IDENTIFICATION AND EVALUATION OF EDUCATIONAL USES AND USERS FOR THE STS

Working Title For This Study

EDUCATIONAL PLANNING FOR UTILIZATION OF SPACE SHUTTLE (ED-PLUSS)

By

H. A. Engle and D. L. Christensen

Final Research Report

This research work was supported by

the National Aeronautics and Space Administration

George C. Marshall Space Flight Center

Contract NAS8-30737

The University Of Alabama In Huntsville

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A Research Study of Six Months Duration
Contract Number NAS8-30737

The University of Alabama In Huntsville
School of Graduate Studies and Research
P. O. Box 1247
Huntsville, Alabama 35807

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TABLE OF CONTENTS

LIST OF FIGURES

PREFACE

The need for a definition of education for this study was quite evident even before the effort was initiated. There are many definitions of education on a continuum from highly structured programs where the learner is a passive recipient of transmitted knowledge to programs where the learner is an active participant acquiring knowledge and understandings sought by the individual to achieve his own goals in a variety of ways. Definitions of education range from strict formal programs to any activity that helps an individual gain new knowledge. Such a continuum is more clearly recognized in contemporary society as one reviews the literature about the diversity of instructional patterns available to meet a variety of student needs. Diverse school systems from the grade school through higher education on the one hand, to a multiplicity of continuing education programs for the masses are available for life-long pursuit according to individual opportunity. Therefore, this Phase I study to identify the potential educational user community had to define the educational target group as being all people in the age bracket from infancy through senior citizenry. Education is defined in this study as any activity that allows a person of any age to gain new knowledge, to broaden understandings, to integrate knowledge in solving problems, to develop awareness of self as a positive member of society, and to interact with others in the development of personality and values that allow for security in the midst of change.

In order to utilize space age technology so that it is made for man, rather than man being made for technology, it is essential that NASA recognize the need for this definition of education in order to establish education as a broad application of the Space Transportation System (STS). Without educational involvement the gap between technological advancement and technology utilization can become so great as to turn popular support against STS. This would inevitably affect fiscal support. With educational involvement as a viable function of STS the recognition of man's benefits from applying technology for educational pursuits enhances the formation of values that evolve into improved life styles. This would provide popular opinion to foster continued and expanded financial support. NASA has demonstrated a strong and continuing interest in education in a variety of ways, including the funding of this Phase I study. The investigators hope that NASA will use the findings of this study to broaden the definition and role of education in forthcoming STS activities.

ACKNOWLEDGMENTS

This work was supported by the National Aeronautics and Space Administration, George C. Marshall Space Flight Center, under Contract Number NAS8-30737. Mr. Ron Crawford and then Mr. Charlie Johnson were the NASA Contracting Officer Representatives for the project and their coordinating efforts, encouragement and consultation during the course of the study are appreciated. Likewise, many other NASA personnel provided essential data and helpful suggestions.

Appreciation is expressed for the cooperation and support gained from the other three Phase I contractors and the key contacts made throughout the educational community. Special appreciation is given to the eighteen members of the UAH ED-PLUSS Advisory Committee.

Mr. Sandy Campbell, graduate assistant, and Mr. Harold Green, educational consultant, are particularly recognized for their extensive research and supporting efforts on this study. As task team members, they served throughout the course of the project in a meritorious way. Mr. Mike Malin, Mr. David Fradin, Dr. Harold C. Steele, and Dr. Robert Morgan provided valuable consulting and advisory service which deserves special recognition.

The manu script was typed by Wilba Newby, who also served as secretary and gave her full support to the project team in accepting and completing a variety of tasks. Her patience and skillful typing were essential to this effort.

INTRODUCTION

General Background

The charter of the National Aeronautics and Space Administration, as set forth in the Space Act of Congress, requires that NASA provide widespread dissemination of information concerning its activities and their related results. Considerable efforts have been expended toward meeting this objective through various NASA educational programs, including the development of educational publications and broadcast material, delivery of lectures, use of spacemobile exhibits and related presentations to large and varied audiences. Additional efforts are now being made to apply space technology more directly to the educational process through demonstrations using telecommunication satellites such as the Application Technology Satellites (ATS) and the Communications Technology Satellite (CTS).

The NASA Office of University Affairs and the various program and project offices have supported and sustained a large number of university research studies since NASA's inception. Many of the successful experiments carried out by NASA in both manned and unmanned space programs were directly developed and in some cases constructed by research and technical personnel from institutions of higher education.

Skylab "Student Experiments" were incorporated into the Skylab manned space-flight program to increase the student's awareness of Skylab activities and experiments, and to encourage more widespread knowledge of the experimental results by the educational community. This educational effort was added to the Skylab Program rather late in the development schedule, and somewhat as an afterthought, thus restricting its effectiveness. However, the educational activities on Skylab did prove to be quite popular. They have received widespread attention and interest from both the educational community and the public in general.

As examples of continuing NASA interest in expanding educational applications for space activities, significant pertinent statements by NASA officials are presented below:

Dr. James C. Fletcher

Better communications will be used in a lot of different ways. Education is the first application that we see very clearly, because we need, even in the high schools, access to large-scale digital computers. We are moving into the computer age, also one of the spinoffs of the space program. High schools, universities, all educational institutions, will have access to a regional computer. Now why do you want access to a computer? Well, computer-aided instruction is the coming thing. This is the quickest way to learn if we can afford to build the system, and by 1985, we think we can.

Today, education in remote regions is a problem. Those of you that are involved in the affairs in the Rocky Mountain States know that we have an experiment scheduled for 1974 with the ATS-F, bringing education to some of the remote parts of the Rocky Mountains and also to Alaska. This has huge potential for other parts of the world as well. But even in our country, we expect this to have a very large impact. By 1985, the quality of education should no longer depend on the locale where students happen to live.

Another aspect which is important to remember is that libraries and universities can be tied together. Libraries are a very big expense to universities, and I speak with some experience. Yet even at the University of Utah, we did not have the coverage, anywhere near the coverage that they have at the Harvard University library or the Library of Congress and of course, not even these institutions can be the equivalent of all the libraries in Europe and throughout the world. With the use of micrographics which can copy down most of the books in the world, all schools and universities can have access to these same libraries...[1*]

*References are listed at end of each chapter.

Dr. Hugh L. Dryden

Universities are the only knowledge-creating institutions that produce more trained people than they consume. As a prime user of trained people, NASA has an obligation to carry on its work in such a manner as to create the necessary new knowledge and produce more trained people as well. Both of these results can be accomplished simultaneously by working within the existing university structure rather than fostering activities which pull the university research away from the teaching environment.

The task of exploring space is one which will stretch the muscles and brains of man; it will test to the utmost our powers of enlisting the cooperation of every element of our society as well as of teams of scientists and engineers... Educators as well as all the rest of us must reexamine our habits of thought and action. We must use our insight and vision to guide our present-day decisions to prepare our successors for the coming developments in the Age of Space Exploration...[2]

Dr. Harry J. Goett

The challenge posed by the Space Age is therefore addressed not only to the scientist and the engineer who are directly engaged in its project. More importantly, it is a challenge to our society and, in particular, to its educational processes. The physicist, the astronomer, the geodesist, the meteorologist, the geologist and the astro-physicist, all have new frontiers open to them. Their job as scientists is to bridge the gap between the known and the unknown. The question we must ask ourselves is whether they are being educated in such a manner as to prepare them to do this job in that new laboratory of space that has been opened up to them...[3]

The broad and varied needs of the educational community represent a unique challenge and require many of the tools that an advanced technical society can offer.

The space program and its new capabilities now being developed may offer education tremendous new opportunities for meeting its needs and purposes. In doing so, NASA would fulfill its basic charter and also more efficiently use its space age developments in the process.

STS Applications Program

Currently, a new international Space Transportation System or STS is being developed for operational use in the 1980's and beyond. It is designed to provide economical transportation for a variety of payloads to and from Earth orbit and into trajectories throughout the solar system, thus allowing more efficient space exploration and utilization for man's benefit. The major elements of this system can be reused after operations in Earth orbit and will eventually replace practically all of the rocket launch vehicles now used for placing payloads into space. STS elements include the Space Shuttle Orbiter and its solid rocket booster motors; the Spacelab manned laboratory; and an Interim Upper Stage (IUS) required for deep space payloads. A more advanced upper stage called the Space Tug is also being developed by NASA; this will offer expanded capabilities and uses for the STS after 1984. Greater system flexibility for operations in geosynchronous orbits, for orbital path changes, and for deep space operations can be provided through use of the Space Tug.

The STS will allow the retrieval, refurbishment, repair and even refiring of spacecraft, thus reducing operational expenses. It can also provide a "shirtsleeve" working environment so the crew and passengers can spend up to one month in Earth orbit, performing the role of a manned space station and allowing a variety of experimental and operational activities to be performed in the unique environment found there. Scientific investigators, technicians, educators, journalists, and others may perform useful tasks in space because of the relaxed STS physical standards and requirements for passengers.

The National Aeronautics and Space Administration is now developing programs for identifying and communicating with potential users of the STS and for broadening the uses and applications for the payloads and experiments incorporated into the reusable space-flight concept. NASA has already identified a number of applications and potential uses and users for the STS through in-house reviews, and has also initiated contracted studies such as the General Electric-Beneficial Uses of Space (BUS) program, with emphasis on space manufacturing applications. Additional NASA efforts are also underway to develop a more comprehensive mission and payload planning program for STS, including the development of user handbooks and guidelines. Emphasis has been placed on new applications of government agencies, industrial organizations, and educational communities. Also, studies are being made to develop a policy and basis for STS user flight charges.

New user studies are designed to incorporate the joint efforts of NASA and supporting contractors and to identify new and/or improved products, processes, and services available through the STS program. They have the objective of expanding the potential benefits of manned space flight programs to the largest possible number of recipients on a world-wide basis. An important consideration of the current planning effort is the development of new educational programs and applications to improve awareness of the availability of STS payloads and experimental programs and the potential advantages that these might have for governmental, commercial, and academic organizations.

Scope of The UAH Study

The University of Alabama in Huntsville was selected by NASA-MSFC to perform a six month planning and feasibility study to identify and document a methodology needed to incorporate educational programs into future missions and operations of the STS. These educational programs could include participation by students, educators, astronauts, principal investigators, or special task teams. They would place emphasis on broader dissemination of knowledge about our newly gained vantage point in space with its unobstructed view of the heavens, its overview of the earth below, and the unique advantages inherent in the low-gravity and hard-vacuum conditions found there.

Communication satellites dedicated to educational applications are primary elements in these educational systems. Unique benefits to the educational community and, more broadly, to the general public may be expected if these programs are made operational.

The UAH Phase I study, designated ED-PLUSS (Educational Planning for the Utilization of Space Shuttle) as a working title, was performed with the following general objectives and considerations in mind:

> Develop recommended procedures and methodologies for identifying and evaluating potential educational uses and users for the Space Transportation System. Techniques will be developed during the planning study for improving communication and interface activities between NASA and the educational community. Also, the development of follow-on program goals and priorities will be accomplished as a part of the study effort.

The UAH study effort supports related studies by NASA and contractor organizations including the other three Phase I studies.[4] Activities of the UAH study will be compatible with the integrated Phase I report to NASA prepared by Stanford Research Institute at Huntsville, Alabama.

Six tasks were identified and accomplished during the course of the UAH Phase I study. The original task statements were modified to more clearly state the tasks in working terms as identified by the COR and assembled by the ED-PLUSS research team. The original Task 6 was to provide a summary report. This was superseded by a task outlined by the COR which requested responses to a series of NASA questions regarding the new user function. Therefore, the final report does not require a separate task designation. The current task statements are listed below:

Task I - Potential User Identification

Identify the educational user community for the purpose of determining needs, goals, and priorities. Educational institutions and organizations will be identified and described as a means of providing a data base for potential input for the development of methodology to be used in contacting and identifying users of STS.

Task 2 - Identification and Analysis of Space Education Programs

Identify recent and on-going space missions and experiments that possess educational content. Analysis of identified approaches used by NASA in the development and dissemination of educational materials from space related activities will be included as they relate to STS.

Task 3 - Planning Methodology for User Involvement

Develop methodology for soliciting participation in STS educational programs by the educational community; this methodology is to be based on selected technical and educational disciplines. STS educational planning efforts performed by other organizations will be incorporated into this proposed study.

Task 4 - Techniques and Programs to Encourage New Users

Identify viable techniques and programs which could encourage new or expanded educational experiments and activities compatible with STS on a regional, national, and, possibly, an international level.

Task 5 - Solicitation of Ideas for Data Bank

Compile a listing of "Follow-On" ideas accumulated during the study. Methods or programs to acquire ideas which could support the study will be incorporated.

Task 6 - NASA Questions Regarding New User Function

Respond to NASA questions concerning operational requirements and interface between NASA and the educational community. Identify skills, timing, and resources required for implementing such a program.

Working titles and lead questions were developed for each task. These are listed below:

<u>Task 1 - Potential User Analysis</u>

Who are the potential educational users of STS?

