were:

Figure IV - 8

ALASKA HISTORY UNITS FORMAT EVALUATION: (n = 29 FOR ALL SCHOOLS RESPONDING FOR EACH STATEMENT)



Statements:

A. Get to use the computer enough.
B. Able to finish at own speed.
C. Had enough time to learn before test.
D. Expected work load is not too much.
E. Grading for my work was fair.

- equipment purchase and maintenance;
- disk purchase, reproduction, and distribution;
- software development and maintenance;
- course-specific materials development, revision, and purchase; and
- training provided regionally and on-site.

The Cost Analysis Model is shown in Figure IV-9.

The following assumptions and specific cost factors provided the basis for the cost analysis:

- The number of sites assumed for 1980-81 was 25, with four courses per site, and an average of seven students per site for each course. (NOTE 1)
- The per-course cost was defined as the per-course cost per site.

Figure IV - 9

COST ANALYSIS MODEL

Per Course Cost Per Site/ Per Student Cost = Local District Share + DOE Share

Local District Share = Equipment Purchase & Maintenance + Course Materials & Disk Reproduction + Regional Training

DOE Share = Software Development + Course Material Development + On-Site Training

- Only the cost for the trainer's time for on-site training was utilized for the cost analysis. (Local supervising teacher costs were not included.)

- Equipment Purchase and Maintenance (NOTE 2)
  - It was assumed that the typical school site would have two Apple II microcomputers and two tape players. Each school district would purchase and maintain this equipment. The Apple II's life expectancy was five years; a tape player could be expected to last two years.
  - The cost of an Apple II computer was $4,000.
  - The cost of a tape player was $80.00.

- Course Materials and Disk Reproduction
  - $20.00 per hour was the assumed rate for copying disks; 5 minutes of copy time per disk;
  - 14 disks per English course at $2.97 per disk;
  - 12 disks per Alaska History course at $2.97 per disk;
  - 1 set of tapes (48 tapes) per English course at $85.68 per set;
  - 5 sets of tapes per Alaska History course for a total cost of $92.82;
  - books were assigned a life expectancy of two years; expendable written materials, one year;
  - $298.00 for written materials (expendable and non-expendable) per English course;
  - $540.00 for written materials per History course;
  - 3 disks per student for an IST course.

- Software Development
  - $150,000 for total development costs amortized over a five-year period (30 courses assumed for the five-year period);
  - maintenance costs based on $12,000 for a one-year period.
- DOE Course Material Development/Revision - $120,000 per course per year. (NOTE 3)
- Regional Training (NOTE 4)
  - two training sessions at three days per session;
  - each training session attended by two staff personnel from each school site;
  - release time per staff at $150.00 per day.
- On-site Training (NOTE 4)
  - three on-site visits per year for each school; two days per visit;
  - $200.00 salary cost per day per trainer.
- Per Diem for Staff and Teachers
  $200.00 per trip for travel costs for each school staff and trainer. (NOTE 4)

NOTE 1: Assumed the IST model would be used only with small rural high schools. Flexibility demonstrated in the application of IST courseware permits wider use.

NOTE 2: The Apple II's projected life expectancy is modest as is that of the tape player. Other users attempting to estimate prices must recognize that Apple II computer costs have come down considerably.

NOTE 3: This cost has been revised downward with experience gained on subsequent courseware.

NOTE 4: The use of audio teleconferencing for training is being considered by the DOE to substantially reduce this cost factor.

Results of the analysis showed that the per-student cost of the IST English course was $268.62 for the school district. The per-student cost of IST Alaska History was $315.92 for the school district. For each IST student, regardless of course, the DOE share was $519.99, resulting in a total per-student cost of $788.61 for English and $835.91 for Alaska History. Table IV-11 presents the cost allotments by category.

The per-course costs for a school district to offer the IST English program at one school site (seven students) were calculated to be $1,856.87 and the IST Alaska History course cost to a school district was $2,188.04 for one school site. The DOE share for one course at one school site was $3,640.00. Table IV-12 presents the cost allotment by category.

Table IV - 11

IST PER STUDENT COST, 1980—81

Cost Category	School District Share		DOE Share
	English	Alaska History	
Equipment	$ 91.82	$ 91.82	$ ....
Software	....	....	45.71
Course Materials	58.23	105.53	165.71
Training	118.57	118.57	308.57
Totals	$268.62	$315.92	$519.99

Table IV - 12

IST COURSE COST PER SITE, 1980—81

Cost Category	School District Share		DOE Share
	English	Alaska History	
Equipment	$ 642.67	$ 642.67	$ ....
Software	....	....	320.00
Course Material	384.20	715.37	1,160.00
Training	830.00	830.00	2,160.00
Totals	$1,856.87	$2,188.04	$3,640.00

If we recognize that training costs will be essentially eliminated in a fully operational system to be supported on an as-needed-basis by audio teleconferencing, the cost of the IST English course then drops to

$361.47 and Alaska History to $408.77. (Both figures represent DOE plus district costs.) This compares favorably with the present State expenditure of $668.20 per-course, per-student.

PERCEPTIONS REGARDING THE EFFECTIVENESS AND DESIRABILITY OF IST INSTRUCTION

Some of the findings noted here have not changed from those expressed at mid-year and described earlier. However, to present a complete picture, all findings of the Pilot Test evaluation are presented; thus, some repetition will be noted.

Teachers viewed the IST model as appropriate for those students who have, and are able to develop, the maturity necessary for assuming the self-direction required. *The majority of teachers believed in open enrollment (student self-selection) as they knew of no valid screening mechanisms for identifying students who could not achieve at least average success.*

Teachers reported that IST tended to enhance accountability which they viewed favorably. Seventy percent of them reported that the student's level of self-direction increased over the year. It was noted that those students who needed more supervision preferred the traditional classroom environment. Ninety percent of the teachers felt IST improved instruction and 10 percent were unsure. This high regard was based on the fact that IST accommodated student differences. Teachers also viewed as favorable attributes: (1) the variety and organization of the courses which would be very difficult for individual teachers to duplicate; (2) the more favorable student response to the essential drills/practice on the computer than to conventional classroom methods; (3) student motivation and increased concentration through a variety of media experiences; and (4) continuity of instruction for students who were frequently absent (in many cases for extended periods during work and hunting/fishing seasons).

In summary, at the completion of the Pilot Test year, all responding supervising teachers recommended continuation and expansion of the use of the IST model. It is believed that this unanimity resulted from the flexibility permitted the teaching staff. In spite of the fact that the direct instructional role was greatly reduced, and the manager role enhanced, the fact that supervising teachers were permitted to control the degree and manner of participation made advocates of them all.

IST CONTRIBUTION TO HIGH SCHOOL CURRICULA

The contribution of IST-type courses was a function of the size of the school and staffing provided. In one school, Alaska History replaced a course normally offered to the 8th Grade. In other schools, it was a new two-semester offering.

The use of IST English varied from all students using it as the only course offered to situations where students were split between traditional and IST courses covering similar material. In one instance, the IST course supplemented an on-going class for all 9th Grade students. It was also used as a remedial course for upper grade levels and for Special Education students where individual help was given by an aide.

The conclusion was that IST courses could be used both to increase course offerings and/or to replace existing courses with many variations in-between.

IS THERE AN IDEAL STUDENT-TO-MICROCOMPUTER RATIO?

It was concluded that there was no such thing as an "ideal ratio." The most common ratio in the participating schools was four students to two micros. However, the realizable student-to-micro ratio depends on the ability to schedule students (a strong function of the rigidity of the individual school class schedules), physical space available, type of supervision provided, the number of simultaneous IST courses being offered, the characteristics of the student body (maturity, cultural background, etc.), cost factors, and micro reliability and maintenance.

HOW EXISTING AND FUTURE IST COURSE MATERIALS AND PROCEDURES SHOULD BE MODIFIED

The responses of the supervising teachers are summarized here, although some of them are repetitions of previous findings. There are, however, several new ones and there is merit in compiling a single listing to which the reader may refer when considering his/her own situation and environment. Therefore, the entire list is presented with explanation associated with those not previously recorded:

- Select students by an open-entry process.
- Make provision in course format for recurrent group discussions and activities.
- Allow for varying degrees of teacher intervention, modification of individualization, and varying amounts of non-IST content and student activities.
- Incorporate more procedural checks.
- Re-design the student record keeping system to reflect the changes required by the roles assumed by the supervising teachers at the end of the Pilot Test.
- Periodically monitor reading level and difficulty of content.
- Design worksheets so that some parts are not weighted too heavily with respect to other parts. An example was that, in an English test where written answers were required for comprehension, students were not yet ready to write

comprehensive or structurally complete sentences and paragraphs.

- Provide sufficient applied practice with the concepts. It was suggested that model sentences and/or paragraphs be presented early in the course and that there be a focus on the development of writing skills before students are asked to answer questions requiring an essay.
- Be aware that inductive reasoning requires a thought process new to most students. Thus, it was recommended that it be introduced gradually to eliminate frustration on the part of some students.
- Re-design worksheets to make them less boring; include artwork, crossword puzzles, riddles, etc.
- Place questions relating to a student's culture and its values compared to others at the end of the unit so that it can be dealt with after exposure to concepts and discussions about culture.
- Include guidelines to limit bias in grading; e.g., (1) all statements of opinion must be supported; (2) students should be consistent with a viewpoint; and (3) accuracy of facts must be supported.
- Supply the schools with kits for projects to ensure that all schools have the required materials.
- Design projects for as little teacher assistance as is commensurate with an individualized program.
- Allow the option to spread computer tests over two time periods at the teacher's discretion.
- Design unit-review items to be different from computer drills.
- Practice in writing essays should precede unit written tests.
- Make the computer tests different from computer drills so that students cannot pass simply by memorizing answers.

ADEQUACY OF TRAINING PROVIDED PARTICIPATING PILOT TEST STAFF

The importance that Project management placed upon proper training prior to the use of the IST system was pointed out earlier. Therefore, the results of participants' evaluation of the training *after* their one year of experience was considered extremely valuable in order to provide guidance for improvements prior to the Field Test and prior to the system's becoming operational.

At the end of training (prior to the Pilot Test), pre- and post-tests were administered to determine participants' familiarity with IST terms. The data showed a significant increase in the mean number of terms acquired during the workshop: six before, and 16 after. To ascertain whether the level of familiarity with the equipment terminology prior to training determined the degree of familiarity reported after training, a correlation was performed between pre- and post-tests. The correlation was 0.24, thereby suggesting that participants' familiarity prior to training did not determine the amount acquired by the end of training.

Sixty percent of the participants felt that the supervising teachers could be effective with a low level of expertise and that the responsibilities of the course coordinators and persons to contact about problems were clearly explained. Only about 45 percent felt that the responsibilities of school staff and role of the principal were explained very well; most others rated them fair. The trainers did a mediocre job in explaining the role of the D & I Contractor and evaluation staff (40 percent felt excellent, 60 percent only fair).

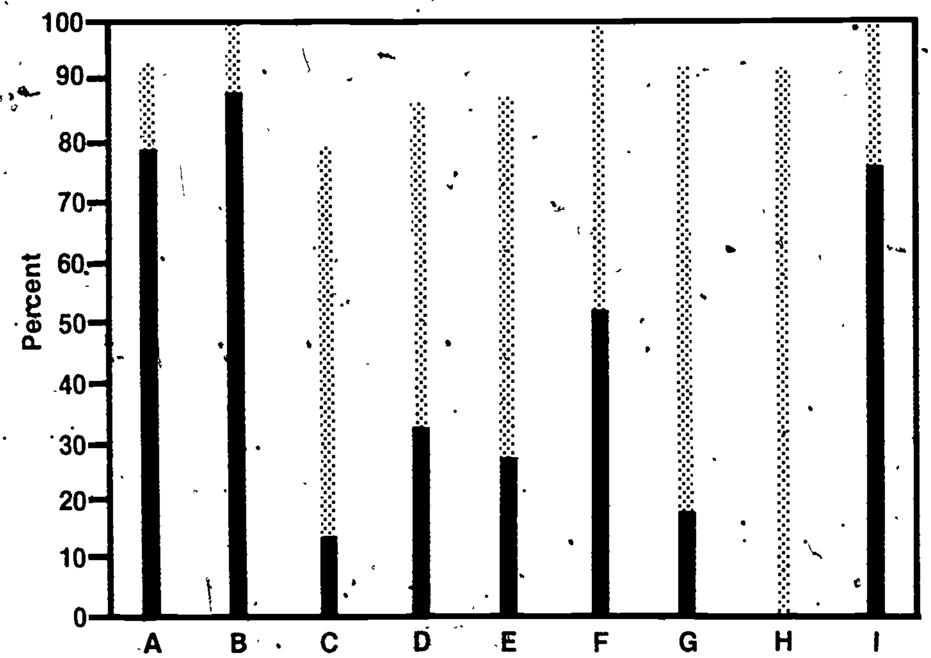
Figure IV-10 shows participants' rating on the clarity of explanations relative to key aspects of the training. Participants were most comfortable about the program philosophy (78 percent excellent), procedures for operating the Apple (87 percent excellent) and how and when to contact course coordinators (75 percent excellent). Forty-five percent rated the explanation of the student grading procedures as excellent and the remainder as fair. It was felt that the remaining areas were not handled very well, in some instances because they required some technical knowledge (how to locate problem sources) or it was impossible to predict the problems discussed (how to handle student difficulties). Of the remaining areas that were handled in a mediocre manner, it is important that the reader take note that those areas should receive special care in preparing for the audience in order to raise their level of understanding (procedures for keeping a log on problems, how to keep student records, procedures for collecting students' course evaluations).