<u>Task 2 - Background Analysis</u>

How have NASA and space technology interfaced with education?

<u>Task 3 - Planning Methodology</u>

What methods can be used to incorporate educational uses and users into STS?

<u>Task 4 - Techniques and Programs</u>

What techniques and programs can encourage new or expanded educational utilization of the STS?

<u>Task 5 - Compile Ideas</u>

What ideas or activities can be accumulated for potential follow-on consideration?

<u>Task 6 - Operational Requirements</u>

What skills, timing, and resources will be required for program implementation?

Figure 1 shows the basic task relationships and their application to the development of the methodology. Educational requirements, techniques, media, and demonstrations

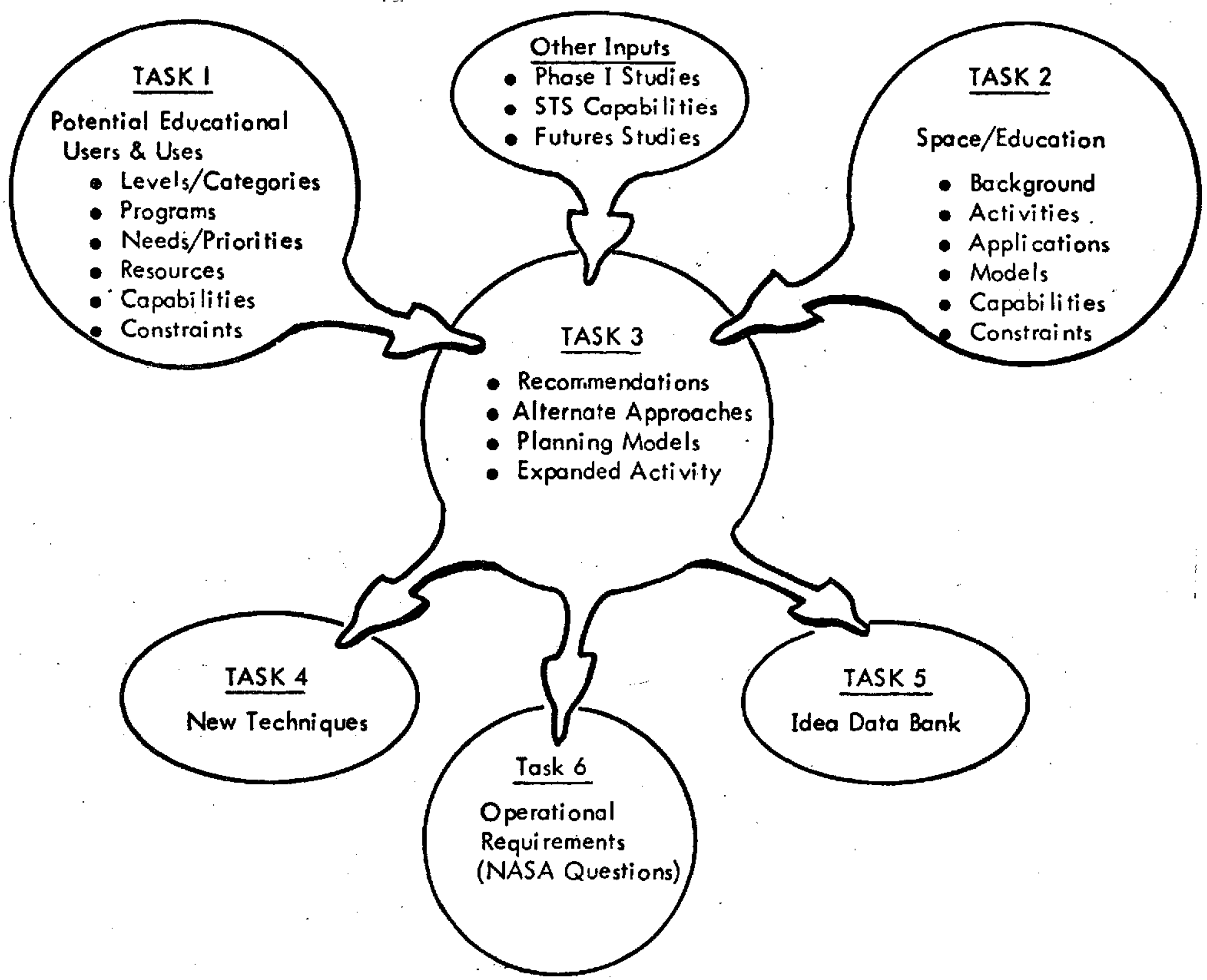

Figure I. Task Interrelationships for ED-PLUSS Study based on surveys and communication with selected members of the educational community were investigated during the course of this research effort. By evaluating the characteristics of the educational community and the activities and capabilities of the space program, it was possible to more effectively develop the models, approaches, techniques, and results obtained for this study. Moreover, the research efforts of the other Phase I contractors were particularly helpful; the methodologies developed under their programs were useful to the UAH program. The short term of the contract did present some difficulties because the scope of effort covered a very large though fairly specific user category. Accordingly, a no-cost, four-month extension was added to the UAH contract to sample and test the proposed methodology and to more broadly disseminate the results of the ED-PLUSS study.

References

1. Dr. Fletcher, James C.
   Statement to the U.S. Senate Committee on Aeronautical and Space Sciences
   FY 1974 Hearings for NASA Authorization Act

2. Dr. Dryden, Hugh L.
   NASA Report TMX-57625
   Washington 1964

3. Dr. Goett, Harry J.
   NASA Report TMX-56149
   Washington 1965

4. Other Phase I Contractors
   - Arthur D. Little, Inc. - NASA Contract No. NAS8-30739
   - Battelle Columbus Laboratories - NASA Contract No. NAS8-30529
   - Stanford Research Institute - NASA Contract No. NAS8-30533

TASK I IDENTIFY LEVELS OF POTENTIAL EDUCATIONAL USERS OF STS AND THEIR CHARACTERISTICS

In order to formulate a methodology that will enable the organizational structure of NASA to interface more effectively with educators, a clear picture of the diversity and scope of the educational community is necessary.

The biological nature of people divides their lives into two basic periods. The first is a period of maturation during which they grow to adulthood. The second is the period of adulthood which continues until their decline and death.

One's life is normally divided into three educational periods. During the period of maturation, educational programs are designed to guide and instruct the student toward his role as an adult. This report refers to this particular period as Level I. The second life period is one of career preparation to become a complete citizen of society. This is the period of development of competencies required of one who is to enter the society on a level at which he can contribute the most to and receive the most from it. The institutions, referred to in this study as Level II schools, usually shorten this period of preparation.

The structure of education in Levels I and II represents an unusual dichotomy. Administratively, it is basically bound to political structures determined by the voters and legislatures of the various states. It must operate within limits. Functionally, it is fragmented into an almost bewildering variety of local, state, regional and national purposes, goals, and needs which shift and change with the dynamic society surrounding them.

After the citizen leaves Level II and enters society at large, the need for education does not stop; it remains until death. The vast area of education outside of Level I and Level II institutions constitutes, for the purposes of this study, Level III. It is by far the largest single educational grouping in this country. It includes nearly two-thirds of the population at any given time. It ultimately receives every citizen.

Level I Description and Characteristics

The education of children from infancy to young adult (ages 3-18) is a continuous effort whose basic goal is achieved with graduation from high school. This portion of a person's education seems to form a logical level of education which this study denotes as Level I. The categories identified within Level I are: 1) early childhood education which is administered outside the public school system in most states, and 2) elementary, middle, and secondary school education which is administered largely by public school systems. More detailed information and an expansion of Level II education is found in Appendix A.

Categories in Level I and their Characteristics

- Early Childhood Education - This level of education is conceived as a planned group of experiences for children from 3 to 5 years of age. Early childhood education serves the following two purposes: 1) it provides for the healthy physical growth and development necessary to meet the demand of future educational training, and 2) it initiates the development of healthy attitudes and basic skills that will encourage future success in a school environment.

  Early childhood education is usually conducted in some type of organized center. The training may occur at home, however, via television programs broadcast on a local, regional, or national level. As an indication of its scope, in October, 1972, there were 4.23 million out of an eligible 10.16 million children enrolled in organized programs of early childhood education. Accurate figures of those children receiving televised programs at home are not available.

  Most funding for this category originates with parents who pay attendance fees for their children in the various centers; local, state, and federal governments financially support the program, as well. In 1974, the federal government provided 260 million dollars to support various early childhood programs. The exact amount of local and state support is not as readily identifiable because of the differences in definition and compilation of statistical data.

- Elementary, Middle, and Secondary School Education – This category consists of a planned series of educational programs designed to guide the physical, social, intellectual, and moral growth of children from 6 to 18 years of age. As children develop into mature adults able to function as free citizens in American society, they will reflect basic educational purposes, which are: 1) to assist each student to achieve the optimal development of the physical, emotional, mental, and social abilities that foster a more productive life style and contribution to society, 2) to provide a foundation basic to student formulation of values essential to the maintenance and advancement of society, and 3) to prepare students to enter the labor market or higher education.

  The population of the schools in this category as of 1972, was approximately 51 million children. It is expected to drop to 45 million by 1982, if the demographic trends now evident continue.

  School expenditures in this category reached 57 billion dollars in 1972, with a projection of 70.4 billion dollars by 1982. The increased magnitude of this expenditure imposes increased responsibility for an improved quality of education upon the 2.4 million teachers involved in this level of education at this time. A further breakdown of these total expenditures indicates that 67% is used for direct instruction and that 85% of direct instruction supports teachers' salaries. Consequently, it is evident that any technology which enhances the effectiveness of monies spent for education would be welcomed by administrators.

  Funding for Level I educational programs is derived from three major sources. The primary responsibility for funding rests upon local governments who provide 49.3% of the total educational expenditures. Basic state support for education averages 37.8% of the total expenditures. The federal government, foundations, personal gifts, and bequests complete the Level I income with combined figures totaling 12.9% of the total.

The picture of Level I schools is not complete without some study of the foremost educational problem they face. Level I schools, probably because they deal with growing children, are the focus of more attention and criticism by the American people today than either Level II or Level III schools, although these receive their share of both. More tax money is spent on Level I by far, more people are involved in a professional way with Level I children and, perhaps because the recipients are children and are presumed unable to speak for themselves, more of the general public seek to become directly involved in Level I education and exert an influence on it than either of the other two levels.

As a result, the administrators and teachers are under constant pressure to add to the things that children "should know" or "be able to do". Since the primary courses of study are determined at the state level and cannot be eliminated without authorization from the state board of education, any additional curricula must be added to the existing school program instead of replacing another subject. This is necessary in order to avoid lengthening the school day. The school administrators' dilemma is illustrated with the following Figure 2. It is easy to understand why many school administrators are not happy to hear of new educational "opportunities" for children.

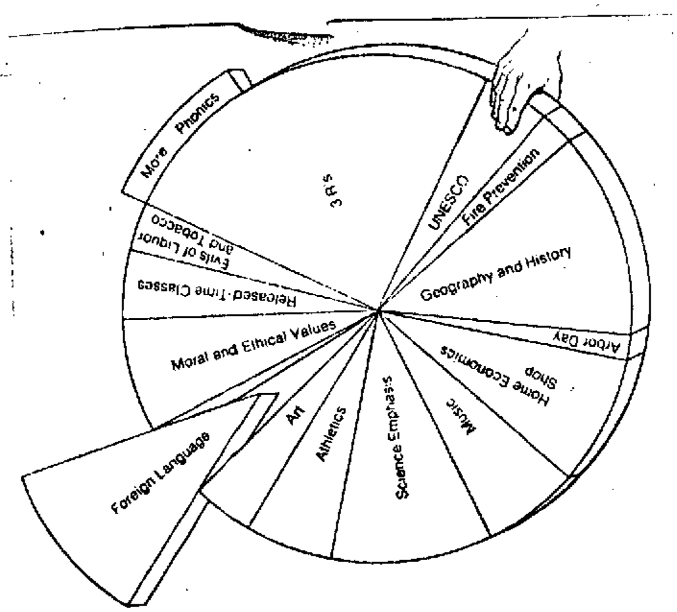

Figure 2. Competition for Additions to Curriculum

Level II Description and Characteristics

For the purposes of this study, Level II consists of two identifiable categories: 1) junior, technical, and community colleges, offering two years of post secondary work, and, 2) four-year colleges and universities that provide extended work leading to advanced degrees. See Appendix A for more detailed information regarding these institutions, which totaled some 2665 in 1973.

Categories in Level II

- Junior, Technical, and Community Colleges - There are 964 two-year institutions in the United States. They serve relatively small "local" areas and are distributed according to population patterns. The majority of students are enrolled in courses equiping them with immediately marketable skills.

  The estimated enrollment of two-year institutions, including vocational/technical students, as of 1972, was 2.9 million. This figure is expected to increase to 4.3 million by 1981. Enrollment figures of vocational/technical institutions are not available separately.

- Colleges and Universities - These four-year institutions numbered 1701 in 1973. Of this total, 1542 are classified as colleges and 159 as universities.