At the end of the Pilot Test year, participants were again given the opportunity to rate the adequacy of training received with regard to: (1) obtaining the competency level needed to operate the Apple computer and (2) clarity of supervising teacher role responsibilities. Twenty-nine percent felt that the training received was adequate for operating the computer, 43 percent were unsure, and 28 percent said training was inadequate. Fifty-seven percent felt that the role responsibilities of the supervising teacher were clearly defined, 14 percent were unsure, and 29 percent disagreed. These results were consistent with those of the evaluation immediately following the training sessions.

The respondents recommended that more time be given to problem-solving with regard to hardware procedures and malfunctions, that school staffs be better informed as to the flexibility permitted in program format, and that Pilot Test teachers should be used for training new users. As a result of these recommendations and in light of findings resulting from the training workshops themselves, changes were instituted to strengthen specific modules of the training package in preparation for the Field Test.

Figure IV - 10

CLARITY OF WORKSHOP EXPLANATIONS ABOUT PROGRAM LOGISTICS: (n = 15)



Areas of Program Logistics:

A. Program philosophy
B. Procedures for operating APPLE
C. How to locate computer problem sources
D. Procedures for keeping a log on problems
E. How to keep student records
F. Student grading procedures
G. Procedures for collecting students' course evaluations
H. How to handle student difficulties
I. When and how to communicate with the course coordinators

Fair
Excellent

PROBLEMS ENCOUNTERED AND HOW RESOLVED

To gain guidance for the future as to how to avoid potential technical and non-technical problems or as to how best to solve them, monthly frequency counts of all difficulties were compiled. Among the non-technical problems, teleconferencing with course coordinators was at the top of the list. Difficulties involved time of day scheduled for the teleconferences (inability to gather all students or inability for class and coordinator to get together at the same time were examples cited) and inability to get telephone connection (busy signals, for instance). On-site supervision of student progress and written course content provided the next largest categories of problems. (These were resolved by the course coordinators.) Start-up procedures (at the beginning of the school year) and scheduling were next, followed by grading of students' work (resolved by the course coordinators) and History projects (lack of materials at very small schools).

Technical problems were most frequently associated with the computer and disks. The remaining problems, those associated with audio-tapes, recorder/players, and the video screen, were insignificant. It is interesting to correlate the problems encountered on-site with statistics recorded at NWREL where repairs were made. During the year's test, 35 components were forwarded to NWREL. Six were actual defects in components; 13 were damaged in shipment; four involved missing chips; and 12 were recorded as "no problem could be found." Of these referrals, only 25 percent needed to be sent for repair. However, in recognition of the job done by the supervising teachers in keeping equipment operational, it should be noted that computer and disk problem frequency totalled nearly 135 incidents. Thus, approximately 100 of these were handled on-site, with or without assistance of the technical consultant located at DOE. The value of a good manual on-site was confirmed.

ATTITUDES OF PARTICIPANTS TOWARD NEW ROLES AND BEHAVIOR

All supervising teachers responding stated that they would like to be IST teachers in the coming year. They all believed that, because of their experience, things would run more smoothly. Many were interested in assisting in expanding the model and applying what was learned in their courses.

At the end of the Pilot Test year, nine of the ten responding teachers viewed the IST courses as requiring less direct instructional and non-direct staff time than a regular course -- a distinct change in perception from the mid-year interviews. The stated reasons for their changed views were: (1) the teacher was not the primary source of information or direction; (2) all core materials as well as numerous supplementary materials were supplied; (3) the grading guidelines had been made efficient and easy to follow; (4) once students became familiar with IST procedures, the teacher was free to spend time on other responsibilities or with students needing help; and (5) flexibility which allowed supervising teachers to convene group meetings with students if perceived necessary, the ability to integrate non-IST material, and the option of merging IST materials into existing courses.

Student reaction to IST courses was positive. At least 80 percent enjoyed the computer drills in both English and Alaska History; more so than drills in the traditional classroom. It was felt that the computer provided excitement, thus motivating students to achieve. Reading assignments were perceived as interesting by 56 percent of students in English, with 19 percent unsure. Thirty-four percent of the students found Alaska History readings interesting; 24 percent were unsure. Work with audio cassettes was found enjoyable by 50 percent of students in both courses; an additional 31 percent in Alaska History and 22 percent in English felt uncertain. In subsequent courses developed for IST, both the reading assignments and cassette materials were modified to increase their student appeal and to provide greater motivation.

NEW ROLES AND BEHAVIORS REQUIRED IN IMPLEMENTING IST

As a result of all the data collected and analyzed, it was possible to compile a complete picture of the participants' roles required by the IST model in the Alaskan environment. The reader has no doubt been struck by the degree to which changes were necessitated by the weather and geography of the State. Although the following is probably not optimum in all situations, it may well represent a conservative and workable model for most conditions and certainly for the developing world. The philosophy of designing-in the ability to function, should one or even several components fail, ensures a highly reliable instructional model with a minimum of user frustration.

• Principal or Designee

Functional areas remain basically unchanged under IST. However, the specific tasks are somewhat different. The role requires the Principal or Designee to ensure that materials and equipment are received and shipped in a timely manner; to provide adequate staff; to provide facilities and equipment to accommodate to the space, power, and storage needs imposed by IST; to coordinate the selection and scheduling of courses and students (a most important item); and to assist staff in solving set-up problems.

• Supervising Teacher

The role involves the basic functions of classroom management, collaboration with course coordinators, and operation and maintenance of computer and other peripheral equipments. The teacher must be willing to adapt the IST to his/her teaching style and instructional program and, where deemed necessary, to adapt himself/herself to the procedures of the IST model.

Classroom management under IST is the primary role as opposed to the traditional supervising teacher's role of direct instruction. IST synthesizes the course content and provides the instructional materials, tests, and course format. Thus, the teacher-student intervention role is to: (1) orient the student to the goals and objectives of the course; (2) familiarize the student with computer operation and use of the software and hardware; (3) establish student routines (which will vary from situation to situation); (4) provide guidance and encouragement to achieve at a pace commensurate with the individual student's potential; (5) clarify problems encountered by students with content or equipment; and (6) provide achievement evaluation methods for and in conjunction with the students.

Collaboration with course coordinators provides the supervising teacher with a source of expertise on problems associated with content, format, and grading of student work.

Operation and upkeep of equipment is an entirely new role. It requires time and hands-on experience to work this into a routine function so that it becomes as natural as other functions the supervising teacher performs.

• *Course Coordinators*

The amount of contact between schools and the course coordinators is left open to be negotiated between them. Major support areas include: (1) consultation with schools on course content, student worksheets, and test performance; (2) coordination of student data reporting procedures; and (3) keeping inventory of course materials and ordering additional materials for sites when necessary.

Continual involvement in system evaluation is an important effort independent of school sites.

• *Technical Assistance*

It would be rare indeed if the course coordinator were also technically capable of assisting sites in the repair of equipment malfunctions. Therefore, it is essential, at least in the preliminary phases, to have a technical consultant continually on-call to assist in solving hardware/software problems that arise.

PROBLEM EVALUATION RECOMMENDATIONS

As has been the practice in the past, a workshop was held toward the end of the Pilot Test year to review identified problems and to recommend means for correcting them. The recommendations took on two forms. The first consisted of recommendations specific to the English and Alaska History courses. The second consisted of recommendations for improving the development of future courses as well as improving procedures for the Field Test and operational years. Participants consisted of ETA Project personnel, Pilot Test supervising teachers, members of the evaluation team, and educational consultants to the Project.

Workshop issues were:

- What could be done at the school level to make IST more effective for students?
- What could DOE do to improve its support for IST instruction?
- What specific corrections or improvements could be made to the Alaska History and English courses prior to the upcoming school year?
- What general revisions should be made to the existing courses over the long run?
- What changes should be incorporated for future IST courses?

A detailed report on this meeting is included in the document, "IST Planning Workshop," compiled by the DOE. Included here are the recommendations of the Working Group that were relevant to future course development and which may also be used as guidelines for readers involved and/or interested in implementing educational systems of their own.

- *COURSE-RELATED*
  - The point system designed for grading worksheets and tests must not weight portions too heavily. It may be appropriate to allow supervising teachers to score or provide no point value at his/her discretion.
  - Models of sentences and paragraphs should be presented early in an English course, prior to the student being required to write an essay answer.
  - Models and examples should be used widely to help students learn what is expected of them, not only in what is to be learned, but also the form their responses are expected to take.
  - Worksheets should be made more interesting through the use of artwork, puzzles, games, etc.
  - Where inductive reasoning is required of the students, a transition should be provided to expose them gradually to the thought processes involved.
  - Definitions of "unknown" words should be provided.
- *COMPUTER-RELATED*
  - Computer test scores may not be as valid as written test scores if students are not graded on computer exercises. The students could develop a nonchalant attitude toward the computer.

- Too short a time limit on exercises performed on the computer could result in significantly lower student performance than those written on paper.
- The computer should use the student's name as often as possible in drills and other exercises.

- The computer should use phrases of encouragement in providing feedback to students -- this promotes student success.
- Graphics, possibly color, and movement on the screen hold student attention.
- Student performance should key the computer to branch to an appropriate instruction or practice example.
- Upper and lower case letters provide a valuable learning experience.

• *PUBLIC IMAGE*

Evaluation data should be made available to sites so that teachers can make presentations to their communities, school boards, etc. However, premature data, e.g., data collected prior to the "bugs" being worked out, can be detrimental.

GENERAL MATHEMATICS AND DEVELOPMENTAL READING COURSES

Concurrent with carrying out the Exploratory and Pilot Tests of English and Alaska History, two additional courses were selected for development based on needs determined by the educational community. The courses selected were of high priority to the special concerns of rural high schools. Development of these courses followed the detailed procedure discussed in the section, "Courseware Development Process," taking into account the findings of the field trials conducted on English and Alaska History and the recommendations of the Student Diagnostic Testing Conference of June, 1978. As a result, diagnostic testing was incorporated as an integral part of both the General Mathematics and Developmental Reading courses. Many problems encountered in English and Alaska History were also corrected.

GENERAL MATHEMATICS

This course was developed as a full-year course, appropriately divided over two semesters. It was built around texts and tables already published and in use. It was also designed to be compatible with the IST software developed for Alaska History and English with only minor revisions. Compatibility was a given for all courses so that costs and complexity of use in the field could be kept to a minimum. It is an important consideration where extensive individualized instruction is to be introduced into a school system.

The primary objectives of General Math were to increase the ability of students: (1) to perform a wide variety of calculations and (2) to perform basic problem-solving skills effectively.

A new feature was introduced into this course: the optional use of peer tutoring. This was instituted in direct response to the greatly reduced role of the course coordinators which resulted from the field testing of Alaska History and English. Any student achieving 100 percent on a given pre-test associated with a given skill area received a tutoring certificate and was eligible for designation by the supervising teacher to assist other students. Students who successfully completed lessons centered around a given skill area and who achieved 100 percent on the post-test were also given a tutoring certificate.

During the review of how best to use the computer, analysts recommended that the following important software modifications be implemented based on experience with other IST courses and the demands of the mathematics materials:

- question-specific help text;
- display of objectives for the supervising teachers;
- underlining (for emphasis);
- recall of screens;
- pre- and post-testing capability;
- a student-selected option for additional time to work problems;
- special graphics for displaying math symbols and problems;
- capability of the computer to check student pre-tests for success level of 100 percent (identification of peer tutors); and
- capability to direct the student to skip several exercises without teacher intervention.

Student and teacher materials were developed simultaneously. The CAI component contained: (1) drill and practice of skills; (2) vocabulary drills (response to a problem detected during the Exploratory Test); (3) development of problem-solving skills (word problems); (4) pre-tests; (5) reviews; (6) skill post-tests; and (7) student record system (for teacher use primarily). Two to four computer activities were provided for per week.

Worksheets were of six types: (1) listening guides (requiring student response to the taped materials); (2) math and lab guides (to provide hands-on experiences with math concepts); (3) challenge worksheets (to provide enrichment for students of high ability); (4) special forms (for use in application topics, e.g., bookkeeping); (5) reviews (to provide sufficient opportunity for review of skills prior to testing); and (6) chapter tests.

Audio tapes were used to: (1) reinforce important concepts; (2) supplement certain portions of the text; (3) provide new information; (4) further explain potentially difficult information; (5) add variety; and (6) repeat verbally certain material students might have difficulty in reading. All items in the listening guide were answered on the tapes, this in response to a major criticism noted during the Exploratory Test.

The "Teacher Guide" included an explanation of the course format and detailed instructions for the supervising teacher. These included: (1) additional guidelines for using the published text; (2) copies of materials from the Student Manual; (3) hard copy of computer activities; (4) scripts and listening guides; (5) worksheets; (6) math labs; (7) tests and reviews; and (8) keys for all IST print materials.