  Enrollment in four-year colleges and universities totaled 8.3 million in 1971. By 1981, the enrollment should reach 8.9 million. The instructional staff is also projected to increase from 479 thousand to 635 thousand during the same period. Because of the expected increase of enrollment in this category, one could anticipate an expansion in the number of institutions. However, based on the current economic outlook and available projections, a decline in the number of institutions and a corresponding increase in class size will more likely occur.

The college and university category includes the following types of institutions:

- Liberal Arts Colleges are usually small, privately supported, offering a "liberal arts" curriculum, emphasizing Social Sciences, Humanities, and Natural Sciences.

- Land-Grant Colleges were originally established as agricultural and mechanical colleges by the Morrill Act of 1862. The curriculum was intended to emphasize the practical aspects of higher education.

- Multipurpose Universities are liberal arts colleges integrated with specialized schools and colleges offering curricula in areas ranging from agriculture, business, and engineering to dentistry, medicine and law.

Three types of expenditures by institutions of higher education of potential value to STS are identified:

- Student education includes general administration, instruction, and departmental research, extension and public services, libraries, operation and maintenance of the physical plant and sponsored activities such as training institutes and related sponsored activities which were specifically financed by outside sources.

- Organized research includes all sponsored research and other separately budgeted research. Does not include expenditures of federally funded research and development centers.

- Related activities includes expenditures for such categories as laboratory schools, medical school hospitals, dental clinics, home economics cafeterias, agricultural college creameries, college operated industrial plants connected with instructional plants but not actually a part of them, and all other expenditures for educational and general activities which are not specifically identified as expended for "student education" or organized research. Projections of expenditures of higher education (in billions of dollars) are shown below:

	1971-72	1981-82 (projected)
Student education	16.6	29.2
Organized research	2.6	4.0
Related activities	.8	1.5

Level III Description and Characteristics

Education does not cease for the people who by-pass college or who complete it and go into careers. The nature and purpose of educational experiences change somewhat, but learning continues throughout life. The vast area of teaching and learning that occurs most typically in industrial settings constitutes the largest segment of Level III education. The skills and knowledge which have not been acquired in Levels I and/or II constitute the basic needs for Level III education. More detailed information and an expansion of Level III is found in Appendix A.

A study of Level III educational activities suggests several broad categories, each of which would be a suitable subject for a follow-on study in depth. Two of them, adult education and vocational education, have been studied in a NASA project recently completed by Washington University of St. Louis, Missouri. Much of Level III, however, consists of individual activities of such diverse nature that it would be impractical to attempt to list them all. Following is a description of three basic categories in Level III:

- Adult/Continuing Education - In recent years the federal and some state governments have funded programs for functionally illiterate adults, i.e., who could not read or write, to attend classes in these skills. Other programs of a general nature have helped millions of adults to obtain a high school level of knowledge.

  In 1972, the federal government appropriated $51.1 million for adult education programs. The balance of this type of education was paid for by its students in the form of tuition and fees. Most adult education programs are funded, at least in part, through federal grants.

- Vocational/Technical – A form of adult education with a specific job skill as a goal. Education in this area is generally undertaken as a program, that is, a series of related courses that together combine the knowledge and skills needed for a particular vocation. The federal and state governments fund the largest portion of activities in this area; the student pays the remainder.

  In 1972, approximately 2.7 billion dollars were spent by government agencies to give nearly 8.8 million students an education of a vocational/technical nature. Approximately 2.7 million of these students were enrolled in adult level courses.

- Industrial Education – That portion of Level III, supported directly by companies and industries for the training or education of employees in job related skills, is as widespread as the business world in which it functions.

  All companies spend substantial time training employees, including hourly paid employees through top level to management. In 1972, an estimated 15 billion dollars was spent by industry for this purpose. Companies with widespread organizations have an increased need for educational capabilities. This is necessary in order to maintain their positions in a competitive market. The need for the very latest state-of-the-art knowledge is acute in all business and industries. The larger the company the greater the need for a flow of information through its often decentralized operations. IBM has solved part of its problems in this area by leasing a portion of a commercial satellite for use in communicating with its far flung branches. Other companies are exploring this possibility, also. The potential for use of the space shuttle system to provide these satellites appears extremely promising.

- Military Education – Evaluation of the U.S. Department of Defense schools and other educational activities lie outside the scope of this study. DOD has reportedly incorporated educational applications into its own STS Mission Models. Much of its educational effort outside of the military schools is undertaken by Level II institutions and is a part of these data.

Basic Needs Common To All Levels

As a result of the ED-PLUSS Task I study, the following list of basic needs, relating to all three levels of U.S. education, was developed. By addressing these common needs, larger utilization of the STS capabilities may be realized.

- More flexible dissemination systems, allowing more interaction between instructor and learner
- More effective means for teachers, students and administrators to observe the innovative practices of their colleagues
- More rapid assimilation of new knowledge into the educational process
- Educators affected by program changes feel a need to participate in the decision making process
- Additional resource allocation to provide learning environments suitable to changing educational purposes and methods
- Needs exist for values which allow educators to view space activities as an improved level of intellectual attainment

General Conclusions

The body and appendix of the Task I report are drawn from a review and analysis of literature and statistics and from relevant interviews by team members with educators. The following conclusions have been drawn from the total material studied:

- The primary characteristic of education is its diversity. The level of diversity increases from Level I to Level II to Level III of the educational community. Apparently, all three levels can benefit from the STS in numerous ways.
- Statistics of population and finances indicate the process of education is one of the largest consumers of resources in the United States. Any technology that improves

its cost-effectiveness could receive wide support.

- Projections of educational statistics indicate that participation in education will increase in the future. A higher median age will result in more interest in education for personal fulfillment and retraining.

- The diversity of funding, control, curricula and organization in education, as revealed by the statistics studied, indicates that educational opportunities are not equitably distributed throughout the nation.

- Alternative schools outside the present classroom structure are described in current educational literature. Examples include "open classrooms", "free university", and "schools without walls". These new concepts are compatible with the use of new technologies. Their diversity and numbers will increase.

- The scope of the educational effort in the United States documented within this report supports the concept of commitment to the education of the masses for a significant part of their lives. A new look at the research and development function to improve methods of education is felt to be needed, including a systems approach to teaching and learning.

- A recurring theme in the literature predicts a constantly changing and expanding curriculum at all levels of education. New and improved technology may be necessary to enable educators to cope with this situation.

- Anticipated advances in telecommunications and related educational technology should improve the efficiencies and reduce the costs of both space and ground based systems (hardware and software). Examples include advancements in computer aided design, instruction and animation techniques, "laser" links, holography, and micro-miniature electronic circuitry.

- Education is presently a labor-sensitive activity. More than 80% of every dollar spent on education goes for personnel salaries. Funds for innovation and new technologies are limited.

- As the population growth rate decreases, the per-pupil cost expenditures of most states will increase, possibly making more funds available for innovative technologies.
- The Federal Revenue Sharing Program is one example of the trend toward greater government participation in the field of education.
- The existence of the Southern Regional Education Board lends support to the conclusion that cooperation between schools and institutions on a local and regional basis will increase.
- As the use of electronic technology increases to allow greater access to knowledge in Level II, the transmission of educational programs from these institutions, both to other schools and the public will increase.
- The literature studied indicates the exchange of students and cooperation of Level II schools between countries will increase from an already high level, thus expanding international programs.

TASK 2 A REVIEW OF SPACE EDUCATION PROGRAMS

A brief review of space education programs is included in this study for two reasons: l) to establish a baseline of information necessary for determining what types of NASA educational activities have occurred in previous, as well as in on-going, projects; and 2) to provide a necessary data base for the development of a new user methodology in Task 3 of the ED-PLUSS research study.

In order to establish the background for the on-going NASA interface with the educational community, it is necessary to consider the historical context. The original NASA Charter of 1958 specifies a requirement for the widespread dissemination of data relevant to its space activities. By its Charter, NASA is "to provide for the widest practicable and appropriate dissemination of information concerning its (NASA) activities and the results thereof".[1] NASA has acted accordingly and for more than a decade has maintained a variety of meaningful relationships with the educational community.

NASA Offices Involved with Education

Several offices within NASA have been primarily involved with the educational community. These offices are identified as: the Office of University Affairs, Office of Public Affairs, and a selection of Program and Project Offices. This summary discusses relationships of each of these offices to the educational community and weighs these relationships in light of new applications for the STS.

Office of University Affairs

The Office of University Affairs (OUA) is responsible for sustaining university contracts. It represents the focal point for NASA's relationship with college and university programs. These programs include such activities as: Research Grants and Contracts, Research Facilities, Multidisciplinary Research, and the Resident Research Associate Program. The OUA maintains the administrative and management responsibility for these programs. The NASA expenditure for FY 1973 amounted to 115 million dollars. These funds supported 280 institutions on some 2,600 projects.[2]

Contracts extended by NASA to the various colleges and universities are currently experiencing a downward trend. In April, 1974, Dr. James Fletcher, Director of NASA, expressed concern about this trend by indicating that NASA appropriations had remained approximately the same since FY 1971, although NASA obligations to universities had continuously declined from 136.7 million in FY 1971 to 114.9 million in FY 1973, with further reductions in FY 1974. Dr. Rocco A. Petrone, then Director at Marshall Space Flight Center, expressed concern about this situation in a May, 1974, statement, ..."it is incumbent upon us to recognize that if NASA is to continue to carry out its responsibilities in the area of science and technology, we must maintain a strong, viable university program."

In a series of studies of NASA university programs, exemplified by NASA SP-185, the results of the total NASA university programs are further identified. From these studies, it is evident that NASA funding has had a significant impact upon many universities to strengthen and build their research and education capabilities. Likewise, these universities have made numerous contributions to many successful experiments and programs performed by NASA and its contractors. A further discussion of Level II participation in the STS is given in Task 3.

Office of Public Affairs

The Office of Public Affairs administers the Educational Program Division of NASA. Included in its function are such activities as the publication of educational materials, the preparation of teacher resource kits, speaker bureau presentations, media announcements, and operations of the Spacemobile. These activities are seen as necessary in the continued development of the STS program. The Office of Public Affairs could well serve as the initial mechanism for contact with any potential educational user of the Space Shuttle.

The activities as identified are well established within educational Levels I and II. Level III potential users could be considered as a future recipient for more educational materials from the Office of Public Affairs. In Task 3, a detailed discussion of expanded educational dissemination activities in support of the STS is presented.

Program and Project Offices

Approximately two-thirds of the money that NASA has invested in universities has been through their program and project offices. These various offices include within their scope of activities the extension of research contracts to universities, as well as more specific educationally dedicated programs. They utilize the faculty and staff members of universities for support of many projects ranging from multidisciplinary research in the space sciences to the investigation of such specific subjects as "Crystal Growth in Zero Gravity".

The expertise found in the Level II community is focused upon the solution of problems of aeronautics and space exploration and upon the creation of new opportunities for university participation in space experimentation. It has also been a policy of NASA, as stated repeatedly by its administrators, to accomplish its mission in such a way as to strengthen the academic institutions which it supports. Therefore, a NASA goal has been the sponsorship of research in the traditional atmosphere of instruction and learning, while encouraging student involvement in these research activities. This goal should be emphasized and expanded for broader utilization of the STS.

Model Programs for Potential STS Applications

The ED-PLUSS research team considered the necessity of investigating several NASA programs with educational impact. The team identified the Skylab Student Experiment Program, educational utilization of Skylab data, and the Applications Technology Satellites

(ATS) series, with emphasis on ATS-6 as significant programs. Each of these will in turn be discussed and the conclusions for potential application summarized in the following sections.

Skylab Student Experiment Program

The Skylab Student Experiment Program was directed by Mr. Henry Floyd of the Skylab Project Office at Marshall Space Flight Center in Huntsville. The basic objective of the program was to broaden knowledge about space exploration and its potential educational benefits to high school students and teachers. NASA selected the National Science Teachers Association (NSTA) as the organization to inform and stimulate the educational community about the NASA objective. The NSTA became responsible for managing and operating the student program and proceeded with only a one year's lead time available. Accordingly, students and teachers across the United States were notified of the opportunity to participate in the Skylab Student Experiment Program. Within two months more than 3,400 proposals were received, which the NSTA called one of the largest responses in more than twenty years of sponsoring student science projects. Twenty-five national winners were then selected. Of these, nineteen eventually met performance and schedule requirements.

The experiments came from the scientific disciplines of astronomy, bacteriology, physiology, zoology, botany, and physics. Several experiments involved direct observations of the earth from space. Complete evaluation of the results of all the experiments has not yet been accomplished, but the program has expanded educator and student interest in the space sciences and an anticipation for similar programs in the future.

Lack of an international counterpart organization to the NSTA apparently prevented NASA from including participation by international students. The educational community of Canada, in particular, desired to participate; however, no effective organizational system appeared capable of disseminating the information and materials to Canadian teachers and students in the time available. In the future, and particularly with the European community participating in the Spacelab development program, international programs for student experiments should be considered and hopefully implemented.