The "Student Manual" was developed for use with the published student edition of the text and included: (1) objectives; (2) course rationale; (3) detailed course direction sheets; (4) instructions for using the text; and (5) supplementary materials.

DEVELOPMENTAL READING

This two-semester course constituted a full year of instruction. It was divided into four sections; each section included nine skill sequences for a total of 36 lessons.

Considerations in selection of an existing course to be implemented as the Developmental Reading course included that it be:

- geared to those whose reading levels test low, but who can work fairly independently with computer and audio assistance under a supervising teacher;
- developmental in nature and not designed to deal with severe learning problems;
- organized so that multiple entry points are possible (another finding of the Exploratory Test) to increase individualization;
- made up with a high percentage of sustained silent reading plus brief comprehension checks.

Each of the 36 lessons consisted of a combination of activities. The general sequence was as follows:

- *INTRODUCTION AND DRILL OF THE SKILL/CONCEPT*
  - introductory audio tape with listening guide;
  - computer activity skill drill.
- *APPLICATION OF THE SKILL/CONCEPT TO LITERATURE*
  - computer activity vocabulary drill;
  - motivational tape or written introduction/discussion questions for the reading selection;
  - literature reading;
  - worksheet or written project on the reading selection.
- *REINFORCEMENT AND ASSESSMENT OF THE SKILL/CONCEPT*
  - practice computer activity and/or workbook exercises;
  - supplementary worksheets (if needed);
  - lesson-skills test computer exercises;
  - bonus selections from text (when provided);
  - extra practice workbook exercises.

At the end of each of the four sections (nine lessons), additional review, assessment, and enrichment of presented skill/concepts were provided:

- ***ENRICHMENT OF SKILLS/CONCEPTS AND ASSESSMENT OF UNDERSTANDING***
  - section review (text);
  - section supplementary activities (if needed);
  - "gold medal" selections from text (for the gifted);
  - section test-computer activity.

As with the General Math course, important software modifications to the basic Alaska History and English were added and included:

- question-specific help texts;
- system for identifying and displaying objectives for the supervising teacher;
- underlining;
- ability to recall screens.

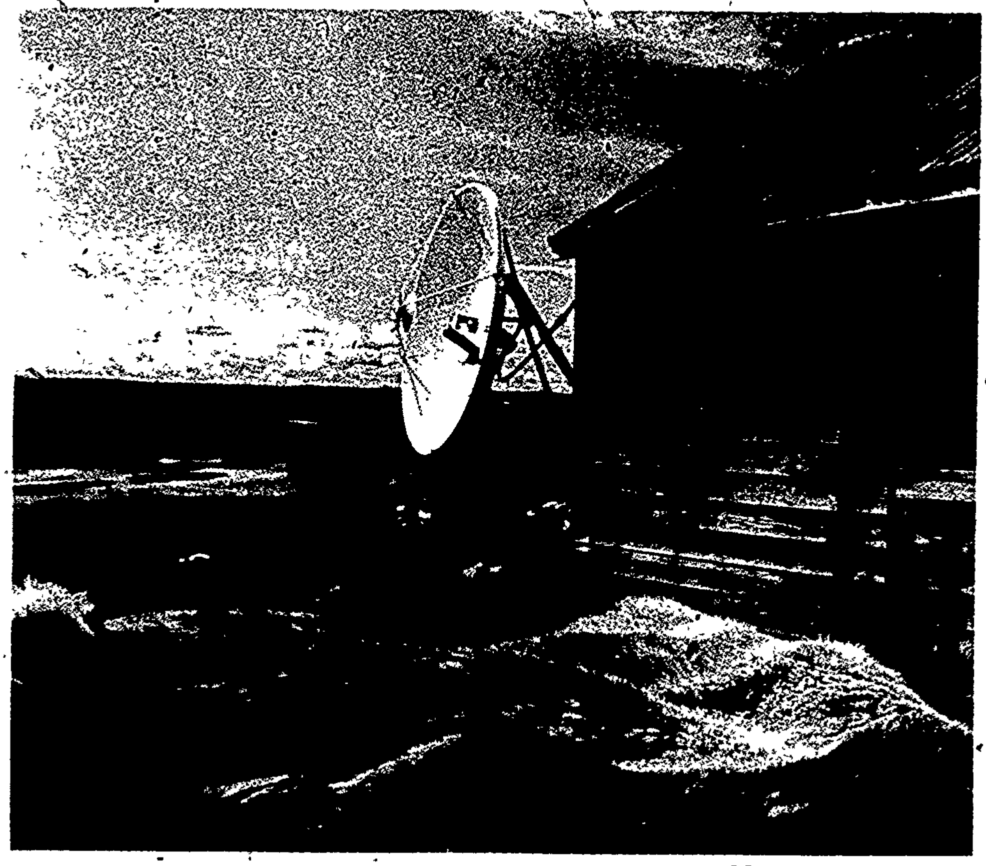
Student and teacher materials were developed along the following lines:

- Worksheets were provided for application of skills and to check for comprehension of reading selections.
- Audio tapes were used to provide: (1) guided reading of skills features in the text to give additional instruction on the skill/concept introduced; and (2) literature selections, background and motivation for the reading assignments.
- Listening guides were provided for many of the tapes to provide for application of skills. Answers were checked with the tapes to ensure that students received immediate feedback and explanations.
- Computer activities provided drill and practice for skills, to introduce vocabulary, and for lesson and end-of-section (nine lessons) tests. Alaska examples were used whenever possible. Help screens were provided as reminders or explanations. Failure in a test resulted in an objective screen which identified the skill missed and directed the student to a supplementary worksheet for review of that skill. Record keeping was provided for the supervising teacher to check student progress and to provide a guide for individual help.
- Written projects were provided for application and expansion of skills and concepts. Several choices were given for each Project to allow greater individualization through teacher guidance.

As in all IST courses, Student and Teacher Manuals were provided.

OPERATIONAL FIELD TEST

In the initial stages of ETA Project planning, a protocol was established that called for field trials of courseware and IST procedures to ensure a smooth transition to the user-supported operational system. The protocol suggested three levels of field trials; Exploratory Test, Pilot Test, and Field Test (if deemed necessary by Project management). It was decided that the IST model and courseware were a sufficient departure from the norm to warrant the implementation of a comprehensive Field Test, at least at this stage of development.



COURTESY OF ALASCOM

The Field Test involved 25 schools in Southeast, Southcentral, and Northern regions of the State. All four courses, English, Alaska History, Developmental Reading, and General Mathematics, were offered to participating schools. The number of courses accepted by a given high school varied from one to four and had no relationship to the size of the school's enrollment. A supervising teacher handled one or two courses, not necessarily related to his/her area of expertise. Teaching aides were used on occasion, but only in those schools where such assistants already existed. The great majority of supervising teachers had other responsibilities that occupied them simultaneously when their IST students were working. The number of students taking a particular course ranged from one to more than 20. Approximately 384 student-courses were involved in this evaluation. However, this should not be interpreted as meaning 384 students participated; some students enrolled in more than one course.

Because of the pre-operational status of the Field Test, an evaluation was prepared and conducted that was more comprehensive than the ones in previous instances. It was designed to be sensitive to the complex pattern of interlocking relationships between courseware, procedures, cultural values, social and environmental contexts, local facilities, community perspectives, students' characteristics, teachers' attitudes, and others. An attempt was made to provide explanations for the level of effectiveness achieved by IST as well as recommendations for changing or improving the approach and/or materials. Details of the evaluation are included in the four-volume report, "Final Report Evaluation of IST Courses FY-81 Pilot Study," conducted by Educational Skills Development, Inc. The highlights of the evaluation are presented here.

In commissioning the evaluation, the DOE identified three basic questions to be answered:

- What can be done to assist in the successful implementation of IST?
- What can be done to improve IST for the coming year?
- Generally, how successful was the IST program, and what level of State support for the program is desirable for the following year?

On the basis of these general questions, 27 specific questions were developed for the evaluation to address. The design was such that most of the specific questions (20 of 27) had several potential information sources from which to develop more complete perspectives. The specific questions covered five broad areas: student, teacher, settings, courses, and costs. To understand the interaction of variables, four site visits were made by the evaluation staff during which detailed observations were made of the interaction of important components of the community. (The site visits are detailed in Part I of the study.)

The answers to the 27 specific questions are contained in Part II. However, as mentioned previously, only the highlights are presented here.

THE STUDENT

What are the students' entry levels and skills?

In answering the question of how effective the IST model was, it was first important to establish the level of the students participating to determine if they were the ones for which IST was primarily designed. The answer to the subject question was based upon test scores from students who, prior to beginning the IST course(s), completed the Alaska Statewide Achievement Test (ASAT) and a pre-test for each course in which they were enrolled.

The ASAT scores indicated that the mean performance of students enrolled in the IST courses was below the State norms of the 1979 8th Grade ASAT standardization group (Table IV-13). There was, however, considerable variability in scores between sites. The site with the lowest total composite score of the four ASAT subtests had means of 12, 15, 15, and 22, while the best had means of 27, 43, 31, and 30, respectively. In addition, the pre-course test scores indicated that the content of the IST course had generally not been mastered by the students prior to enrollment in these courses. The conclusion reached was that there was considerable evidence that the students taking the IST courses were the kind of rural students for whom the courses were primarily designed.

Table IV - 13

COMPARATIVE ASAT PERFORMANCE

		Mean Scores		
	Number of Items	ASAT 1979 Standardization Group (All Students)	ASAT 1979 Rural Students	ASAT 1980 IST Students
Math Computation	36	23	15	18
Math Application	66	40	29	33
Reading Comprehension	45	30	19	24
Reading Word Identification	39	29	24	28

What characteristics of the student population contribute most and least to successful performance in IST courses?

Tables IV-14, 15, 16, and 17 indicate that overall student performance improved significantly in all four IST courses; however, this was not consistent across all units/chapters.

It should be noted here that:

% Gain = Mean % Difference/(100 - Pre-course Mean %).

Table IV - 14

ALASKA HISTORY PRE-COURSE AND POST-COURSE PAPER-AND-PENCIL TESTS SUMMARY STATISTICS

Unit	No. of Items	No. of Students	Pre-Course Mean%	Post-Course Mean%	Mean % Difference	%Gain	t-Value
I	4	43	44.2	71.5	27.3	48.9	5.14***
II	4	43	26.2	35.0	8.8	11.9	1.83
III	8	43	28.8	51.5	22.7	31.8	5.97***
IV	4	43	37.8	46.5	8.7	14.1	1.83
V	4	43	52.2	64.5	12.3	25.7	2.97**
Overall	24	43	36.3	53.4	17.1	26.8	8.03***

*p ≤ .05
**p ≤ .01
***p ≤ .001

In the Alaska History course, performance of the students improved significantly in Units I, III, and V. This improvement was generally consistent with student progress since most students completed Units I and III, but few attempted II and IV. The significant improvement in Unit V may be due partially to the fact that this unit concerned Alaska's natural resources and is general knowledge to the students as can be noted from the students' pre-course Unit V test performance.

In English, student performance improved significantly in Units I, IV, V, VIII, and XII, but decreased significantly in Unit VII. Most students completed Units I through VI and significant improvement would have been expected in at least these areas. Therefore, the reason for the lack of significant gain in II, III, and VI is unclear, nor is it possible to explain the notable gains in Units VIII and XII.

In Developmental Reading, the performance of students improved significantly over all course units. Therefore, it can be concluded that,

Table IV - 15

ENGLISH PRE-COURSE AND POST-COURSE PAPER-AND-PENCIL TESTS SUMMARY STATISTICS

Unit	No. of Items	No. of Students	Pre-Course Mean%	Post-Course Mean%	Mean% Difference	%Gain	t-Value
I	7	43	59.9	77.7	17.8	44.8	3.87***
II	3	43	79.0	80.0	1.0	3.2	0.20
III	3	43	53.3	52.6	-0.7	-1.4	-0.18
IV	3	43	58.0	69.0	11.0	26.2	2.39**
V	3	43	57.3	77.7	20.4	46.9	4.05***
VI	3	43	53.3	57.3	4.0	8.6	0.90
Semester 1:	22	43	60.1	70.6	10.5	26.2	5.01***
VII	3	43	41.0	33.3	-7.7	-13.0	-2.23*
VIII	3	43	45.0	58.0	13.0	24.2	2.52*
IX	3	43	78.3	76.7	-1.6	-7.7	-0.42
X	3	43	45.7	51.0	5.3	9.8	1.10
XI	3	43	38.0	37.3	-0.7	-1.1	-0.21
XII	8	43	32.0	45.0	13.0	19.3	4.00***
Semester 2:	23	43	43.5	49.1	5.6	10.0	3.23**
Overall	45	43	51.6	59.6	8.0	16.5	6.34***

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

as students progressed through the lessons, their general reading ability improved significantly.

In General Mathematics, performance improved significantly in Chapters I, II, III, and IV. This was consistent with student progress through the course since most of them completed Chapters I, II, and III, some completed Chapters VI and VII, but none completed Chapters VIII and IX.

In all courses, the entry levels of the students contributed significantly to post-course test performance. Table IV-18 indicates that the pre-course test score correlated at least .60 with post-course test scores in each course. Additionally, ASAT subtest scores also correlated significantly with IST performance. The Math Application subtest showed the most consistently high partial correlations in all courses. Findings in this Table also indicate that age and grade level did not significantly correlate with performance in any course.

Table IV - 16

DEVELOPMENTAL READING PRE-COURSE AND POST-COURSE PAPER-AND-PENCIL TESTS SUMMARY STATISTICS

Subtest	No. of Items	No. of Students	Pre-Course Mean%	Post-Course Mean%	Mean% Difference	%Gain	t-Value
Word Identification	55	10	77.8	85.5	7.7	34.2	3.17**
Comprehension	55	40	46.4	55.6	9.2	17.2	4.66***
Study & Research	52	40	60.7	72.2	11.5	29.3	6.31***
Literary Understanding & Appreciation	52	10	41.0	57.3	16.3	27.6	4.53***
Overall	52	100	54.8	64.9	10.1	22.4	7.06***

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

Table IV - 17

GENERAL MATH PRE-COURSE AND POST-COURSE PAPER-AND-PENCIL TESTS SUMMARY STATISTICS

Chapter	No. of Items	No. of Students	Pre-Course Mean%	Post-Course Mean%	Mean% Difference	%Gain	t-Value
I	12	77	65.9	70.6	4.7	13.7	2.13*
II	7	77	58.4	64.4	6.0	14.4	2.24*
III	7	77	35.3	50.3	15.0	23.2	4.81***
IV	9	74	39.3	48.8	9.5	15.6	3.05**
Semester 1:	35	74	51.7	59.3	7.6	15.7	4.27***
V	8	68	29.8	36.0	6.2	8.9	1.69
VI	7	68	24.9	27.7	2.8	4.0	0.90
VII	7	68	17.9	20.4	2.5	3.1	0.80
VIII	8	65	32.2	32.1	−0.1	−0.4	−0.05
IX	5	65	31.4	30.8	−0.6	−0.9	−0.17
Semester 2:	35	65	27.3	29.7	2.4	3.3	1.08
Overall	70	65	39.2	44.6	5.4	8.9	3.67***

*$p \leq .05$
**$p \leq .01$
***$p \leq .001$

Table IV - 18

CORRELATIONS OF PRE-COURSE TEST SCORES WITH POST-COURSE TEST SCORES, AND FIRST ORDER PARTIAL CORRELATIONS OF ASAT SUBTEST SCORES, AGE, AND GRADE LEVEL WITH POST-COURSE TEST SCORES WITH PRE-COURSE TEST SCORES PARTIALED OUT

	Post-Course Test			
	History	English	Developmental Reading	General Math
Zero-Order Correlations With Pre-Course Tests	.698***	.823***	.797***	.600***
First - Order Partial Correlations With Pre-Course Test Scores Partialed Out				
ASAT+ Subtests				
Math Computation	.356*	.265	.172	.321*
Math Application	.472**	.567***	.406**	.394**
Reading Comprehension	.446**	.574***	.005	.335*
Reading Word Identification	.312	.425**	–.065	.401**
Age	–.064	.079	–.206	–.004
Grade Level	–.047	.022	–.182	–.058

+ASAT = Alaska Statewide Achievement Test

*$p \leq .05$

**$p \leq .01$

***$p \leq .001$

In summary, therefore, it may be concluded that:

- Student entry levels contribute to a large extent to how well students will perform in IST courses. Therefore, the use of educational diagnostic criteria for placement of students in IST courses appears appropriate.
- In diagnosing basic skills, mathematics application and reading comprehension should be emphasized.

What are students' attitudes toward IST courses and instructional modes?

Most students preferred computer exercises (74 percent) and at least one-third preferred workbooks/worksheets (45 percent) and teachers (35 percent). The modes liked least were the audio tapes (10 percent) and other classmates as teachers (16 percent). It appears that peer tutors were not looked upon favorably. However, the reasons for this or how this could be improved were not ascertained at the time.

Sixty-eight percent of the students found reading and written instructional components to be somewhat or very interesting. Unit tests were most preferred, but the published texts, workbook materials, and outside readings were also highly regarded. Projects were liked the least, but were still liked very much by more students than not at all.

The audio tapes were liked least of the IST components of instruction; 20 percent considered them boring or uninteresting. No students found the computer component uninteresting or boring, while only 4 percent viewed the reading and written components in that way. However, none of the components was rated poorly. Even audio tapes were viewed as at least interesting by 75 percent of the students.

Seventy-one percent of the students considered the difficulty of the courses to be about right. The majority, 53 percent, indicated they almost always understood what had to be done and could work by themselves. However, Alaska History and English had considerably lower percentages, 32 percent and 25 percent respectively, than General Math (58 percent) and Developmental Reading (54 percent). Perhaps this was because these were the first designed courses and could not be totally corrected without major re-design. No students in any course indicated that they rarely or never knew what to do and needed teacher help. Eighty-six percent of the students indicated they could finish their lessons when working on IST exercises and 90 percent stated they could finish their lessons while working at their own pace.

Student self-perception was highly positive, viewing themselves as hardworking and competent. Thirty-two percent expected to do well and get high grades on new assignments. Sixty-two percent tried to do well but did not necessarily expect to get high grades at all times. Only 6 percent indicated an expectation of rarely, or never, getting good grades.

In summary, IST students were much like other students in more accessible or larger schools and seemed capable of working independently, at least part of the time.

Who are the students who took courses (in terms of demographic variables)?

Students were randomly selected. Most were of Native origin and their families tended to depend on fishing and hunting for subsistence. Their major academic interests were stated to be math and reading. Their major social interests were sports. The grade levels ranged from 5 to 12. Student age ranged from 10 to 20 years. Median grade level of students enrolled in English, Developmental Reading and Math was 9th. Students enrolled in Alaska History had a median grade level of 11.

In summary, it appeared that the courses were usable across a wide range of grades and ages, depending on the level of student achievement going in.

What is the relationship between attendance and IST performance?

There was evidence that the number of lessons completed was related significantly to the number of days a student attended class. The relationship between the number of lessons completed and post-test scores was only moderate before and after pre-course test scores were removed in English and General Math. There was no significant relationship for Alaska History and Developmental Reading. This lack of significant relationships might be the result of the individualization fostered by IST in that the students can pick up where they leave off and continue until they catch up after returning, even if the break is substantial.

In summary, analysis of data suggests that IST has met one of its primary goals, that of helping students whose attendance in-class is erratic. This bodes well for additional courses based on the IST model and could mean that many students who would ordinarily drop out of school could be satisfactorily educated.

THE TEACHERS

What are supervising teachers' attitudes toward IST?

Seventy-four percent considered the IST courses/program to be well-designed for their classrooms and 68 percent viewed the amount of work required of them as generally less than that required using traditional courses. The remaining 32 percent viewed the courses as requiring a reasonable amount of work. None considered the courses to be "too much work" or "not worth the bother." This was a significant change from earlier field trials indicating that much had been learned from those experiences. Fifty-eight percent of the teachers preferred to use the course intact. The remaining 42 percent preferred to use parts and everyone stated they would keep the computerized portions as well as the workbooks and exercises. The components most compatible with their teaching styles were the computer activities and textbooks; the least compatible were considered to be the audio tapes and projects. Although audio tapes were the least preferred component of the course, most teachers felt they were important for some students.

What pre-service training and other services should be provided supervising teachers?

Data collected indicated that training provided was adequate for teachers to get started. However, additional meetings would be helpful where teachers could attend if they felt it necessary. Some recommendations made were:

- Spring - Workshop for administrators and teachers. It should give an overview of the courses and details of ordering. Forms for ordering should be completed there if possible.
- Late Summer - Workshop for the newly designated teachers and those wishing a review. Content of workshop should cover an overview of the IST model and details on organizing, managing, and administering the courses.
- Mid-year - For experienced teachers. Topics should include simple maintenance and new products. The workshop should also be a users' seminar for exchanging ideas and information.
- A visit should be made to each site early in the school year to help with set-up problems and to provide general assistance to supervising teachers.
- The User's Manual should be expanded to include guidelines for setting up the classroom, administering the course, motivating students, managing student learning, and record keeping.

How much supervision is required by IST students?

In general it was found that supervising teachers need not provide constant supervision, but they should be readily available when assistance was needed. Assistance at the outset could be as much as in a traditional course but, as the students became more familiar with the routine, the time required could usually decrease to less than that required in traditional courses. Supervising teachers could be involved in instructing other students or grading papers while providing needed supervision.

Although the student-to-teacher ratio was not critical (within limits), it was found that teachers or aides could supervise up to seven

IST students while attending to other responsibilities. This number is not hard, and could be adjusted up or down depending on the local situation.

What characteristics of the supervising teacher contribute most to their success?

IST teachers averaged over six years of teaching experience, with more than three years in the school districts where they taught the IST courses. Sixty-four percent had Bachelor degrees. The teachers' major areas of study were very diverse. None of the above attributes showed significant correlation with student success. Further, familiarity with computers did not appear important to teaching success but there was evidence that prior experience with the course materials did. Teachers, who felt better prepared to handle classrooms in which there were several different kinds of ongoing activities simultaneously and those who reported prior experience with audio tapes, appeared to get better results on post-course test student performance. This appears to verify Pilot Test results indicating that teachers capable of functioning outside the bounds of traditional classroom procedure were more capable of working with the IST students.

In summary, it would appear that classroom-management training for individualizing education, functioning within a classroom in which diverse, large and small group activities go on, and experience in the use of audio tapes would be worth emphasis in the pre-service training of IST teachers. It may well be that, in selecting IST teachers in the first place, the above characteristics should be sought.

THE COURSES

What were the most effective and least effective components in IST?

Prior evaluations tended to answer this question based on surveys of teacher and student views. In this instance, a more scientific inferential approach was adopted based on observations of site visitors, student test scores, and equipment reliability.

Hardware/software effectiveness was considered in terms of availability, i.e., whether the amount of time the components were down for repair had an impact on their usefulness to students and supervising teachers. Although the average down time for hardware malfunctions was 25 days, the number of malfunctions was few over the life of the Field Test. Software and diskette problems seemed to occur at the same rates as hardware problems. The average waiting time for replacement of diskettes was somewhat longer than for hardware. Thus, it was concluded that the hardware and software were very reliable considering local site conditions and the prior experience, or lack thereof, of site personnel.

Site visitors reported that IST students were usually engaged in some IST activity during the observation periods. Most observations included students working with printed materials or the computers. Fewest observations were recorded for students using audio tapes. This is, of course, compatible with teacher reports suggesting less acceptance of this component by the students.

Evidence that the components were considered effective educational tools was that, in only four out of 25 site visits, did observers report components being used for purposes other than the intended ones. Further, observers reported that at 23 of the 25 sites, teachers did not seem to have difficulty managing the courses in the classroom. This was considered a remarkably high proportion of teachers able to deal with so innovative and complex an educational intervention.

The quality of the IST components in instruction could be inferred by noting that, as previously reported, student performance significantly improved in all four courses. It is interesting to note, however, that, although audio tapes were considered the least liked component, classrooms using audio tapes tended to have students with better performance, particularly in Developmental Reading and General Math. Further, audit trail analysis of Alaska History students showed that presentation of course content with audio tapes prior to interacting with a computer activity corresponded to significantly enhanced student performance in the computer activity.

In summary, as noted throughout the life of the ETA Project, emphasis must be placed on replacement of malfunctioning hardware. Interruption of an activity for up to three months was encountered in one community in the Northern Region.

Review and revision of audio tapes to make them highly interesting and accepted should be a high priority for those seeking to use a variety of stimuli for student learning. It was the only component that showed significant correlation with student performance, especially for poor readers. It would appear that increased attention to teacher training in classroom use of this component is warranted.

Did the components and units in IST courses mesh well into integrated courses?

The evaluators found that:

- The length of an instructional activity should be monitored. It may be more appropriate to reduce lengthy sessions to several shorter activities with greater use of media options and less passive learning in order to achieve better attention rates.
- Cognitive levels being addressed by the instruction, activities, and tests should match the level of cognitive skills called for by the objectives.

- It is good practice to develop the various formats in such a way that each media option exercises various cognitive levels.

Are cognitive levels of IST materials and tests appropriate for the target population?

Cognitive level for this evaluation was divided into three parts: Level 1, knowledge that could be recognized and recalled; Level 2, knowledge that required some degree of comprehension or understanding, requiring that the new knowledge be placed in the broader context of what was already known; and Level 3, involving application of knowledge creatively, in new formats, or in problem-solving.

Most computer activities were considered Level 1 for all courses, some were in Level 2, but none was found in Level 3.

Level 1 was prevalent in most print materials in Alaska History and English and in many of the tape exercises, while Level 3 was absent or rarely included in lessons. However, outside readings and the standard text books often included problem-solving or other kinds of higher level activities as did many of the workbook activities and activity sheets.

In summary, it was found that there was a need for higher level cognitive patterns to be built into the courses, especially the computer exercises. It would appear that "drill and practice" was taken too literally, as it is in much courseware designed for this grade level and lower. It was recommended that a way to overcome this bias would be to use experts in the cultures of the target audience, education, instructional design, and cognitive psychology, to recommend how to incorporate the appropriate cognitive levels.

What is the instructional design for IST?