During the development of the Skylab program, NASA enlisted the aid of contractors to consider ideas for live broadcasting of educational programs from orbit.* These ideas were not developed because of time restrictions. Even so, they might be considered for the STS with longer lead times available. Major illustrative ideas follow:

- Live television broadcasts could have been made every day while Skylab was in a nominal, operational state.
- Television broadcasts could have been continuous and up to twenty minutes in length.
- Television broadcasts could have been received by NASA's communications network and routed to commercial and educational channels for distribution.
- Principal investigators and other interested scientists could have cooperated with NASA in preparing experiment demonstrations.

An outline of a typical 45-minute Skylab educational presentation was also prepared. This included real-time TV direct broadcasts from the space station, teacher workshops, and a listing of educational objectives. Illustrative objectives follow:

- The students and teachers would be made aware of the limits of real time transmission as related to "line of sight" signal availability.
- The teachers and students would gain an awareness of the opportunities to improve man's life by using a new perspective for his problems.
- The students would gain a feeling for "shirtsleeve" working conditions in Zero-G.
- The teachers would gain valuable discussion material in a wide range of topics (e.g., health problems, pollution, environment, scientific processes and investigation, the future of mankind, etc.).

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*Educational demonstrations from space, though not from orbit, were carried out, on a limited scale, in the Apollo program. For example, during the Apollo 14 flyback in February, 1971, several zero-gravity experiments (electrophoretic separation, heat flow and convection, liquid transfer, and composite casting) were televised to Earth. In one of four heat flow tests, flow was observed following the heating of a sample of oil containing a suspension of fine aluminum flakes. During the course of Apollo 15 lunar surface experiments, a hammer and a feather were dropped to demonstrate that gravity forces affect light and massive bodies alike. Air-resistance being absent, both objects reached the ground at the same time.

- Experimental proofs of fundamental laws of classical physics would be demonstrated in a unique way.
- Students and teachers would begin to appreciate the ecological considerations of man and his environment due to the limited space and closed cycle considerations of Skylab.

Educational Utilization of Skylab Data

The preface to one of the educational sourcebooks concerning Skylab experiments states:

> "The most immediate benefits that derive from a multidisciplined scientific program such as Skylab are a large volume and wide range of scientific information. A secondary benefit is that this very large amount of up-to-date information can be related in a timely manner to high school curricula. The time lag between the generation of new information and its appearance in text books is often measured in years rather than in months.
>
> It was the intent of the Skylab Education Program to eliminate this characteristically long delay by timely presentation of scientific information generated by the Skylab program."

Accordingly, a series of slides, films, filmstrips, teacher guides, and other media have been produced and made available to teachers throughout the country. A multi-volume series of documents were developed under contract to support the total objective.

Concern over apparent inadequate user interest in many of the materials prompted a conference in Houston, Texas, to evaluate the materials that had been produced and were planned for production in the future. The recommendations of the educators relating to educational materials stemming from Skylab and future missions was edited and prepared in the form of a report by the National Science Teachers Association representative. These comments and recommendations are described in Appendix B.

The Skylab Program is an example of a NASA effort in which the educational dimension was applied rather late in the developmental sequence. In looking forward to the Space Shuttle, Space Tug, Spacelab and related projects, it seems logical that education should at the very outset become an integral part of the STS developmental process.

Applications Technology Satellites

In 1966, NASA began launching a series of Applications Technology Satellites (ATS) in order to test and improve communications satellite systems and applications. The latest satellite in the series was launched by a Titan II rocket on May 30, 1974. With this satellite NASA is: 1) demonstrating the feasibility of deploying a thirty-foot parabolic antenna in space, 2) demonstrating fine point orientation and tracking capabilities of the satellite, and 3) testing the stability mechanism of the satellite. In addition to testing operational capabilities, ATS-6 is demonstrating different ways in which satellites can be used. The ATS-6 includes more than twenty application experiments in the following general categories: tracking weather conditions, analyzing the atmosphere, conducting spacecraft experiments, locating aircraft and transmitting multiple radio and television signals.

ATS-6 is one of the largest unmanned satellites in orbit; it weighs more than 3,000 pounds with the size commensurate with its audio/visual signal transmission capability. The strong signal produced by ATS-6 allows the use of smaller ground station receiving terminals. The cost of construction of these receiving stations ranges from $3,000 - $5,000; this figure includes the television receiver, converter, and antenna. The signal is so strong that in the educational applications project scheduled for India in 1975, antennas will be made from chicken wire; the total cost for ground station equipment will range from $500 - $600.

For the purpose of this research study, ATS-6 was primarily considered for a particular educational application known as the "Applachian Education Satellite Project (AESP)". AESP is a communications experiment to demonstrate the feasibility of delivering in-service education courses and supporting information services (in career-education and elementary reading) to teachers in the Appalachian region via satellite. Other applications of ATS-6 have educational implications and should also be reviewed for expansion into educational utilization of the STS.

The immediate AESP educational objective is the improvement of the effectiveness of the classroom teacher, thereby upgrading the quality of reading and career-education instruction for Appalachian students. The question to be answered by AESP and similar projects is, "Can the linking of existing organizations such as the Regional Educational Services Agencies with communication satellites produce more effective and significant in-service teacher training?"

Six educational objectives have been identified by the Appalachian Education Project Staff. The objectives are structured to:

1. explore the feasibility of using fixed-broadcast satellites and linking terrestrial communications systems to deliver educational services;
2. examine the effectiveness of the instructional sequence of televised lecture, audio questions with immediate feedback, ancillary practice activities, and review testing;
3. broaden understanding of workable ways to organize trans-state projects conceived to solve common problems when greater economy and quality is promised by large-scale delivery and resource pooling;
4. develop procedures for preparing software for heterogeneous audiences and various hardware systems;
5. demonstrate the feasibility of developing central computerized information systems for delivery via satellite;
6. demonstrate the feasibility of increasing the number of communications satellites, broadcast channels, and air time, in order to increase course options and make quality education equally accessible in all parts of the country.[3]

The significance of ATS-6 and, more particularly, its AESP application, becomes evident when Space Shuttle is considered as a launch vehicle for future "dedicated" educational satellites. The educational ramifications are substantial when the overall project is viewed as a demonstration of the feasibility of producing high quality, revenue-shared courses in multiple disciplines for cross-state delivery via satellites. More specifically, the ATS-6 can be considered as a model for dedicated educational satellites and evaluations of its evolution and development can aid in the development of the STS user community for educational applications.

A press conference was held via ATS-6 from the University of Kentucky to the Appalachian regional centers in August, 1974, which was attended by members of the ED-PLUSS study team and the NASA Contracting Officer's Representative. Appendix C provides additional information about this conference and AESP results.

The Impact of Aerospace Programs on Education

Educational programs related to aerospace science and technology have been used to expand the interests and participation of students, primarily in the field of aeronautics. The following summary reviews the impact of aerospace education programs on the educational community and considers possible ways to place greater emphasis on the "space" aspects as well as the aeronautical.

Aerospace education seeks to communicate knowledge, to impart skills, and to develop attitudes relative to the scientific, engineering and technical--as well as the social, economic, and political aspects of aerospace activities. The scope of aerospace education spreads through various educational levels, from pre-primary to postgraduate functions; it spans areas of study from general applications to special career occupations.

From an educational point of view aerospace is not an end in itself--except for those who will pursue specialized studies and careers or who will require specific skill training. Rather, aerospace represents a logical, practical, and timely means to modern educational ends. Teachers in all disciplines, at all levels of education, report increased educational attainment by using relevant aviation and space-oriented examples, facts, information, activities, and experiences. Professor Joseph Coulter of the University of Oklahoma has even proposed that courses on aerospace be given as a minor in liberal arts unrelated to engineering or business. He has stated:

"The vast body of aerospace knowledge and its impact on the social, economic, political and technical well-being of everyday American living and on modern business is so great that failure to provide experiences in aerospace education is tantamount to curricular nonfeasance."

Aerospace education is being offered as one-week units which are parts of mathematical, scientific, or social living courses. These courses also cover the entire spectrum of bibliographical services, separate credit courses and extra curricular activities, including ambitious public school programs in which students are trained, through a level qualifying them for positions as airline pilots and mechanics. In addition, teachers in more than 20,000 elementary schools of the United States are now utilizing aviation and space units as a regular part of the curriculum for both career and academic study. And for a number of years, more than 10,000 teachers have attended one of the 200 to 300 aerospace education workshops held at colleges and institutions throughout the country each year.[4]

More than 1,500 high schools offer credit courses in aerospace education, and some 600 colleges now offer aerospace courses or complete programs ranging from introductory flight training to full degree programs in aerospace. There is no sharp line of demarcation between the atmosphere and space, and the Space Shuttle is being designed to operate throughout these regimes. Likewise, there is no well-defined boundary between aeronautical education and space educational activities. One should blend smoothly into the other in harmony with the characteristics of the environments under study. The level of integration of space into education should also parallel the evolution of space activities as they affect the everyday affairs of people on earth.

Aeronautical education is now a rather well-developed discipline simply because aeronautics is a well-developed science. Space education is in its infancy because space travel and exploration are likewise in their infancies. Space-oriented curriculum resource guides have been developed by NASA in cooperation with educational institutions for use by teachers who want materials that are more closely related to their daily teaching activities. This type of material should be broadly disseminated and its effectiveness clearly evaluated to provide guidelines for the future.

In any historic review of space-related activities, there are numerous highlights that demonstrate ways in which technologies have opened vast areas of achievement, the significance of which could not be measured immediately, but only within longer time periods. Perhaps this is the most valid approach for assessing the potential impact of space technology on the broad and diverse levels of education. It can be concluded, however, that the space effort has heightened interest in providing new and improved programs in a variety of subject areas. It has fostered interest in science courses and has introduced new knowledge. It has stimulated programs for the re-training of teachers as a means of avoiding obsolescense. It has strengthened textbooks and related materials, and it has contributed greatly to an active collaboration between college and university subject-matter specialists and their public school colleagues. On the purely practical side, it has undoubtedly been responsible for the infusion of significant amounts of money into the schools through such institutions as NASA, the National Science Foundation, and the National Defense Education Act.

Basic educational skills are attained in the classrooms where teachers capitalize on the interests of youngsters and older students alike who are attracted to the timely, dynamic, action and adventure-oriented happenings in aviation and space. In short, aeronautical space studies provide a curricular means to educational ends--the preparation of young people for the twenty-first century.

Conclusions and Recommendations

The following conclusions and recommendations are summarized for Task 2:

- NASA might consider the educational discipline as an additional application category for STS missions. This would more directly focus attention on this key discipline and help to gain broader STS support from the educational community.
- The present NASA organizational structure is currently providing a number of key services to the educational community. These should be expanded for the STS

period and improved liaison and coordination activities developed to more effectively utilize the in-house NASA capabilities for support of education.

- Planning efforts are needed now if NASA intends to pursue an active role in developing educational applications for the STS. Long lead times are needed for effective utilization programs within this diverse and fragmented market. This time is apparently available.

- Additional analyses are needed to identify models and evaluate methodologies such as those discussed in Task 2. These can provide baselines for expanded educational programs in the STS (Skylab and ATS-6 are good examples of identified models with well developed methodologies for interfacing with the educational community).

- NASA might consider the possibility of becoming a prime user of the STS capabilities for internal educational needs. An active demonstration program for "showing by doing" could enhance interest within the Level III educational community.

References

1. National Aeronautics and Space Act of 1958, (42 U.S.C. 2451 et. seg.) As Amended October, 1964, Section 203, Paragraph 3.

2. Active Grants and Research Contracts, NASA's University Program, Office of University Affairs, Springfield, Virginia: National Technical Information Service (NTIS) FY,73.

3. Claudine Ausness, Betty Bowling, An Experiment in Educational Technology, An Overview of the Appalachian Education Satellite Project, Technical Report No. 2, Lexington, Kentucky: Resource Coordinating Center, March, 1974.

4. Wayne R. Matson. "Aerospace Education: An Overview", Aerospace, V. 12, No. 1, February, 1974.

TASK 3 DEVELOPMENT OF METHODOLOGY FOR USER INVOLVEMENT

The basic objective of Task 3 was to develop a methodology for expanding the educational utilization of the STS by the educational community. To meet this objective, a better understanding of the nature and characteristics of potential educational users, and the capabilities and interests of NASA educational programs were required. Tasks I and 2 helped to support this background analysis. In addition to these tasks, additional inputs were necessary before a detailed consideration of applicable methods and techniques could be performed. These inputs included evaluations of the other three Phase I studies and related NASA and contractor studies. Possible application of the STS capabilities as related to educational activities and programs, with a consideration of future events related to all aspects of this definition study were also investigated.

Inputs to Task 3

Task I Input

This task identified and described three basic educational levels with an explanation of needs, purposes, capabilities, resources, and constraints provided. Certain key needs such as rapid access to new knowledge and more effective dissemination systems were also identified. Funding resources and expenditures were described for each identified level. Constraints to innovation and change were considered in some detail to further clarify the nature of the potential educational market for the STS. Finally, a listing of general conclusions was developed as essential input for Task 3.