It was concluded that the IST course construction had a more empirical than conceptual base. That is, a variety of media options was used to develop lessons based on instructional objectives and well-documented needs. However, the reasons for choosing one medium over another for a particular instructional element seemed not to be considered. It was felt, however, that the media design was well constructed and the addition of some visual components would make it even more effective. Further, the media design should have supported an instructional design rather than replacing it.

In any revision of the IST courses, or courses in general, it was recommended that the linguistic, psycholinguistic, and sociolinguistic conception of the learner be used for the language arts and that cognitive psychology provide the conceptions of the learner applied to mathematics and science. This lack of an overall model for conceptualizing what and how to teach may have contributed to some of the problems encountered, e.g., lack of higher cognitive-level tasks, the very high levels of reading difficulty of Alaska History, and the problems with the audio tapes.

In summary, it was recommended that future instructional design of courses should specify the purpose for the use of each medium and should include a guide for correspondence between objectives, learning processes, learning outcomes, and selected media options.

COSTS

This discussion concerns the material drawn from the IST Cost Report by Dr. Emanuel Mason of Educational Skills Development, Inc., performed as part of the Field Test evaluation. The models developed and assumptions made are included in Appendix B.

What were the per student costs of IST and its components?

Using the model established in the IST Cost Report, the actual per-student costs allocable to a site and DOE for Fiscal Year 1981 are shown in Table IV-19. These figures were obtained by spreading the costs per course over the number of students listed in the last column of the table. Since most DOE model costs were related to development, evaluation, and field testing, such numbers will be widely spread out in the operational configuration. Further, as the number of students increases, the per-student costs will reduce. If the same four courses were used with 600 students at 100 sites, the per-student costs would be as shown in Table IV-20.

Table IV - 19

FY-81 COSTS

	Cost to DOE	Cost to Sites	Total	Number of Students
Alaska History	$1751	$202	$1953	75
English	2027	130	2157	59
General Math	1047	141	1188	117
Developmental Reading	1056	127	1083	116
Total	$5881	$600	$6381	367

Table IV - 20

ESTIMATED PER STUDENT COST FOR 600 STUDENTS, 100 SITES

	Cost to DOE	Cost to Sites	Total Cost
Alaska History	$219	$261	$480
English	199	182	381
General Math	204	195	399
Developmental Reading	204	201	405
Total	$826	$839	$1665

A student taking a full day of IST courses (six) at the cost noted in Table IV-20 would require $2,498 from DOE and the local sites. (The cost is derived by taking the average cost of the four courses to both DOE and the site and multiplying by six.) From the site alone, $1,260 would be required. This is well within the average daily membership (ADM) of approximately $6,919 per rural student provided to cover Fiscal Year 1981. The ADM is an amount paid to schools based on a complex formula devised by the State to support education of students K-12. It varies from site to site depending on local conditions, size of school, degree of isolation, etc. The remaining ADM, approximately $5,659/student (average), could be used for other local site educational needs. Should these figures be borne out over an extended period of operation, substantial savings would be realized and could result in greatly upgraded educational opportunities in rural communities -- the primary aim of the ETA Project.

How does the per-student cost of IST compare to conventional courses?

The cost comparison was derived by first considering that the cost of print materials were common to both the traditional teaching and multimedia approaches. To that cost was added the cost of the teaching staff required -- to arrive at an overall cost for the traditional approach, and the various media components -- to arrive at the IST cost. The costs per student for print materials alone for FY-81 are shown in Table IV-21.

Table IV - 21

COST PER STUDENT FOR PRINT MATERIALS FOR FY-81

	Cost to DOE	Cost to Sites	Total	Number of Students
Alaska History	$ 832	$ 107	$ 939	75
English	946	65	1011	59
General Math	491	75	565	117
Developmental Reading	495	66	561	116
Total	$ 2764	$ 313	$ 3076	367

This can be compared to the total FY-81 IST course costs derived previously and shown in Table IV-19 of the immediately preceding section. This shows that, for the small number of students in the Field Test, the media options increased costs by about a factor of two. To get a fair picture of comparative cost, however, it must be considered that the reason additional courses are not taught now in rural schools is that the number of teaching staff is inadequate. Therefore, to the cost of print materials must be added the cost of at least one teacher (the exact number cannot be estimated without some idea of the number of additional courses to be offered). Assuming, however, that 80 percent of

25 sites (25 sites responded to the survey instruments required to perform the evaluation) would have to add a teacher if IST were not available, the cost of 20 new certified teachers must be added to the site totals. The model assumed that a teacher cost approximately $40,000 per year including salary, benefits, and travel. This increases the total cost for non-IST courses by $800,000 to $1,055,274 (from Cost Analysis Report). The cost of offering the courses with the audio and computer portions was $550,022. The resulting cost ratio for the total 25 sites (including DOE and site costs) is:

$$\frac{\text{Traditional Courses}}{\text{Complete IST Courses}} = \frac{\$1,055,274}{550,022} = 1.86$$

These approximations cannot be applied to any specific site. However, there is a substantial potential for cost reduction as the number of schools and students involved grows, even for the model as presently implemented. It should be kept in mind that the incremental cost of adding students is low, basically involving additional course materials. Further, the DOE costs are essentially one-time development costs plus some administrative expenses. As the number of students grows, these costs are spread over a larger and larger population, resulting in substantial reduction over the cost per student of the Field Test. Extrapolating several years into the future and using an amortization schedule of two to four years for various development and equipment costs, 1,000 students would spread the DOE investment so that it averaged approximately $120 per student per course. Site costs would be about $180 per student per course. Thus, for the four courses used in the Field Test, the per-student overall cost would be $1,200 as compared with $6,382 for the Field Test and $1,665 for the hypothetical 600-student case cited earlier.

In summary, it would appear that large-scale use of the IST model is warranted and that the major goal of the Project, cost reduction for quality education, is achievable. As in all projects of this kind, cost is not everything, and the differential in learning effected by the model over traditional methods should also be investigated. It may well be that IST offers additional bonuses.

What are the teacher training costs?

For the FY-81 Field Test, transportation for teachers to the training site and salaries for their substitutes were borne by the local district. All other costs were paid for by DOE. In the future, however, all costs will be borne by the local school districts. Further, the training costs cover the pre-session training meeting and a mid-year meeting to discuss and resolve problems that appeared at the end of the first semester. The costs, estimated in the Cost Report, assumed an average of 1.5 teachers trained per site and the average length of stay per teacher was 2.5 years. This is consistent with the supervising teacher demographic data reported earlier showing approximately three years for the teachers involved at IST sites. Table IV-22 shows the calculated costs.

Table IV - 22

SUPERVISING TEACHERS' TRAINING COSTS FOR FY-81

	Total FY-81 Costs (Non-Amortized)	FY-81 Per Teacher (Amortized)	FY-81 Per Student (n = 367) (Amortized)
DOE	$ 75,000	$ 833	$ 82
Local Sites	65,280	725	71
Total	$ 140,280	$ 1,558	$ 153

If the cost of regional supervisors' visits are accounted for, i.e., visits to sites made to assist in setting up facilities at the beginning of the IST year, an additional five dollars would then be added to the $153 shown. This is still a small contribution to the per-student cost of the FY-81 Field Test and very well worth it.

In future years, as the number of IST sites, courses, and students grow, the absolute contribution to the per-student cost would be less, somewhat, but would become a substantial fraction of it. For example,

$150/$1,200 approximates 12.5%

for the 1,000-student situation. Further, if the desires of the supervising teachers for a spring workshop, followed by a pre-course workshop in summer, one in mid-year, and a "refresher" in the second year were to be instituted using the present approach to training, training costs could rise substantially. Therefore, looking into ways of using teleconferencing for at least two of these workshops would contain costs and perhaps reduce them further, depending on how many workshops required the teachers' presence at a specific location. Another approach to cost containment would be to develop a training package including instructional computer disks and support materials to handle a large part of the training load.

RECOMMENDATIONS

The findings of the Pilot Test evaluation added new insights into the design and implementation of an individualized student learning system. Therefore, the major findings have been generalized and are presented here for consideration and utilization by readers where they suit the context of their environment:

STUDENTS

- Since student entry levels contributed to a large extent to how well they performed, the use of educational diagnostic criteria for placement in IST-type courses may well be appropriate.
- Mathematics applications and reading comprehension should be emphasized in diagnosing basic student skills.
- Peer tutoring should be used with caution as it may cause resentment in other students.
- Properly handled, the majority of students who by nature and/or cultural background are more comfortable in group situations, can achieve a high degree of self-sufficiency over time.
- There is considerable evidence that breaks in formal learning, even on the order of weeks, do not negatively affect student performance if they have become comfortable with working independently -- individualization allows them to "catch up" if they are sufficiently motivated.
- Assignments should probably be given to students who will be away from the classroom for any extended period in order to ensure that a specified number of lessons are completed by the end of the school year.

TEACHERS

- There is a great deal of evidence to show that, when involved at a sufficiently early stage and after receiving proper training, teachers will readily accept their altered roles in the teaching process.
- As students become more comfortable with individualized study, the amount of work required of the supervising teachers usually decreases below that required in the traditional classroom.
- Teachers find that the components most compatible with their teaching style are the computer exercises and textbooks. The least compatible appears to be the audio tapes and projects.
- Teachers prefer the option of occasional training workshops to maintain and/or sharpen their skills.
- Every new site preparing to use the IST-type model should be visited early in the school year by a knowledgeable person to assist the supervising teacher with classroom set-up problems and to act as a resource.
- Supervising teachers should be available in the same room to assist IST students; however, teachers can be involved with other activities simultaneously without detriment to the IST students.
- There is evidence that teachers, who had prior experience with the course material, who were comfortable with non-traditional teaching, i.e., multiple simultaneous activities in the same

classroom, and those who had prior experience with the use of audio tapes, fostered better student performance.

- Training workshops should prepare teachers to work in classrooms where diverse activities are going on and to use audio tapes properly.

- The most appropriate use of aides appears to be to perform record keeping functions, grading, and monitoring of student progress and equipment usage.

COURSES

- There is substantial evidence to indicate that the presentation of course content with audio tapes results in better student performance. Where audio tapes preceded computer interaction, significantly enhanced computer-activity performance was achieved.
- In development of multimedia courses, emphasis should be placed on the content and its presentation on audio tapes.
- Supplementary audio learning experiences, "mathematical-logical" teaching methods, and computer graphics should be used for students with poor reading-comprehension skills.
- Lengthy instructional activities should be broken down into several activities using several media options to stimulate more active learning and to achieve better attention rates.

- Cognitive levels called for by lesson objectives should be present in the instruction, activities, and tests.
- Each medium should exercise various cognitive levels.
- The instructional design of individualized study courses should specify the purpose for the use of each medium and should include a guide for correspondence between objectives, learning process, desired learning outcomes, and media options.
- Since much instruction in academic subjects is cumulative and based on the student's attainment of prior skills and knowledge, guidance should be given in the lessons/activities/units most essential for student completion if they are to study more advanced topics.
- The interactive nature of instructional computer frames should be emphasized.
- A cognitive information-processing, instructional-design model appears appropriate for computerized instruction and a causal attribution approach for the affective and motivational aspects.

COSTS

- The IST model becomes more cost-effective as the number of students and courses increases since the addition of students requires only an incremental investment over the basic cost of installing the system at a school in the first place.
- Since teacher training will become a sizable portion of an IST-type operational system, techniques for reducing the cost of this element should be considered and could involve: (1) use of telecommunications for refreshment, "hot line," and some instruction; (2) use of experienced local site people as resources; and (3) training package including instructional diskettes.

INSTITUTIONALIZATION

ORGANIZING FOR THE FUTURE

With the evaluation of the Pilot Test, development of the IST was essentially completed. What remained was for the DOE to define the ongoing role of the ETA Project Office in the institutionalization of IST throughout Alaska. However, many changes had occurred in the four-and-one-half-year period that IST was under development and these factors had to be taken into account for the operational system. The factors that appear most likely to impact IST are:

- The Alaska State Legislature has authorized funds to develop and implement a statewide television network via satellite to provide life-long learning opportunities to Alaskans in small as well as large cities and communities (Learn/Alaska Network).
- The State authorized implementation of an audio teleconferencing network covering 240 villages and cities (also part of Learn/Alaska).
- The Department of Administration has been given the responsibility to study and eventually combine into a comprehensive network the large number of separate data, electronic mail, and other systems existing and being generated within the public sector.

It is apparent that the DOE has a great deal to gain by being an active member in the process of evolving Alaska's comprehensive public communications network. In order to do so effectively, it was necessary to consolidate all technologically supported educational programs under a single organization that could represent DOE's interests.

In July, 1981, the Office of Educational Technology and Telecommunications (OET&T) was formed combining under a single organization both the ETA Project and Learn/Alaska Program, the major telecommunications/technology activities of the DOE. The stated purpose of OET&T is "to develop and implement appropriate applications of electronic technologies to the process of instruction, management of instruction, and the administration of educational systems in the State of Alaska."

The OET&T Goals are:

- to provide department-wide planning, coordination, and integrated use of a broad variety of electronic technologies for service to public schools and selected education agencies;

- to develop and implement methods to improve the administration of public education in the State through the use of the full spectrum of electronic technologies;
- to assist the State's public school educators in effectively using appropriate educational technologies to supplement local curriculum and address educational needs. The Office will provide assistance, where indicated, including research and development, dissemination of information, training, and other assistance as may be requested by local education agencies;
- to work with other State agencies in the development of policy, system design, and maintenance of integrated telecommunications networks for the support of public education in the State;
- to monitor the development of emerging electronic technologies and determine their sole or combined feasibility for use in public education in the State;
- to continue to operate currently utilized DOE technology and telecommunications systems, as necessary, for the continued effective utilization by public schools;
- to assess the broad impact of electronic technologies on Alaskan education and incorporate the results in ongoing management decisions.

The immediate effect of forming OET&T was to integrate the staffs of ETA and Learn/Alaska (Appendix C). Although each will service its own client populations for the present, steps have been taken to integrate all technologies into a comprehensive educational system. Steps being taken to accomplish this integration are:

- the design and implementation of a single fully integrated program of services and training involving a match between user needs and the full communications bandwidth, i.e., from data to voice and full-motion video;
- a redefinition of existing policies and agreements with other agencies and individuals to accommodate the new structure.

To further strengthen education's voice in the planning and implementation of statewide networks, the DOE is working even more closely with the University of Alaska (U of A), its partner in the Learn/Alaska Network. Cooperation between OET&T and the U of A provides a combined voice that speaks for the educational community representing Grades K-12 and higher education.

INFORMATION DISSEMINATION

The importance of keeping all interested and involved parties current on the nature of IST, its advantages and limitations, and its successes was recognized when the ETA Project was initiated in 1977. At that time institutionalization was a goal designed into the Project by Project management and the NIE Program Office.

Dissemination initially concentrated on a planned program involving presentation of papers at State and national conferences, information flyers and other publications, attendance at statewide meetings of teachers and administrators; and talks and flyers to the State Legislature and School Boards. These activities will be continued, However, several important steps were taken in Calendar Year 1981 to formalize and expand the dissemination activity. The most important were:

- The commitment by DOE/ETA to sponsor, on a yearly basis, a conference on the use of computers for education. Although primarily aimed at Alaskan educators, attendance by anyone in the country is encouraged. The first conference, "Computers for Learning," was held in Anchorage in March, 1981. Though budgets were tight, about 150 Alaskan teachers and administrators attended, paid for by their local school districts. This demonstrated that interest was much higher than expected.
- The "ETA Newsletter," a publication issued by the DOE every month and circulated to all Alaskan school districts. Its purpose is to inform educators of the latest happenings of the Project, but also to make them aware of useful new software that has become available and technology advancements involving computers, videodisc and others.
- Alaskan Association for Computers in Education is a new professional association formed after the conference on "Computers for Learning" because of the tremendous interest that is growing in the Alaskan educational community. Initial funding for the Association was provided by the DOE. At this writing plans are underway for the Association to produce its own newsletter. The second computer conference, held in April, 1982, was attended by 350 participants.
- "Learn/Alaska," originally a publication associated with the program of the same name, will include information about audio and computer happenings. This is a professionally produced publication similar in quality to commercially produced multi-color publications.

COURSEWARE

NEW COURSES

Two subjects were identified in FY-81 to be developed into full-year IST courses -- General Science and U.S. History. This brought to a total of six the number of full-year courses sponsored by the ETA Project. As with General Math and Developmental Reading, these were based on

available texts since a search of existing correspondence courses failed to come up with any of comparable quality. An outline of each of the courses appears in Appendix D.

In FY 1982, two additional subjects were identified for development into IST courses; Consumer Education and Health Education. The RFP for their development was issued just prior to the end of the NIE sponsorship, October 1981. A brief description of these courses also appears in Appendix D.

NEW APPROACH

With the completion of Consumer Education and Health Education, eight full-year courses will have been completed. Using the English and Alaska History courses as a guide, each such course will take about two-and-one-half years to develop, field test, and release for general use. The process is a relatively long one. However, in the period since the ETA Project began, the number and quality of computer educational units (programs addressing single and multiple objectives, but not course length) had grown tremendously. ETA Project management recognized this and made the decision to investigate the most promising of them to determine their usefulness in the Alaskan environment. The purpose was to identify as many as possible, and to recommend to the schools those that were appropriate. In this way, schools would gain access to many individualized units that could be incorporated into the classroom in a short time. These units could not fill the role of the full-length courses, nor was that the intention. Their introduction would make available a wide range of excellent learning modules in areas where full-length courses were not warranted or would bolster others until new courseware became available. The library of computer programs at the Minnesota Educational Computing Consortium (MECC) was studied to estimate the feasibility of converting their computer programs to run on the ETA Apple II computers. It was found that no conversion was necessary and that the MECC programs were compatible with the Apple computers in the field.

Expanding upon the concept of making as much good courseware available to the schools as quickly as possible, DOE has consummated an agreement with MECC whereby the State pays a yearly fee for access to their program library. At a small additional dollar cost, schools and colleges have the right to use the programs for a full year. Also, under this agreement, schools and colleges may purchase MECC materials at 50 percent of the list cost.

A library has been established at DOE where computer programs in the public domain and commercially produced programs are stored and used for demonstration purposes. The materials are not available for loan because there are not enough to provide for a circulating library and because the damage and loss potential could be excessive.

USER AND INSTITUTIONAL RESPONSIBILITIES

From the very outset, the ETA Project designed into its plans the seeds of its own demise; i.e., to hand over to State operating divisions and the user community the responsibility for the funding and management of the operational components that proved to be cost-effective and affordable. The strategy that was implemented involved:

- Careful design, development, and testing were conducted with major costs borne by the Project.
- System elements were developed which addressed the general educational needs of all levels, from administrators to students, rather than focused on a single level. The driving function was priority needs regardless of where in the hierarchy those needs existed.
- Participants were informed at the outset that the burden of supporting all elements would ultimately be borne by the users, starting with communication-usage costs when field implementation began. An increasing percentage of direct utilization charges was assigned to local districts for system usage as it matured and progressed toward operational status.
- A concerted and continuing effort was made to keep the State Administration, State Legislature, and educators at all levels informed about the Project.
- ETA Project would continue support for only those elements which had not been proven by field trials, using State funds alone after NIE support ceased.

USER RESPONSIBILITIES

With the initiation of field trials in 1978, some of the burden of the Project cost was shifted to the user districts. In the Pilot Test, where most schools were involved in the IST for the first time, only the cost of teleconferencing with the course coordinators and calls to DOE for assistance were charged to the users. Of course, there were the costs associated with providing the supervising teachers and aides (at those sites where aides were used) as well.

In the Field Test conducted in FY-81, the Alaska History and English courses were considered to be sufficiently developed so that new schools, those that had not participated in the Pilot Test, paid for the cost of reproduction of the diskettes, audio tapes, written materials, and associated worksheets. General Math and Developmental Reading were as yet unproven and were thus supplied free by DOE. In addition, all sites were responsible for the repair and maintenance of the computer and its associated equipment and the audio cassette players.

By September, 1981, 95 schools had applied to participate in the field trials for the 1981-1982 school year. The new schools would have to purchase materials associated with four courses -- Developmental Reading and General Math having joined English and Alaska History as approved courseware. In addition, U.S. History and General Science would be fielded for the first time. The costs to the schools for the materials associated with each approved course are as follows:

Alaska History	
1 complete set of classroom materials*	$356.67
1 set of student materials**	$ 49.43
English	
1 complete set of classroom materials*	$284.82
1 set of student materials**	$ 25.58
Developmental Reading	
1 complete set of classroom materials*	$313.15
1 set of student materials**	$ 37.94
General Math	
1 complete set of classroom materials*	$230.86
1 set of student materials**	$ 34.11

* = 1 set required per class;
** = 1 set required per student

As in the Field Test of FY-81, all sites will be responsible for repair and maintenance of site equipment. One additional cost will be borne by the sites from here on in: the cost of teacher training, including travel and board.

INSTITUTIONAL RESPONSIBILITIES

By the time of the Pilot Test, Management, Law and Finance (DOE) had taken over the responsibilty for the Reimbursable Service Agreement (RSA) with the Division of Data Processing (Department of Administration). This Division was responsible for computer hardware and software. Similarly, the Division of Communications was responsible for all the telecommunications components used by the ETA Project. Starting in July, 1982, ETA will no longer fund this network; it will be turned over to an operating organization of DOE. Thus, by the end of 1981, Project management retained responsibility only for courseware development, training of supervising teachers, field trial evaluations, identification of Alaska-suited computer software, and some dissemination functions.

Operational responsibilities had been effectively transferred to the operating divisions within DOE and other Departments and to the users!

CONCLUDING REMARKS

This document was intentionally written as a history of the IST model. It represents a step-by-step account of the introduction of a technologically supported educational innovation on a large scale. The lessons contained here have meaning to all educators interested in bringing about a change in traditional patterns of teaching and learning. Indeed, the lessons learned are of value, not only in rural areas and in education, but anywhere and in any field where innovation is contemplated. All people are reluctant to change unless they can be shown that the change has associated with it the rewards commensurate with the "sacrifices" of established norms with which they have grown comfortable.

Throughout this volume, recommendations have been included and put in such a form not only to show their value in the context in which they were born, but also to provide guidance to the many readers who will look to this volume for assistance in their own situations. It is because the sponsors of this Project, the National Institute of Education and the State of Alaska, wanted a living document, one that could be used by others to provide guideposts along the path to change, that this volume has taken its format. In this way, the reader can see what necessitated these recommendations and relate them to his/her own situation. If the situation is similar, the recommendations have a large measure of validity in their context; if the situation is radically different, the suspect recommendations should be avoided or modified to conform to the reader's needs. In any event, all recommendations are "flags" identifying for the reader areas to be aware of, even if not directly applicable.

In his presentation, "Introduction of a Successful Educational Innovation - The Educational Telecommunications for Alaska Project (ETA)" at the Rutgers University Conference, "Telecommunications in the Year 2000" (November 19, 1981), Mr. Albert Feiner, former NIE Program Manager, summarized the Alaskan experience into 16 key points (Table IV-23) that are rules to follow when introducing change. All the "guidelines" are self-explanatory; however, some deserve to be stressed again.

- *Items 2 and 3:*

  It is essential that all involved realize that the acceptance of innovation is a personal thing. Until the users internalize the value of the innovation, *in their own context*, it will not be utilized. This is not accomplished in the course of one year and may take more than five.

- *Items 8 and 9:*

  Over the past twenty years, *demonstrations of educational technology have*, in the main, *failed to foster institutional* *change*. A mechanism must be built in from the beginning to transition the innovation to user support should acceptance be noted and expectations raised. We have found that by building upon the original model, each new addition receives support from those already receiving satisfactory service.

Table IV - 23

GUIDELINES FOR A PROJECT DESIGNED TO INTRODUCE INNOVATION

- **Use the technology to enhance the solution of the problem rather than as an opportunity to apply a favored technology.**
- **All involved must make a long-term commitment.**
- **Funding mechanism must be established to at least create a "critical mass."**
- **Be flexible -- be able to adapt to the unanticipated.**
- **Institutionalization begins at the planning stage.**
- **An information dissemination plan must be developed at the very beginning.**
- **Pre-selling of the concepts to those who will be impacted is essential.**
- **The project should be designed as the "nucleus" of the eventual large-scale implementation.**
- **The "nucleus" should be composed of "Enthused Supporters" and represent a microcosm of the full-scale environment.**
- **Uncontrollable variables must be identified to the greatest extent possible.**
- **Evaluation must be built-in as an on-going management decision making tool.**
- **Users must have a meaningful and continuing role.**
- **Plan from the outset the gradual hand-over of responsibility and funding for the operational system.**
- **A training program is key to institutionalization.**
- **Allow users to innovate within their local environment.**
- **Beware of the existing technologies.**

- *Item 11:*

Short, but meaningful, evaluations must be designed from the outset to test critical stages of the innovation introduction. These can be as short as one or two months, but are essential in guiding management. *Do not be afraid to make radical changes if the situation demands.*

- *Item 14:*

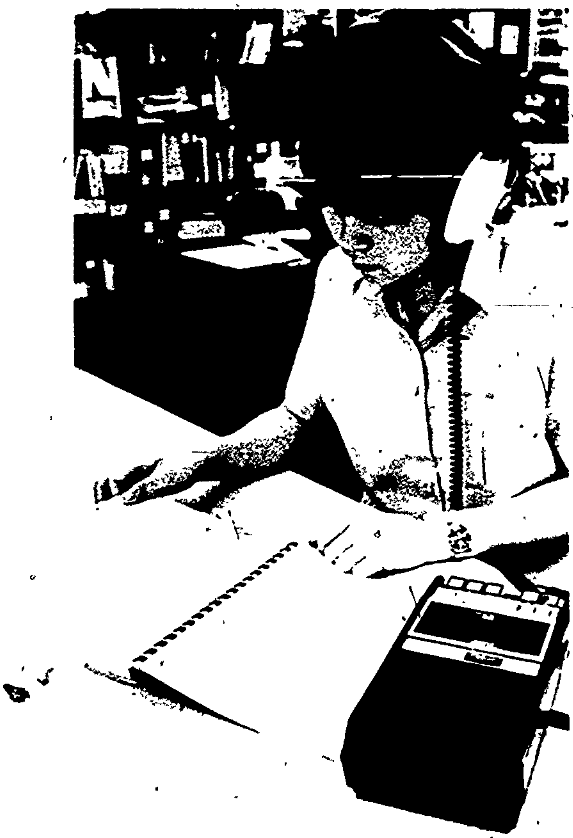
The interface of people with technology, especially those unaccustomed to that interface, is very important. They must be made comfortable in the presence of flashing lights and machines that "talk back." Further, all levels of users must be made to understand what is going on. In the introduction of the EMS, for example, although there were trained operators who actually used the on-site microcomputers, *superintendents and administrators were given talks and even took part in the operator training sessions.* There were no surprises for them.