Task 2 Input

As NASA has demonstrated a basic and continuing interest in educational programs, Task 2 was also considered necessary for the methodology development task. A primary purpose of Task 2 was to provide a better understanding of those NASA educational activities which could serve as models and which could be expanded to allow greater educational utilization of the STS. To meet the objectives of Task 2, an evaluation of various NASA offices and activities was performed. Interviews and meetings with NASA personnel, including numerous telephone calls, were made to clarify the educational interests and program objectives of NASA. Particular attention was given to Skylab and ATS-6 educational programs, with potential application to the STS through related and/or expanded activities. In this way, potential educational applications and capabilities for the STS were defined and provided as inputs to Task 3.

Other Phase I Contractor Studies

A review was made of the final reports performed by the other three Phase I contractors.* This review was very helpful in the performance of the overall UAH study. It helped to focus attention on a number of considerations required for the particular STS user community being addressed. The educational community, because of its broad, diverse, and fragmented nature, interfaces with and is a part of domestic, foreign, governmental, industrial and, of course, academic elements of the total world community. The results of the Phase I contractor studies complemented and supported the development of a methodology for possibly expanding the STS utilization to meet the needs of this large user community.

The ADL investigation of basic issues, the BCL detailed analysis of basic marketing methods and techniques, and the SRI elaboration of systems techniques, including alternate futures dimensions, were extremely pertinent to the UAH study. Liaison and interface requirements for evaluating "buyer and seller" functions were likewise valuable and the

* Arthur D. Little, Inc. investigated various business/public policy issues and international marketing considerations.

Battelle Columbus Laboratories (BCL) placed emphasis on domestic, industrial, and commercial sectors.

Stanford Research Institute (SRI) developed a methodology for the U.S. federal and state governments (but not including military).

overall depth and clarification of basic requirements for identifying and developing new users and uses for the STS were directly applicable to the overall educational community. Accordingly, the UAH study could apply many of the methods and techniques of the other Phase I contractors into Task 3 and subsequent tasks.

Educational Capabilities of the STS

The overall capabilities of the STS are certainly not fully understood or stated at this time. The basic payload capabilities are fairly well defined by NASA and discussed in some detail within the other Phase I studies. Battelle established the significant parameters of the STS for the user community within the scope of their Task I. The A. D. Little report also covered this subject in their Chapter IV and Appendix B. All of the Phase I contractors have emphasized the need for further definition and dissemination of these expected STS capabilities. Through analysis of those STS capabilities now available, the UAH research study has identified and now presents three basic types of STS capabilities having educational implications:

- *Telecommunications* - In the 1940's Arthur C. Clarke suggested the use of communication satellites. Educational applications for communication satellites have been emphasized almost from the beginning of this basic concept. Expendable rocket boosters and upper stages have recently carried communication satellites into high earth orbits. Educators are now using them to address educational needs through demonstration programs.

  During the course of the UAH study, Dr. Wernher von Braun, Vice President of the Fairchild Industries, Inc. and former Director of the NASA Marshall Space Flight Center, reiterated one of the primary advantages of STS utilization for launching dedicated educational satellites, as opposed to the use of expendable launch vehicles. He stated that a reduction to one-fourth the current launch cost could be expected for satellites similar to the ATS-6, thus widely expanding the interest and potential utilization of educational satellites by the user community.

The STS also offers the unique capability of retrieving, refurbishing, and repairing satellites. In addition, a relaxation of design standards and development of standard modular components for production quantities would likely be realized through the STS. These factors could reduce satellite costs and subsequently allow their broader utilization for educational purposes.

A national educational telecommunications network is now possible as the Federal Communications Commission has set aside the necessary frequency spectrum for the exclusive use of non-profit educational services. And U.S. industries are developing commercial communication satellite systems which will incorporate this requirement.

In Appendix D a general outline is presented to describe the application of communication satellites for educational purposes. This can be used as a further guide and elaboration on this subject.

- Educational Utilization of STS Experiments - Broader educational utilization of all aspects of the STS experiments and operational programs should be emphasized by NASA if the full educational potential of this program is to be realized. A listing of various educational utilization activities which can now be identified, with comments on each, is presented below:

  - Principal Investigators from Level I educational institutions - The direct involvement of high school students in Skylab, the embryonic U.S. space station, has been discussed in Task 2. The success of this student experiment program, even with the limited time available for its development, has been cited by the National Science Teachers Association, NASA, and the participants as being very successful. From the Skylab program several activities can be directly applied to the STS program. These include the procedures and format for such a program; an available compilation of ideas for possible consideration and/or incorporation into the STS; and a number of ideas and suggestions which were made, but not applied because of time limitations. The recommendation that international participation would have been a desirable objective of the Skylab program was identified. Also, real time and live television broadcasts would have enhanced the educational value of selected experiments.

- Principal Investigators from Level II educational institutions - As shown in Task 2, NASA spent $115 million in FY '73 to fund some 2600 research projects at 280 institutions. This interface with the educational community is considered of extreme value by Dr. James C. Fletcher, Director of NASA. Dr. Fletcher recently requested that all NASA research centers maintain and, if possible, strengthen their research programs with U.S. universities.

  Many of the university researchers have participated directly with NASA in the conception, development, and application of space experiments in a broad number of disciplines. This activity should be expanded and methods developed to fund new experiments for the STS and to broaden faculty and student participation, if broader educational utilization is to be realized. And the rather restricted group of people now making up the "Scientific Space Club" should be encouraged to support this expanded activity. This point was clearly made by Mr. Michael C. Malin, a researcher at the California Institute of Technology and consultant on the ED-PLUSS study. He stated in a recent letter:

  > "Shuttle payloads will not likely be able to pay for themselves cost-effectively, since very few things in the world are worth $150.00 a pound. It is clear that NASA will have to find some other reason for shuttle development--and educational benefits may help provide this reason. The U.S. entered the "space race" because it saw, among other things, that it had fallen behind the Soviet Union in many areas of education. If it is not to fall again into the trap of neglecting to educate enough people to promote technological advance, the United States needs to focus its educational system; hence the challenge of space exploration and development. The most important aspect of the space program is the philosophical and cultural benefits we receive by exploring a new frontier. If it can, NASA must find a way to exploit this idea in its attempt to promote the shuttle.

An important group of people needs to be considered by the studies reported on in Huntsville--namely, the present NASA users. These men and women have a wealth of expertise which should be drawn upon to better define the goals and objectives of the shuttle and its associated user programs. This is clearly true in the area of education, where you know well the benefits to be achieved from drawing upon the experience of others (one might even say that was a definition of education). As an example of the type of people who might be consulted, at a recent meeting in Palo Alto, California, the Division of Planetary Sciences of the American Astronomical Society held an open discussion of the shuttle and its uses, in which some 150 persons participated. Opinions were quite split and good arguments for and against the shuttle were presented. These scientists are, for the most part, uninvolved in current NASA planning, and this should be changed.

One problem raised at the Palo Alto meeting should be given immediate attention. This had to do with the question of man-rating shuttle pay-loads. I am not sure if NASA has addressed this issue, but some decision should be made early in the program, since it will seriously affect payload and user development. It is clear that the cost of man-rating payloads will prohibit many small users from participating, and will certainly restrict just the sort of off-the-shelf, simple, inexpensive experiments NASA seeks to encourage."

Fortunately, the reduced time required from experiment conception until its flight and evaluation of results can be considerably shortened because of the unique nature of STS. This capability should be strongly emphasized to the educational community because more rapid diffusion of new knowledge is essential to the educational process.

o Educational program experiments emanating from orbit - In addition to the principal application programs now planned or being identified for STS, another disciplinary category might be considered. Presently identified scientific or technical disciplines include astronomy, physics, Earth observations, life sciences, communications and navigation, materials processing, and space technology. Any or all STS application program experiments should be considered for potential educational value and possible demonstration activities. The uniqueness of the space environment and results from the related STS payload programs used to exploit this uniqueness should likewise be quickly disseminated to all educational levels. And a new category covering experiments and programs dedicated primarily to education could help to focus on this important discipline.

Experiments and programs dedicated to education could be developed for the STS. These might involve both orbital and ground activities working in concert. For example, earth resource monitoring activities from orbit could be enhanced by incorporating broad scale student participation in ground truth measurements. In this manner, such STS capabilities as the monitoring of pollution sources and pollutants could be utilized; the educational community could participate in the development and application of the resulting data. Likewise, greater involvement of the arts and humanities with possible support from foundations should be encouraged.

- Piggy-back experiments - Small "piggy-back" (also called "suitcase" and carry-on) type experiments have been suggested for the STS program. Because of the large payload carrying capacity of the orbiter payload bay, it is probable that on certain missions space would be available for a variety of small and possibly oddly shaped experiment packages. Educational institutions could be encouraged to take advantage of this situation and develop scientific, technical, and educational experiments to meet their research, and possibly, academic needs.

  The following summary statement was prepared by Rockwell International, Inc., the prime contractor for the Space Shuttle Orbiter and its liquid propulsion rocket engines, and applies directly to the subject of "piggy-back" experiments for educational use. It also reiterates some of the advantages from and capabilities of the STS for this application:

"Some Space Shuttle missions will be flown with payloads that do not fully utilize the orbiter's payload capability. This excess capacity, or dedicated payload space on other missions, could be used for experiments furnished ready to fly by university students, faculties, or staffs. Such experiments could cover the spectrum of research that would benefit from a vacuum of unbounded volume, the absence of gravity, and an unobstructed view of the heavens, none of which can be duplicated in earth-based institutions.

There are many advantages to using Shuttle as a carrier of university experiments. Because of the mild launch environment, university researchers could develop space experiments for costs comparable to those of a typical laboratory experiment. Since there will be frequent flights, the total length of a research project could be shortened to the length of time a student normally spends in graduate school. Once the experiment is deemed safe from the standpoint of vehicle and crew safety, it could be flown repeatedly, as flights become available, and be free of the numerous restrictions presently associated with experiments carried on expendable launch vehicles.

The internal operation of the experiment and the analysis of resultant data would be the exclusive purview of the graduate student and his faculty advisor. In some areas of research, such as the biological and medical sciences, it may be advantageous for a member of the university to personally conduct his research aboard Shuttle, which offers for the first time the opportunity for individuals other than astronauts to fly in space. Interfaces with Shuttle are flexible enough to permit a multiplicity of payloads without unduly restricting the orbiter or the payload. In addition, university research efforts would be given essentially "free transportation" to space (if the experiments were carried, on a noninterference basis, on flights in which the full payload capability was not otherwise being used).

- Educational Dissemination Programs - As Task 2 clearly shows, there is a large amount of educational material concerning space exploration available to the public. Such material is broadly disseminated upon request to individuals and groups representing all three educational levels. Materials developed for the educational community include: filmstrips, films, photographs, charts, curriculum guides, models, resource materials, audio and video tapes, and transparencies. NASA has demonstrated outstanding capability in preparing these materials for communication purposes. Artists, writers, lecturers, journalists, and newscasters have prepared this information for mass media and small group presentations. Television, radio, newspapers, magazines, and journals have been utilized for mass media purposes.

All of the above types of dissemination resources are needed and should be expanded for application to the STS. As NASA adds the new user function, new approaches should be implemented. This study has identified several areas that appear to need special consideration as NASA adds the new role of actively seeking new users of the STS capabilities. Two major areas of interest are included in the following discussion:

- The need for awareness - As soon as NASA decisions are made regarding STS activities, it is imperative that the educational decision-makers be made aware of the STS capabilities. A high percentage of the contacts sampled during the study were not aware of NASA capabilities which could apply to their needs. There was little or no awareness that they could be users of the STS outside of the scientific and technical disciplines. Awareness of the potential educational utilization of the STS is, of course, related to the need for a NASA organizational structure that will make the educational "buyer" aware of what the "seller" has to offer.

- The need for involvement - A soliciting and liaison function is needed since educational users desire to use that which meets needs, while the seller seeks to develop products or services to meet those needs. An interface is most important when the seller can employ technology in a large variety of ways and the buyer has such a diversity of ways to meet needs. The dilemma is compounded when the three educational levels all seek different kinds of products or services from NASA and industry. Therefore, early planning for educational demonstrations at the research and development level should involve broad dissemination of potential outcomes so that educational community involvement will set the pace for products or services most likely to be used.

Such a program will require dedicated participation in planning on the part of the user and awareness of the STS capabilities to be demonstrated and developed. Participation in early planning which is made known to other potential users, along with progress reports and findings which give direction or modify a given demonstration, should be disseminated through all levels of the educational community in order to successfully reshape the teaching-learning process. Assuming attitudinal change precedes behavioral change, the magnitude of the STS should expand the need for educational dissemination programs to enhance mass acceptance of space age applications. NASA should disseminate its wares and capabilities aggressively.