• *Item 15:*

Internalization of the usefulness of the technology is essential to acceptance, as mentioned earlier. There is no better way to build strong grassroots support than to allow local personnel to use the technology as it best fills their needs. One of the greatest successes enjoyed by the ETA Project has been the innovative ways school administrators and staff have used the intelligent terminals for their own local uses, e.g., for keeping student files and for financial record keeping. These users are among ETA's strongest supporters.

• *Item 16:*

The technologies introduced in the Project were in all instances well-studied and understood. Their strengths and weaknesses were known ahead of time. However, when these technologies must interface with existing, and in many cases, "primitive" ones, BEWARE! It can be unreliable and unregulated local power sources or noisy local telephone loops, etc. that destroy the effectiveness of the system concept. These must be accounted for *before* monies are spent to install the new technology.



APPENDIX A

VERIFICATION THAT COURSE SHOULD BE REVIEWED

COURSE: ______________________

____

Any course to be reviewed must meet these preliminary requirements, therefore answers to *all* of these questions should be "Yes." If any questions must be answered "No," please check with Alaska Telecommunications Program staff before proceeding.

1. Is this course a standard course offering in secondary schools in the U.S.A.?

   ______ YES ______ NO

   Comments:

2. Does the course cover two complete semesters?

   ______ YES ______ NO

   Comments:

3. Are the following materials part of the course?

First Semester			*Second Semester*		
Text	______YES	______NO	Text	______YES	______NO
Scope and Sequence	______YES	______NO	Scope and Sequence	______YES	______NO
Student Workbook	______YES	______NO	Student Workbook	______YES	______NO
Teacher Guide	______YES	______NO	Teacher Guide	______YES	______NO

   Comments:

4. Is the course available in large quantities from a commercial publisher or other curriculum development project?

   ______ YES ______ NO

   Comments:

5. Is the copyright date for the course 1975 or later? ______YES ______NO
   Specify the copyright date: ______________________

   Comments:

CANDIDATE COURSE MATERIALS SUMMARY RATING SHEET

SUBJECT: ____________________

MATERIALS: ____________________

PUBLISHER: ____________________

AREA	*RATING*
1. Reading level of materials is at or below 8th grade.	YES NO
2. Sufficient quantities of supplementary materials are readily available.	YES NO
3. Defnied scope and sequence is available.	YES NO
Complete teacher's guide containing suggested class/student activities and projects is available.	YES NO
4. Copyright release license requirements assured.	YES NO
5. Course is organized and complete.	Low 1 2 3 4 5 High
6. Course is adaptable for unique requirements of Alaska (within project constraints).	Low 1 2 3 4 5 High
7. Course exhibits usability and flexibility.	Low 1 2 3 4 5 High
8. Course content is complete and of high quality.	Low 1 2 3 4 5 High
9. Course avoids inappropriate stereotyping or bias.	Low 1 2 3 4 5 High
10. Course is compatible with IST Software (Version II)	Low 1 2 3 4 5 High

Summary and Recommendations:

CANDIDATE COURSE REVIEW WORKSHEET

SUBJECT: ______________________

MATERIALS: ______________________

PUBLISHER: ______________________

Area 1: Establish that course reading level is at or below 8th grade (publisher data, use of readability formula, other data).

Questions to Consider in Your Review:

- Is publisher data on reading level complete?
- Are publisher claims data-based or are they opinions?
- Do claims appear to be borne out in your review of the materials?
- Is the reading level for supplementary materials the same as for the text(s)?
- If not, is the teacher alerted to variations and/or provided with alternatives?
- Are provisions made for teaching specialized vocabulary?

Strong Points:

Weaknesses:

READABILITY REQUIREMENT MET: YES NO

CANDIDATE COURSE REVIEW WORKSHEET

SUBJECT: ______________________

MATERIALS: ______________________

PUBLISHER: ______________________

Area 2: Establish that sufficient quantities of supplementary materials are readily available.

Questions to Consider in Your Review:

- Are the recommended supplementary materials (accompanying or referenced in the course materials) generally available, or would they have to be developed or adapted?
- Does the course rely extensively on the teacher to identify and provide supplementary materials?
- Are problems in obtaining, providing or using supplementary materials evident?
- Is there an over-reliance on the use of supplementary materials?
- Are existing supplementary materials consistent with course materials?

Strong Points:

Weaknesses:

REQUIREMENT FOR AVAILABILITY OF SUPPLEMENTARY MATERIALS MET: YES NO

CANDIDATE COURSE REVIEW WORKSHEET

SUBJECT: ______________________________

MATERIALS: ______________________________

PUBLISHER: ______________________________

Area 3: Establish the availability of:

3.1 a defined scope and sequence statement

3.2 a complete teacher's guide containing suggestions for class/student activities and projects

Questions to Consider in Your Review:

- Is the scope and sequence statement clear, comprehensive and easy to follow?
- Are the teacher materials comprehensive?
- Could a teacher whose specialty is *not* the specialty of the course find enough information in the teacher materials to teach the course comfortably and competently?
- Does the teacher's guide provide adequate guidance for using course materials?
- Are suggestions for activities/projects adequate? Could they be implemented in rural Alaska villages?

Strong Points:

Weaknesses:

REQUIREMENTS MET FOR: • AVAILABILITY OF SCOPE AND SEQUENCE YES
• COMPREHENSIVE TEACHER'S GUIDE YES

CANDIDATE COURSE REVIEW WORKSHEET

SUBJECT: ______________________

MATERIALS: ______________________

PUBLISHER: ______________________

Area 4: Establish that copyright release license requirements needed would be assured.

Questions to Consider in Your Review:

- Is copyrighted material used extensively in the course?
- Do the course materials include the necessary releases? Are sources appropriately acknowledged?
- Could computer activities and audio materials be created without requiring that numerous copyright releases be secured?

Strong Points:

Weaknesses:

COPYRIGHT RELEASE REQUIREMENT MET: YES NO

CANDIDATE COURSE REVIEW WORKSHEET

SUBJECT: ______________________

MATERIALS: ______________________

PUBLISHER: ______________________

Area 5: Assess the nature and extent of the course's organization and completeness.

Questions to Consider in Your Review:

- Does the table of contents provide a clear overview of the contents of the course?
- Do chapter headings clearly define the content of the chapter?
- Is there a glossary? An index? Does the glossary contain all the technical terms used in the textbook?
- Are graphs and charts clear and supportive of the textual materials?
- Are illustrations well done and appropriate for the student population?
- Is there any use of advance organizers or other guided reading format?
- Do end-of-chapter questions include literal, interpretive and applied levels of comprehension?
- How well do the "pieces" of the course fit together?
- Do materials complement and reinforce each other?

Strong Points:

Weaknesses:

RATING FOR THE COURSE IN THIS AREA: Low 1 2 3 4 5 High

CANDIDATE COURSE REVIEW WORKSHEET

SUBJECT: ____________________

MATERIALS: ____________________

PUBLISHER: ____________________

Area 6: Assess the adaptability of the course in terms of meeting the unique requirements of Alaska taking into consideration the Project constraints of time, staff and budget.

Questions to Consider in Your Review:

- How easily can audio and computer activities be developed that will cover appropriate content *and* reflect the unique aspects of Alaska?
- How well does the course lend itself to the use of Alaska "examples"?
- Is the course designed in such a way that Alaskan examples would fit in with and reinforce the content? (Would they compete with or detract from the content?)
- Would Alaskan students be able to relate to and understand the manner in which the course content is presented?
- Would adaptations require deletion of materials, extensive time, or money, or additional staff?

Strong Points:

Weaknesses:

RATING FOR THE COURSE IN THIS AREA: 1 2 3 4 5

CANDIDATE COURSE
REVIEW WORKSHEET

SUBJECT: ______________________

MATERIALS: ______________________

PUBLISHER: ______________________

Area 7: Assess the usability of the course.

Questions to Consider in Your Review:

- Does the course represent an organized system of learning?
- Is the course organized in such a way that the text must be followed exactly or is the organization flexible so that it permits variations in use?
- Does the course require training or extra information for the teacher before it can be taught?
- What was the assessment of organization and completeness (Area 5) and how does this relate to usability?
- Are materials durable, attractive, easy to use?

Strong Points:

Weaknesses:

RATING FOR THE COURSE IN THIS AREA: 1 2 3 4 5

CANDIDATE COURSE REVIEW WORKSHEET

SUBJECT: ______________________

MATERIALS: ______________________

PUBLISHER: ______________________

Area 8: Assess the quality and completeness of course content.

Questions to Consider in Your Review:

- Does the content challenge students to think and find solutions?
- Is the concept level appropriate for the student population?
- Does the content reflect valid and current knowledge?
- Does the content address basic educational objectives?
- What kind of educational need does the content address?
- Does the material make provision for both process (skill) and knowledge (content) development?
- Is content organization logical?

Strong Points:

Weaknesses:

RATING FOR THE COURE IN THIS AREA: 1 2 3 4 5

CANDIDATE COURSE REVIEW WORKSHEET

SUBJECT: ______________________

MATERIALS: ______________________

PUBLISHER: ______________________

Area 9: Assess the nature and extent of bias in the course.

Questions to Consider in Your Review:

- Does the course reflect the cultural and ethnic diversity of our society?
- Are minority and ethnic groups treated naturally and knowledgeably?
- Is the material free of inaccurate and/or offensive information?
- Does the material avoid reinforcing stereotypes?
- Are individuals, groups and families presented in diverse and representative manner?
- Are males, females and minorities adequately and appropriately represented?
- What kinds of role models are presented?

Strong Points:

Weaknesses:

RATING FOR THE COURSE IN THIS AREA: 1 2 3 4 5

CANDIDATE COURSE REVIEW WORKSHEET

SUBJECT: ____________________

MATERIALS: ____________________

PUBLISHER: ____________________

Area 10: Assess the compatibility of the course with IST Software Version II.

Questions to Consider in Your Review:

- What kinds of computer activities could be appropriately developed for this course?
- Will the format available for computer activities in Version II permit the development of activities appropriate for the course content?
- Are there logical places in the course where computer activities would be appropriate?
- Are there course requirements in terms of content that *cannot* be handled via the IST software? If so, are such requirements adequately addressed by existing materials?

Strong Points:

Weaknesses:

RATING FOR THE COURSE IN THIS AREA: 1 2 3 4 5

APPENDIX B

COST MODELS FOR FY-81 FIELD TEST

With three-and-one-half years of experience and three field trials under its belt, ETA management authorized development of cost models for the IST in order to systematize the parameters of cost estimation for implementation of the IST at participating sites and for future statewide implementation. The cost models contain both circles and rectangular boxes. The factors that represent fairly constant costs, e.g., cost of classroom sets, are shown as rectangles; while more variable costs, e.g., number of students at a site, are represented by circles. The assumptions used in constructing the models are the following:

- Since some of the development costs were not available as separate items for each component, e.g., print materials, audio tapes, and computer exercises, the following weighting factors were used:

  - Print materials - 57 percent of total program
  - Audio component - 10 percent of total program
  - Computer component - 33 percent of total program

- Amortization schedules assumed four-year usable life of all course components and equipment, except tapes and diskettes (for which a two-year life was assumed).
- In the projection of costs for 600 students per course, it was assumed that typically about six students would be taking each course at a site. Therefore, all computations were based on six students per course at each of 100 sites.
- Since overhead costs would be present for physical plant, heating, phones, etc., only those costs that were uniquely attributable to the IST program were included in the present study.
- One-half the cost of each cassette tape recorder was attributed to IST since tape recorders are widely used in the classroom.
- Teacher costs (including salaries, benefits, travel allowances, etc.) were not included in the cost models except those related to teacher-training. This was done because it was assumed that such costs are part of overhead costs.
- Inflation was not considered as a cost factor. Therefore, the present models reflect a constant dollar value for amortization of costs.

1. COST MODEL FOR ONE IST COURSE AT ONE SITE (FIGURE B-1)

The cost of offering each course in a rural site is based on the following factors:

- number of IST courses to be offered;
- equipment costs (purchase and maintenance);
- teacher training;
- number of students enrolled in the course;
- software costs;
- costs of consumable and non-consumable classroom materials.

Figure B - 1

COST MODEL FOR ONE IST COURSE AT ONE SITE

$$\frac{1}{A}\left(B + C\right) + \left(D \times E\right) + F + G + H$$

Where:

A = Number of courses at the site.
B = Cost of hardware & equipment maintenance at the site*.
C = Teacher training cost per site.
D = Students registered for the course.
E = Cost per student set of materials.
F = Cost of diskettes per course.
G = Cost of classroom set of materials per course (non-consumable).
H = Cost of classroom set of consumables per course.