STS Futures Studies

It is difficult to project into the future or to direct change. At best, we can only attempt to expand our capabilities and become more adaptable to the constant and rapid changes we are now undergoing or anticipating. And we can plan, develop, and implement those concepts and methods which can direct change into those favorable paths having broadest benefits to mankind.

With the coming operations of the STS and the related scientific and technical benefits potentially available, the way is ideally open to bring education tightly into the experimental and application loops, making it possible for the educational community to learn of and participate more directly in the outpouring of knowledge that is certain to take place. An educational approach is one of the most effective ways to demonstrate what space research is all about and how it can benefit humanity. And it is essential that those involved in the space program apply the very technology they generate to the educational process.

Figure 3 shows a future scenario relating the identified educational possibilities and potential applications of the STS into a composite view emphasizing the mutually supporting role of Orbiter/Spacelab activities in low earth orbit and educational satellites in geo-

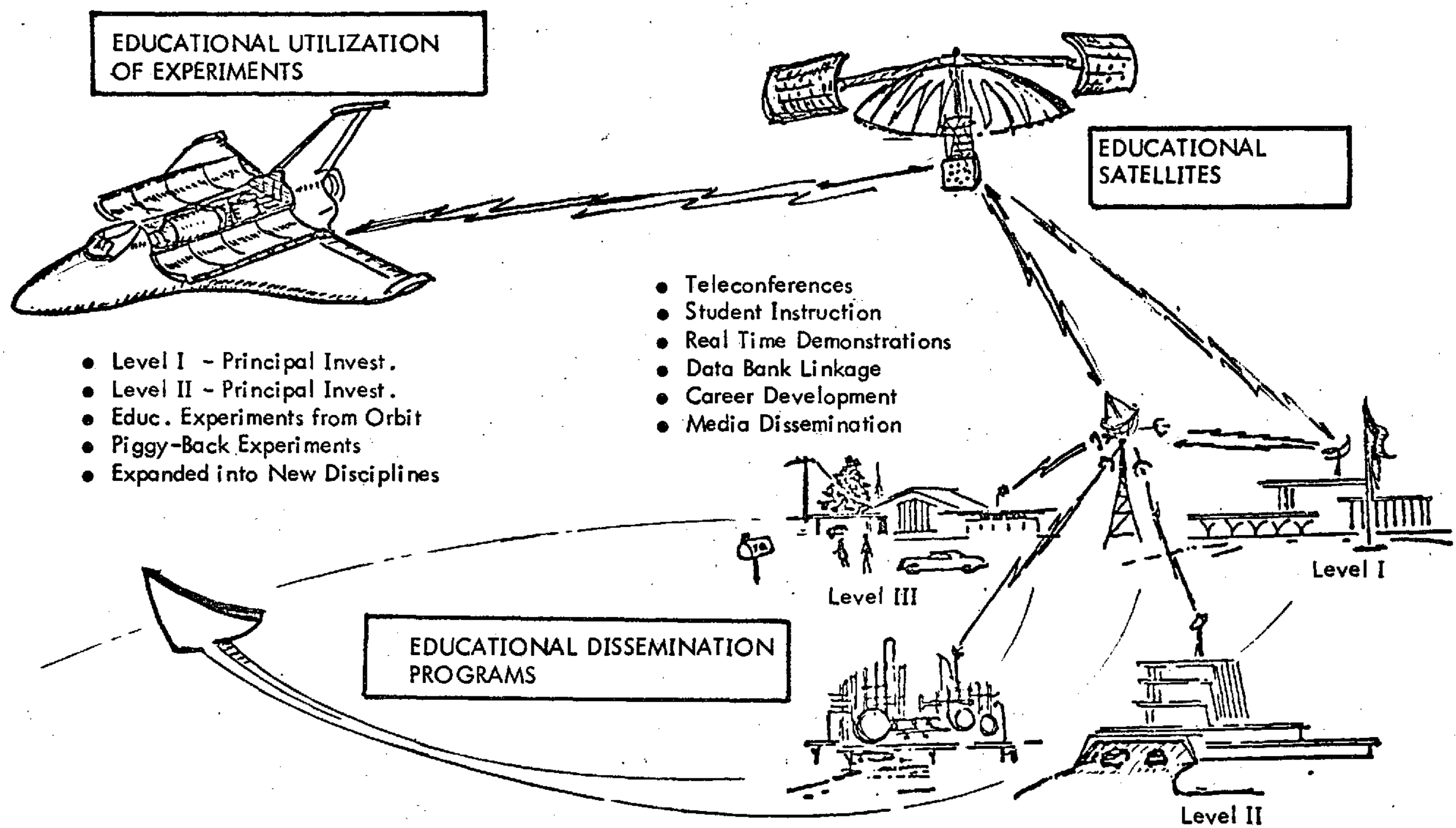

Figure 3. Educational Capabilities for STS

sychronous orbit. This type of scenario should be further developed, used as an example of STS educational capabilities, and to expand educational community interest in this concept.

The Stanford Research Institute Phase I Study discussed the futures context as related to STS in some detail. Their context and "third dimension" approach is as valid for educational planning as it is to the overall STS utilization. The Post Industrial I and Post Industrial II societies are essentially descriptive of alternate societal values. The concepts represent a realistic method through which education may define its primary role as that of a socially responsive institution. Regardless of which future or combination of future opportunities is realized, education must remain compatible with the human values determined as being representative of whatever "future history" develops.

In planning for educational use of the STS, NASA must be concerned with societal values of the STS era. Because education is a socially responsive institution, its characteristics and values mirror the "real" values of society. Therefore, a continuing study of education is desirable to accurately assess these "real" values. Education by its very nature also affects and has impact on society. Therefore, the future can be affected by increasing educational community awareness of space exploration activities.

Methodology Development

The planning and development of an effective methodology require the integration of a particular set of functions into the body of the methodology and an output which achieves the designated requirements and stated objectives. The output can be in the form of a flow diagram, a listing, or a matrix (or possibly combinations of these), showing pertinent considerations for each functional element. Methodology is essentially a plan or projection of what is to be accomplished in order to reach valid goals and how it will be done. Stated in the words of Roger Kaufman,[1] it must include the elements of:

- Identifying and documenting needs
- Selecting among the documented needs those of sufficient priority for action

- Detailed specifications of outcomes or accomplishments to be achieved for each selected need
- Identification of requirements for meeting each selected need, including specifications for eliminating the need by problem solving
- A sequence of outcomes required to meet the identified needs
- Identification of possible alternative strategies and tools for accomplishing each requirement for meeting each need, including a listing of the advantages and disadvantages of each set of strategies and tools (methods and means).

Thus, the determination of what is to be done and the identification of requirements for doing it effectively and efficiently become the primary tasks of methodology development.

A systematic approach is necessary when planning and developing a viable methodology for educational applications. Both the needs of the potential user and the current status and capabilities of educational technology must be considered and evaluated to provide innovative techniques and develop new educational program plans. Inherent problems and requirements for the desired educational system should be determined and discrete tasks and schedules developed for meeting the objectives of the planning effort. In addition, the priorities of potential users must be considered as well as the availability of new educational technology. The methodology should then establish priorities and schedules, recognize and identify program barriers and their possible elimination, specify the resources needed for program development and operation, and establish, on a task basis, all steps involved in the total program. When applying a systematic approach to the method, the classic feedback loop must also be administered if the effectiveness of the applied technology and resulting educational benefits are to be evaluated and measured.

The methodology that was developed to meet the objectives of this task was required to consider a number of factors. Not only was it necessary to closely evaluate the multiple levels and fragmented structure of the educational user community; the varied capabilities, interests and potential activities of both NASA and the STS also had to be investigated.

In order to incorporate the various considerations imposed on the basic methodology, a number of basic design factors should be assessed, including the following requirements:

- Encourage participation by user community in early planning phases of the STS/user interface program
- Include a NASA commitment to expand educational applications for STS
- Develop operational elements that can interface and allow effective communication between "buyer and seller"
- Adapt to rapid change and future modifications as they become apparent
- Incorporate sampling, demonstration and simulation systems to develop interest and a demand from potential users
- Identify common interests of potential users and potential funding sources to meet their objectives

The Battelle and SRI Phase I Studies included a number of other significant parameters to be considered in methodology development for the identification of new STS uses and users. Likewise, the ADL study identified key issues of importance to NASA in their development of a related program. Most of these considerations also apply to the ED-PLUSS study because of the diversity of the educational community and the broad scope of its market potential.

Methodology for the ED-PLUSS Study

The UAH study has developed a methodology which is generalized in form but which can accomodate a number of variable functions and inputs. Likewise, it can be broadly applied to meeting objectives and system requirements other than educational applications of the STS. A diagram of the development approach for this methodology is shown in Figure 4 It is recommended that NASA apply this methodology development plan and resulting methodologies to each of the three educational user levels described in Task I. To assist this activity, a description of each functional element in the methodology development is given below:

- Requirements and Objectives - This element applies to meeting the basic needs

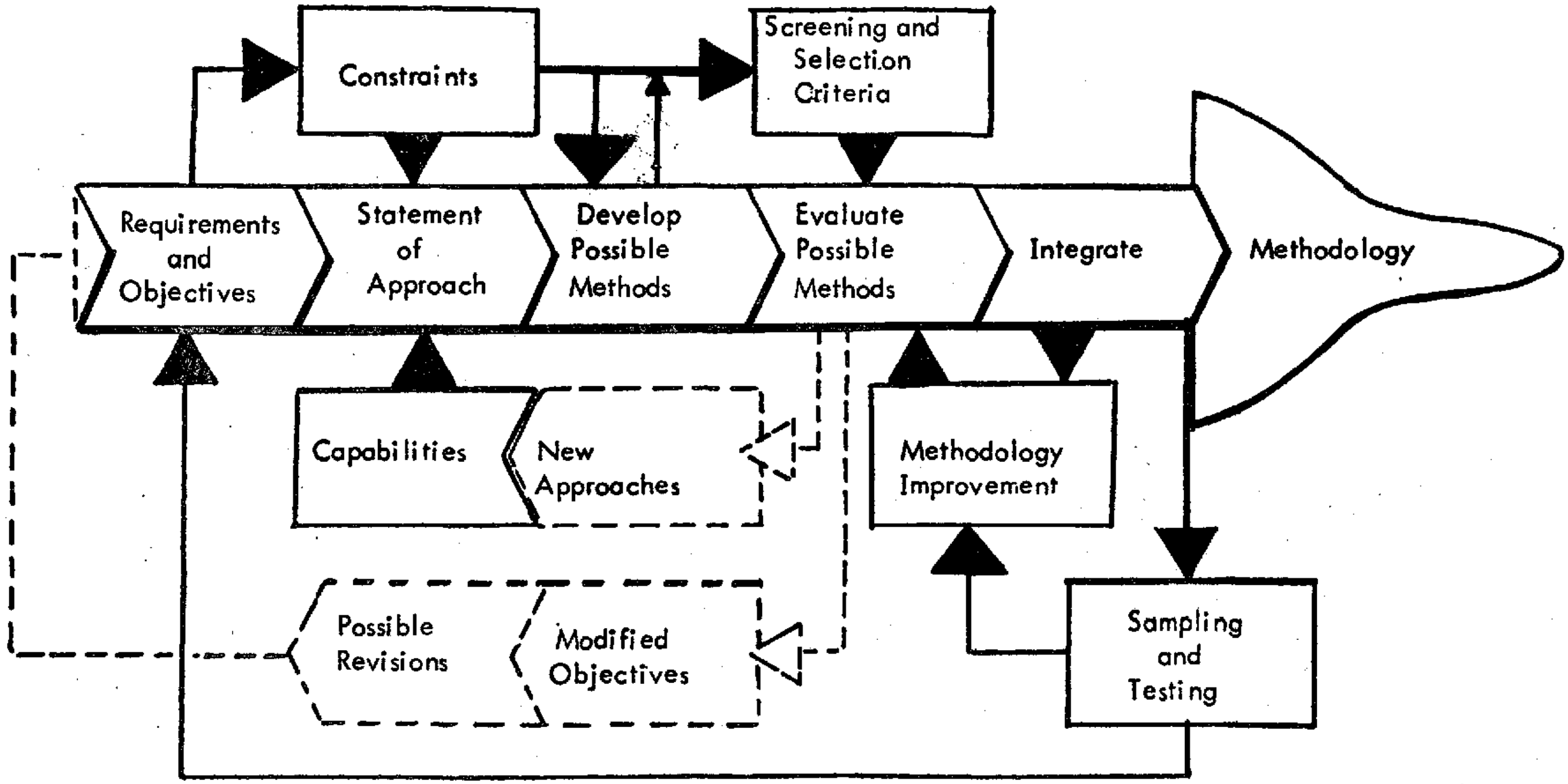

Figure 4. Methodology Development for ED-PLUSS Study

of the new user, the design requirements of the methodology and the NASA objectives of expanding STS utilization. All aspects must be clearly stated and defined if a feasible methodology is to be developed.

- Constraints - Policy, financial, physical, situation, organizational and communication barriers must be considered among others, for both the "buyer" and "seller" in this element. Many of these types of barriers, as listed in the Battelle Phase I Study, apply to both the educational community and NASA. In the case of educational applications for the STS, the financial, organizational and communication barriers appear to be predominant.

- Capabilities - The capabilities element again applies to those of NASA and the educational community. In addition, the interface function (called the new user function or NUF by NASA) must also be evaluated for capabilities (as well as policies, etc). Resources and new technological approaches are of paramount interest. And the STS capabilities for educational applications, as discussed in this report, should be considered and, hopefully, expanded for broad dissemination.

- Statement of Approach - After considering detailed factors developed in the constraints and capabilities elements of the methodology, a statement of approach (and possible restatement of the basic objectives) is required. This provides a translation in suitable terms for the next analytical step.

- Develop Possible Methods - In this case, a listing of methods and techniques for marketing, as developed in the Battelle Phase I Study, should be evaluated for educational user applications and techniques unique to the educational market emphasized. Demonstration programs and the use of consultants, seminars, and meetings are examples of applicable methods. In each case, prime consideration should be given to attaining the stated objectives.

- Screening and Selection Criteria - This key element requires careful analysis of such critical parameters as risk, cost-effectiveness, performance and timing based largely on the establishment of priorities and the refinement of policy decisions.

Constraints and methods of all types provide the basic inputs for consideration. This filtering process then allows application of the selected methods for further evaluation.

- Evaluate Selected Methods - The next requirement is a "trade-off" study which considers and compares the developed priorities of the selection process and identifies the methods and tasks to be implemented. From this evaluation, certain modifications to the original objectives may become apparent and new approaches may evolve to refine the capabilities element. Potential market programs for expanding the utilization of the STS at each educational level would be identified by this stage and a tentative plan of action laid out to match the needs and interests of buyer and seller.

- Integrate - In this most important element, synthesis would be performed to integrate the selected methods into a well-defined and functional program. A number of methodologies could be developed because of the diverse nature of both the educational user community and potential educational applications for the STS and because of the multiple facets of their interface in the marketing mode. Likewise, alternate or "backup" methods may evolve or short term samples made to further refine the methodology prior to the display of its finally developed form.

- Sampling and Testing - A determination of effectiveness of the developed methodology should be made. A variety of sampling and testing methods will likely evolve, including the use of interviews, workshops, demonstrations, and questionnaires. By sampling and testing the developed methodology, improvements and refinements can be accomplished. Feedback loops to investigate the possibility of revising the original objectives or further refining the methodology could be applied. Concept Verification Testing (CVT) and other simulation programs have been developed by NASA which could also prove to be extremely useful for testing viable educational programs for the STS.

- Futures Analysis - Thoughout the methodology development process, as shown in Figure 4, the futures context must be considered as the third dimension. Each element of the methodology has an alternate future. Particular attention must be given to potential changes in objectives, capabilities, and constraints among the buyer, seller, and interface functions. As an example of an important consideration for evaluating the educational user community, projections in population changes must be carefully reviewed for related impact on all educational activities. The U.S. Bureau of the Census and other sources for statistical data can help to provide this type of information. The Task I conclusions in this study also consider future population and educational funding trends and should be utilized accordingly.

- Display of Output - The developed methodology for meeting a particular set of objectives and requirements may take a variety of forms. Usually, a flow diagram or matrix of some type is prepared to assist in communication and to more clearly show the flow of activities required and their relationships. A data bank or Management Information System (MIS) should also be developed to incorporate, maintain, and control the large number of possible considerations within each of the basic elements of the methodology. A typical methodology for the development of STS uses and users from government agencies is given in the Stanford Research Institute, Phase I study. This comprehensive approach should accomodate many of the characteristics of the educational community, particularly where government funding is used. Likewise, the techniques and organizational recommendations provided in the Battelle Phase I report should particularly apply to Level III of the educational community. From these Phase I studies numerous methodologies could be developed and displayed. However, it is essential that a clearer definition of the basic policy issues and "front-end" decisions be made as emphasized in the A.D. Little Phase I study. Otherwise, many false starts and unrealistic planning could evolve.*

*As stated by Oliver Wendall Holmes, "The art of life consists of making correct guesses on insufficient information; insufficient because we can never know all of the elements that enter into a right decision."

Methodology Application

To apply the methodology process shown in Figure 4, a large number of discrete steps and evaluations must be made. A flow of information from the potential user to NASA is needed to establish user needs, priorities, capabilities, constraints, resources, and other critical characteristics of interest. This information may come from many sources and the use of consultants having a direct working knowledge of the educational field will be essential to the task. Information flow from NASA to the potential user is likewise a critical phase of the methodology development process. Proven methods used on the Skylab, ATS-6 and other NASA programs should be used and expanded where possible. New methods of dissemination are likewise needed to cross-link STS capabilities and the educational user community.

Figure 5 shows the basic relationship between NASA offices involved with education and the educational user community. Each of the offices and basic capabilities shown can interface with any given educational level and their related supporting activities. The interface activity could be represented by a NASA function or a new "middleman" function or a combination thereof. The interface or liaison organization is critical to the overall effectiveness of the program and must be organized and directed with the many considerations developed from this Phase I study.

The next step in applying the methodology developed for this study will require key decisions by NASA relating to stimulation of new educational applications from the STS program. This step is a "chicken and egg" type of thing between perceived user requirements and a responsive concept to meet these requirements. Scenarios which clearly state potential user benefits can enhance this interaction and should be developed for this purpose.

Figure 3 is an example of a futures oriented scenario that shows the broad potential scope of educational applications from the STS. It also helps to explain the self-sustaining aspects and supporting relationship of each major application area. Other scenarios and methodologies should now be developed to investigate selected user levels and matching

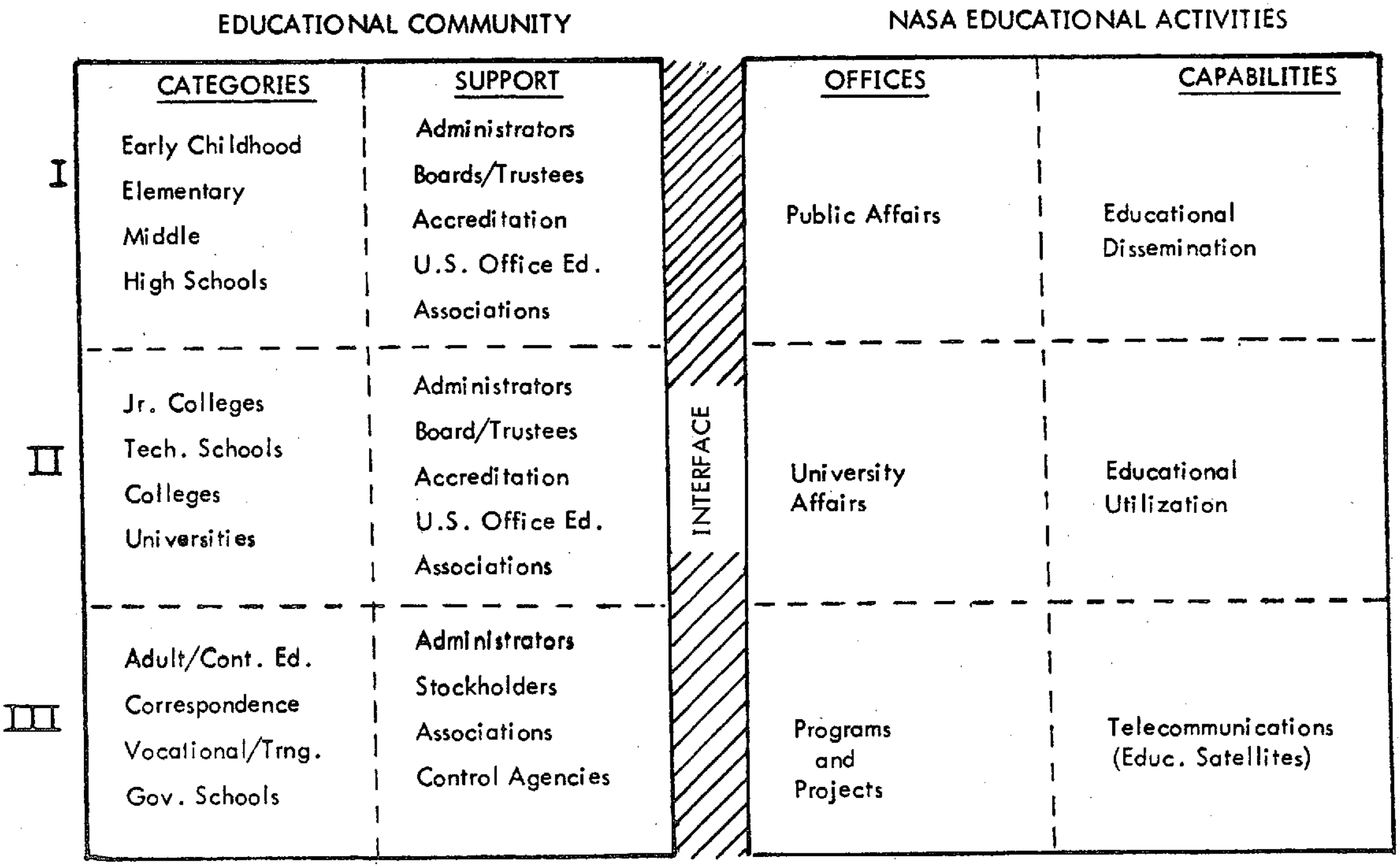

Figure 5. Relationship of NASA to Educational Community

them to identified and potential capabilities of the STS.

During the course of early follow-on activities to this contract, preliminary flow charts which can display a methodology for a particular level of educational application for the STS should be developed. Also, sampling of the proposed methodology is needed by requesting comments from selected contacts made during this study. In this way, developed methodologies can be tested by an early review of their validity and content.

An example of the application of a major educational effort by a large government agency was recently given in a dissertation by Dr. Jonathan M. Wert of TVA.[2] In his dissertation, Dr. Wert described a process model which showed how a federal government agency could utilize its resources and cooperate with others to develop environmental education programs. Questionnaires related to needs, capabilities, constraints, priorities and concerns were included and could possibly be applied to space education.

In summary, any developed methodology should at least address the following considerations:

- Long-range planning strategies
- Understanding of user needs and priorities (user description and justification)
- Technological assessment of the state-of-the-art at time of program operation
- Cost-effectiveness of selected methodologies compared to alternatives
- Program objectives clearly stated and related to overall strategies
- Pricing plan (cost of goods and services)
- Life cycle analysis
- Technical feasibility
- Alternate approaches
- Schedule of key events
- Implementation tasks
- Key management decision points
- Clear communication channels
- Motivational aspects

References

1. Kaufman, Roger A. Educational System Planning, Englewood Cliffs, N.J. Prentice Hall, Inc., 1972.

2. Wert, Jonathan A., A Process Model Showing How A Federal Government Agency, Such As The Tennessee Valley Authority, Can Utilize Its Resources To Cooperate With Other Agencies In The Development Of Environmental Education Programs For The Tennessee Valley Region. An Unpublished Dissertation, The University Of Alabama, University, Alabama, 1974.

TASK 4 METHODS TO ENCOURAGE USER AWARENESS

The two-fold purposes of Task 4 include: 1) the identification of educational networks or focal points for coordination of that vital interface necessary to meet regional needs, and 2) the identification of techniques that may stimulate greater user awareness of the STS capabilities. These two purposes are inseparably connected because the techniques selected for use are directly related to the selected educational networks. Obviously, both purposes must be carefully integrated into the planning methodology presented in Task 3. In one sense these two purposes can be viewed as two major plateaus of the techniques; the first plateau represents networks to be used to identify the power structures (decision-makers) of any user level. An example in this plateau is the NASA selection of the National Science Teachers' Association (NSTA) as the network to reach science teachers and to involve students in the Skylab Student Experiment Program. The second plateau represents the numerous techniques now available to inform, motivate, and stimulate user awareness and participation. The Skylab Student Experiment Program again serves as an example based on the competition program held to motivate and select student participants.

As the three rather distinct educational levels in the United States were evaluated in Task I, it was noted that these same levels could be associated with comparable educational levels in other countries. Therefore, the analysis of educational networks in the U.S. could be applied similarly to any other country with appropriate identification of their needs and capabilities. It is recommended that this effort be performed to broaden the scope of educational applications for the STS. Since Task 4 received only limited attention, it is also recommended that further serious study of its considerations be performed as more definition is given to the time-phasing of the STS activities related to education. Since education is basically supported through a taxation rather than a product base, the initial funding sources for demonstration and technology refinement will likely stem from national level networks.

Educational Network Considerations

The identification of priorities for the educational networks suggested herein is made more difficult by the large number of networks found in each educational level under study. Although there may be common elements in Level I and Level II, the lines of authority for reaching the user will be quite different in the various regions of the United States. In this study five rather comprehensive networks have been identified as the vehicle of contact. They are: 1) administrators, 2) federal agencies, 3) education associations, 4) educational communications networks, and 5) regional education service agencies.