Note: *Subject to the number of courses & students/course. Additional computer may be required for more than three courses & 6-8 students per course.

2. TOTAL COST OF PRINTED COURSEWARE FOR EACH COURSE (FIGURE B-2).

The model used for computing the costs of the printed portion of each course that are attributable to DOE and each site is shown in Figure B-2. The printed portion of the courses consisted of all manuals, texts, workbooks, supplementary readings, teachers' guides, unit tests, etc. These materials alone would represent a fairly complete set of course materials in traditional classroom settings.

Figure B - 2

MODEL FOR THE TOTAL COST OF PRINTED COMPONENT OF AN INDIVIDUAL IST COURSE

$$\underbrace{\left\{\tfrac{1}{2}A \div B + \tfrac{1}{3}C\right\}}_{\text{Doe Costs}} + \underbrace{\left\{D\left(\tfrac{1}{3}E + F\right) + \left(G \times H\right)\right\}}_{\text{Site Costs}}$$

Where:

A = All DOE costs excluding audio & computer component costs.
B = Number of courses (e.g., four in FY-81).
C = Development costs for each course.
D = Number of sites involved.
E = Cost to train average number of teachers per site.
F = Cost of average number of classroom sets of materials (consumable & non-consumable) per site.
G = Total number of students enrolled per course.
H = Cost of a student set of materials for each course.

3. COST OF PRINTED AND AUDIO COMPONENTS FOR ONE IST COURSE

Figure B-3 shows the cost model depicting the addition of the audio component to the printed component of IST. Basically, what is added to the DOE portion is the additional cost of producing the audio cassette tapes. Additional costs to the local sites include the portion of the classroom materials covered by the audio component, the tapes, and the tape recorder. Tape costs are to be spread over a two-year period of assumed useful life. Tape recorders and other audio component expenses are to be amortized over four years.

Figure B - 3

TOTAL COST OF AN IST COURSE WITH AUDIO COMPONENT AND PRINT MATERIALS

$$\left(A + B\right) \quad \left(C + D + E\right)$$

DOE Costs (A + B) — Site Costs (C + D + E)

Where:

A = DOE costs from Figure B - 2 for each course.
B = .17 x A = Estimated cost of developing audio components for each course.
C = 1.17 x site costs for each course in Figure B - 2.
D = Amortized cost of tapes.
E = Amortized cost of tape recorder/player.

4. COST OF ONE FULL MEDIA IST COURSE (PRINT, AUDIO, AND COMPUTER COMPONENTS)

Figure B-4 shows the cost model depicting the addition of the computer component to the printed and audio components. Basically, what is added to the DOE portion is the additional cost of developing computerized instruction. Additional costs to the local sites included the hardware and software needed to implement the computer component. Diskette costs are to be spread over a two-year period of assumed useful life. Computers and other component expenses are to be amortized over four years.

Figure B - 4

COST MODEL FOR A COMPLETE IST COURSE FOR FY-81

$$\left(\frac{3}{2} A + \left(B + C + D\right) \times \frac{1}{4}\right) + \left(\left(1.5 \times E\right) + F + \left(G - H\right) + \left(I \times J\right)\right)$$

DOE Costs — Site Costs

Where:

A = DOE costs from Figure B - 3.
B = Hard and software consultation.
C = Version 1.0 + enhancement.
D = Diskette costs.
E = Site costs from Figure B - 3.
F = Diskette costs.
G = Computer hardware costs.
H = Average number of IST courses per site (for FY-81 = 2.8).
I = Cost of additional diskettes.
J = Number of students enrolled x 2.

APPENDIX C

LEARN/ALASKA NETWORK

The following material about the Learn/Alaska Network has been developed from articles contained in the "Learn/Alaska Instructional Telecommunications Network" magazine published by the Alaska Department of Education and the University of Alaska.

Daytime instructional TV programs have been broadcast via satellite since 1977. However, exploitation of long-range communications full video bandwidth had not been explored and its potential not fully understood.

In 1979, the Legislature requested a study of the feasibility of using television for instruction on a statewide basis The DOE and U of A undertook such a study in cooperation with local and regional public education agencies and the State's public broadcasters. The resulting document, "A Report on the Feasibility of Telecommunications in the State of Alaska" was submitted to the Legislative Council in February, 1980, and recommended, in part, that:

- Instruction requires interaction, or two-way communication, as a vital part of the learning process.
- Instructional television can be effective for learning, provided that:
  - programs are relevant to Alaska;
  - students have opportunity to respond;
  - teachers are trained in selecting ITV programming;
  - programs are available in the classroom when needed.
- Television broadcasts can provide timely access to instructional programs, live courses or special events, and teleconferencing.
- Audio conferencing provides a cost-effective way to permit interaction, either with a television broadcast course, or using audio alone when visual materials are not required.
- Instructional TV/audio conferencing for Alaska should be established on a regional basis, since the heaviest use could be expected within regions and districts.
- Funding should permit local and regional program productions, and support for projects most relevant to local needs.
- Any development of this technology should be coordinated for shared use by all age and grade levels of education.

In the 1980 legislative session, Governor Hammond received and signed a bill for $8.6 million to cover costs necessay to initiate the majority of the ITV/audio conferencing recommendations.

1. AUDIO CONFERENCING SERVICES

Installation of this network began in March, 1981. A community installation contains a terminal (portable) with up to six microphones. Audio conferencing provides a means for groups located at different locations to interact with each other over phone lines/satellite circuits. By using the portable terminals and microphones, groups of students and educators in different Alaskan communities could simultaneously participate in instructional courses or teachers and other school staff could receive training in the use of IST courses without having to physically locate at a central site.

Costs for the terminals, installation, and use of the system will be paid by the network, unlike the IST model which requires such support from the local sites. Larger communities may be served by several conferencing locations.

To use the conferencing network, users will request time through local coordinators, indicating their first and second priority times for the conference. The local coordinator will forward their request to the network scheduler, and will receive verbal, then written, confirmation. Coordinators at each site participating in any audio conference will notify participants in each community of the time and place for the conference On the day of the conference, participants meet at the designated locations. When the session is ready to start, the network operator calls each site. When all sites are connected, the session begins.

2. INSTRUCTIONAL TELEVISION (ITV)

Beginning in the 1981-1982 school year, ITV services have been expanded. Rather than five days per week, educational programming is broadcast seven days per week and up to 18 hours on particular days. In many communities, 10-watt translators (mini-TV transmitters) are, or will be, installed so that the educational programming can be received directly in the schools and homes. Many of the broadcast programs are available for off-the-air recording locally. In addition to origination at a central location, regional uplinks are planned to permit broadcasts from a number of communities.

APPENDIX D

NEW COURSES SPONSORED BY THE ETA PROJECT

GENERAL SCIENCE - FY-1981

- Unit 1 - What Makes Up Our World

  Matter
  Atoms
  Energy
  Chemical Change

- Unit 2 - How Does Energy Affect Matter?

  Heat and Temperature
  Forces and Motion
  Waves and Sound
  Light

- Unit 3 - How Do We Make and Use Energy?

  Electricity and Magnetism
  Energy for Everyday Use
  Sources of Energy

- Unit 4 - How Is Our Planet Changing?

  Changes Happening Now
  Changes in the Rocks
  Changes Through Time
  Changes in the Atmosphere
  Our Changing Frontiers

- Unit 5 - What Makes Up Our Changing World?

  Life on Earth
  All Living Things Are Similar
  Community Relationships
  Continuing the Species
  The Human Organism
  The Quality of our Environment

U.S. HISTORY - FY-1981

- Unit 1

  Digging Up America
  Native American Cultures
  Woodland Indians

- Unit 2 - The New World - 900-1750
  - Explorers and Exploration
  - New World Attractions
  - Permanent English Colonies
  - Immigrants and Immigration
  - Colonial Ways of Life
- Unit 3 - Becoming A Nation - 1750-1800
  - English or American
  - Colonial Conflicts
  - An Attempt at Union
  - A More Perfect Union
  - Political Parties Begin
- Unit 4 - The Great West - 1500-1840
  - Spanish Borderlands
  - Indians of the Great West
  - Louisiana and Beyond
  - Conflict Inside and Out
- Unit 5 - The Early National Period - 1815-1850
  - Different Ways of Life
  - Government and the People
  - A Period of Reform.
  - From Sea to Shining Sea
- Unit 6 - The Union in Crisis - 1850-1877
  - The Slavery Culture
  - Steps to War
  - The Home Fronts
  - Fighting the Civil War
  - The Aftermath
- Unit 7 - An Industrial Nation - 1876-1900
  - Inventors and Inventions
  - Railroads and Factories
  - Workers and the Labor Movement
- Unit 8 - Cities Come of Age - 1865-1900
  - Peopling the Cities
  - Life in the New Cities
  - Governing the City
- Unit 9 - Expansion and Conflict - 1865-1900
  - The End of a Way of Life
  - The Mining Frontier
  - Ranchers and Cowboys
  - Southerners and Sharecroppers

- Unit 10 - Politics and Foreign Policy - 1876-1920

  Post-Reconstruction Politics
  Expansion and Jingoism
  The Progressive Movement
  The Great Crusade

- Unit 11 - Good Times and Bad - 1920-1940

  A New Lifestyle
  The Great Crash
  A Time of Isolation

- Unit 12 - The World At War - 1940-1960

  A New Global Conflict
  Postwar America
  The Cold War
  Left Out of the American Dream

- Unit 13 - The Price of Power - 1960-Present

  Struggling for the Dream
  At Home and Abroad

CONSUMER EDUCATION - FY-1982

This course is designed to develop a variety of skills and attitudes for successful management of personal and financial resources. Intelligent and rational decision-making is a key concept underlying all content areas. Contents are to include at least the following areas:

- Personal or family decision-making (goal setting, value clarification, personal resources - time, skills, money)
- Gathering and evaluating consumer information (advertising, publications)
- Shopping skills (sources, quality and service comparisons, methods of payment)
- Credit (advantages vs. disadvantages, sources, loan responsibilities, costs)
- Banking services (savings, checking, loans)
- Consumer responsibilities and protection (contracts, effective complaints, regulatory agencies)
- Taxes (types, how to file)
- Budgeting (developing, implementing, evaluating)

HEALTH EDUCATION - FY-1982

This course is designed primarily for small rural and isolated communities - the interrelationship of physical, emotional, and environmental health is to be stressed. Content will include at least the following areas:

- Personal Health (exercise, sleep, rest, relaxation, posture, cleanliness)
- Human Growth and Development (all major body systems, growth during major stages of life, biological and emotional maturation, human reproduction)
- Diseases and Disorders (chronic and communicable)
- Oral Health, Vision and Hearing (caring for and treating teeth, eyes and ears)
- Nutrition (relationship of health to adequate food intake)
- Emotional Health (understanding and accepting oneself and others, handling stress, adjusted and maladjusted behaviors)
- Substance Use and Misuse (tobacco, alcohol and other drugs)
- Environmental Health; Safety and Survival Skills (air, noise, and water pollution; fire, vehicle, home and school safety; first aid)
- Consumer Health (choosing and using appropriate health personnel and products)
- Health Careers

LIST OF ILLUSTRATIONS

ABBREVIATIONS

PREFACE

ACS	Alaska Communication System
AEBC	Alaska Educational Broadcasting Commission
AETC	Alaska Educational Telecommunications Consortium
Alascom	RCA Alaska Communications
APBC	Alaska Public Broadcasting Commission
ASOSS	Alaska State-Operated School System
ATS	Advanced Technology Satellite
AVEC	Alaska Village Electric Co-op
BIA	Bureau of Indian Affairs
DHEW	Department of Health, Education and Welfare
DOE	Alaska Department of Education
ERIC	Educational Resources Information Center
ESCD	Education Satellite Communication Demonstration
ETA	Educational Telecommunications for Alaska Project
NASA	National Aeronautics and Space Administration
NEA	National Education Association
NIE	National Institute of Education
OT	Office of Telecommunications in the Governor's Office
RCA	Radio Corporation of America
REAA	Regional Educational Attendance Area
RRC	Regional Resource Center
SPAN	Systematic Planning Around Needs
UNESCO	United Nations Educational, Scientific, and Cultural Organization
WACS	White Alice Communications System

INDIVIDUALIZED STUDY BY TELECOMMUNICATIONS (IST)

ADM	Average Daily Membership
APR	Alaska Public Radio
ASAT	Alaska Statewide Achievement Test
CAI	Computer-Assisted Instruction
CCS	Centralized Correspondence Study
CMI	Computer-Managed Instruction
CSD	Alaska Center for Staff Development
D & I	Design and Implementation Contractor
DOE	Alaska Department of Education
EMS	Electronic Mail System
ETA	Educational Telecommunications for Alaska
FTE	Full-Time Equivalent
IST	Individualized Study by Telecommunications

MECC	Minnesota Educational Computing Consortium
NEA	National Education Association
NIE	National Institute of Education
NWREL	Northwest Regional Educational Laboratory
OET&T	Office of Educational Technology and Telecommunications
RRC	Regional Resource Center
SERRC	South East Regional Resource Center
STEP	Sequential Test of Educational Progress
U of A	University of Alaska

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