Administrators

The possibility of educators realizing the opportunity to utilize the STS capabilities rests upon the decision-making power of educational administrators who directly interface with the various boards/trustees/stockholders on one hand and the voting/public voice of the consumer. Though such bodies have many things in common, they differ markedly from each other within states, between states, and between broader geographical regions of the nation. Nevertheless, these are the people who will significantly affect the implementation of any STS educational activity. For a major effort like the launching of dedicated educational satellites, it seems at this juncture that key administrators from all three educational levels should be contacted in a search for common needs. Administratively, it would appear that some type of independent group should be established to coordinate the telecommunications services that would become available.

Federal Agencies

Many federal agencies have funds designated for educational purposes. United States Office of Education (USOE) contacts have indicated that there are at least twenty-six different federal agencies that earmark funds for educational activities. Key leaders in each of these agencies should be made aware of the STS capabilities they could use for educational purposes. Again, the interface between these agencies and international affairs would add another viable factor to educational programming. It may be that the United Nations Educational, Scientific and Cultural Organization (UNESCO) would be a first stage contact for cooperative international educational exchange programs, as well as a potential funding source for educational utilization of the STS.

Education Associations

The many professional academic disciplines, accreditation, and philanthropic associations that should be aware of the STS capabilities are included in this network. Such awareness might well be made difficult to achieve when one considers that the Department of Health, Education and Welfare has identified more than 750 education associations in the 1973 Education Directory. Some of these associations have funds that could be used for the educational utilization of the STS. Others would have influence on other funding sources or joint venture programs. They should be closely evaluated for this possibility.

Educational Communication Networks

This network system was included because of the direct implication of telecommunications on advanced educational technology. A minimum amount of terrestrial linkage is desired in order to optimize user application of a variety of techniques and to utilize the capabilities of large communication satellites. And the impetus to establish such networks is greatly increased when one considers the possibility of low cost ground receiving stations that can join regional, national, and international networks. The number of networks for education has almost doubled in the past five years but there are still many areas that could benefit almost immediately from communication satellites dedicated to education. Figure 6 provides a view of the U.S. networks as of 1971-1972.

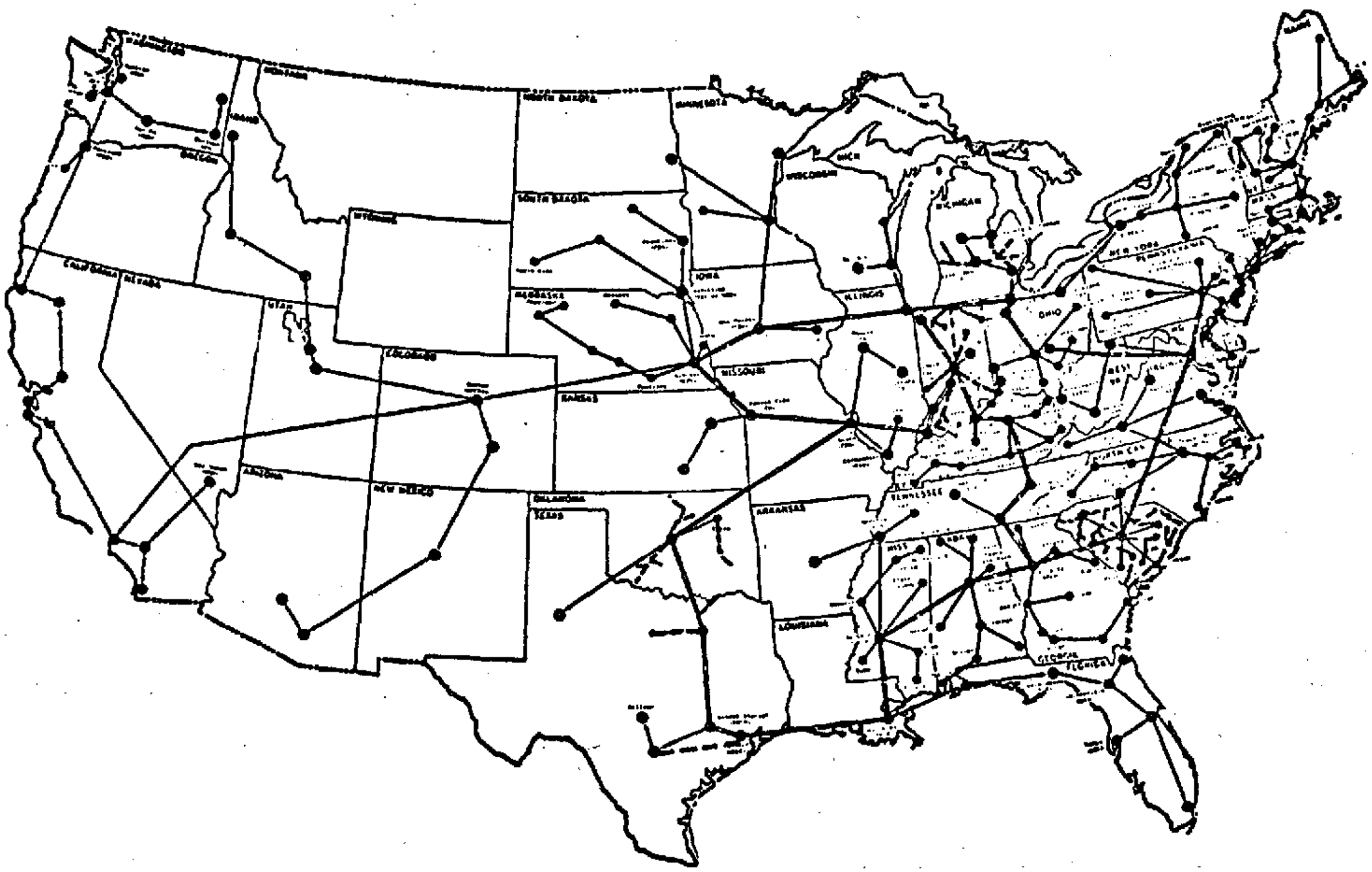

Figure 6. Educational Communications Networks - 1971-72

Regional Education Service Agencies (RESA)

The RESA network is best defined by considering the various regions of the U.S. in contrast to identifying a national network. Through a variety of projects, federal and foundation funding sources have sought to develop pilot efforts to bring educational systems into cost-effective cooperative and consortium activities. Such names as "Renewal Centers", "Regional Educational Laboratories", and "Regional Educational Service Agencies" are examples. Agencies such as these have been utilized to identify the sites used in the current Appalachian Education Satellite Project (AESP) which uses the ATS-6. Further study may show that such networks may be used or may serve as model networks to assure educational leaders that their regional needs will be considered in determining the appropriate educational utilization of the STS capabilities. These networks may also serve in the early stages as the dissemination system to bring about greater awareness of the STS educational capabilities.

A relatively new organization in this category is the Joint Council on Telecommunications (JCET). Since their efforts could be directly related to the communications aspect of the STS educational activities, it may be that JCET should expand its charter to serve a more direct broker function between seller and buyer.

Typical Methods/Techniques Considerations

A rather exhaustive report of marketing techniques was made in the companion Battelle study. Some of them are a part of this study, along with others that were considered essential for stimulating educational user awareness of the potential uses of the STS. These methods are intended to involve selected audiences rather than mass audiences since it was assumed that general population information would be disseminated concurrently.

Consultants

Several kinds of consultants will be needed to assure efficient contact with potential users. NASA may best achieve its purposes by contracting with marketing consultants to reach specific target groups or networks as described in the preceding section. Special consultants who can translate the technical capabilities of the STS into laymen's terms for the educational user are also needed if new applications are to be developed.

Publications

Key educational leaders need personal contact to become aware of the STS potential and in turn they can provide more knowledgeable leadership if they have published materials to share with constituent groups. Publications should be made available at many levels and should range from the detailed and technical to specific examples of educational applications and the potential scope of applications. At a later stage, publications should be made available to better acquaint the leaders with their involvement in the total process and to give credit for their efforts.

Conferences

Studies have shown that conferences are best used when specific target groups are involved. This would suggest that NASA priority decisions are needed to identify the crucial decision-making networks within the educational levels identified. This is a method NASA has used quite well and could readily adapt to involve potential users.

Demonstrations

This method is currently in use with the AESP application of ATS-6. The opportunity to visit such a demonstration, however, is somewhat restricted due to travel limitations of potential users. Demonstrations might be based on a mobile concept where the demonstration unit would have flexibility rather than requiring the potential user to travel to a demonstration site. In this way a demonstration van could be sent to a region, state, or national conference with demonstrations geared to providing "hands-on" activities for potential users. Also, NASA might establish "on-going" demonstration sites as pilot centers for visitors to observe and interact with experimental users.

Workshops

A variety of workshops should be considered to reach the leadership components of the networks identified in the different educational levels. The workshop method should be used to gain understanding of user needs and capabilities so that NASA can demonstrate the STS potential product or service. In this way the user has more direct input in the product or service development cycle which in turn assures more effective operation and utilization.

NASA Tours

A variety of tours could be sponsored by NASA to help stimulate awareness of STS capabilities. The important point to keep in mind is to have the tours relate to educational applications of the STS. It is assumed that the number of locations available to conduct tours will limit the tour frequency in the early stages. Therefore, NASA may have to screen the educational market leadership so that only key persons are included.

Seminars

Many studies show that this method is quite popular among educators. The flexibility in this method allows NASA to set the seminar at almost any geographical location. With this method NASA can go to the user to stimulate awareness through the two-way dialogue provided by the seminar. This method facilitates the exchange and analysis of ideas. NASA personnel are encouraged to use this method to explore with educators their interests, needs and applications relative to the educational utilization of the STS.

Science Fairs

Science Fairs have had a wide range of success throughout the U.S. but annual dates for such events may not allow the flexibility that NASA will need at certain stages. This method could be valuable for contacting the more active student in science who is likely to be interested in the STS educational applications. This is especially the case for educational utilization of student experiments, piggy-back activities, ground truth testing activities, and real-time demonstrations by principal investigators.

TASK 5 COMPILE "FOLLOW-ON" IDEAS

During the course of any research process many different ideas and concepts are evaluated, then those of merit are usually incorporated into the total effort. This is particularly true in the case of a Phase I study where definitions of follow-on program phases are being developed and "brainstorm" sessions allow a multitude of approaches to be considered.

Many ideas, both directly and indirectly related to follow-on activities, were considered during the course of the ED-PLUSS study. Some of them have been introduced in the body of this report. A brief description of ideas having potential interest to NASA for expanding educational applications for the STS are presented below:

Surveys, Interviews, and Questionnaires

Follow-on efforts are recommended as part of a Phase II program to provide further identification of potential educational uses and users for the STS and clearer definition of user needs, interests and priorities. Priorities could be established by identifying categories according to the availability of funds. This activity should use various sampling techniques, including surveys, interviews and questionnaires. The surveys could search for attitudes and ideas while interviews and questionnaires could probe for commitment levels, resource requirements and availability, and the constraints or barriers which could be identified or anticipated.

Contacts and References

A comprehensive and organized listing of key contacts and references was developed by the ED-PLUSS study team to aid in the research efforts. The material should be further organized and expanded to provide individual names, organizations and background information on a variety of potential users and advisors for STS educational applications. This type of reference material is vitally needed to provide a better interface with the educational community and its multi-tiered networks and to aid in additional program design and implementation phases.

Workshops

During the Phase II period, it is recommended that two or three day workshops be conducted at key points throughout the country (near potential educational user concentration areas). Key educational leaders from various disciplines could be invited, as well as selected industrial and governmental leaders with a demonstrated interest in education. Also, representatives from other countries (such as embassy and UN officials) could be invited to participate in these workshops to gain international interest. The primary purpose of the workshops would be to present the scope and capabilities of the STS and solicit ideas for educational applications. Participants would also be asked to contribute efforts during the planning and development phases of this program. As a result, new contacts and interests in the total STS program could be realized, and coordinated efforts between government, industry and educational institutions could be established to maximize the educational utilization of the STS.

Presentations

The field of education has regional, national and international meetings where problems of wide scope are identified and challenged. It is proposed that efforts be made to have speeches and programs developed for presentation in general or "departmental" sessions with emphasis on the educational capabilities of the STS. Such meetings usually have an exhibit area where materials pertaining to the theme of the meeting are displayed. Appropriate literature with information about interest, uses, and names of other potential users could be distributed. Media development and a list of available speakers for significant meetings could also be initiated during the Phase II program. Annual national meetings of professional groups such as those listed below might be considered for their potential input to this effort:

American Association of School Administrators
Association for Supervision and Curriculum Development
National Association of Secondary School Principals
National Association of Elementary School Principals

Also, regional, national, and international meetings attended by associations or foundations might be identified and considered as potential sites for introducing STS educational applications.

STS User Sourcebook

Source materials are needed to describe the STS capabilities and educational applications for the benefit of all potential users. A loose-leaf STS User's Sourcebook is particularly needed to aid in contacting the educational community. This sourcebook could include background information, have certain elements of a press package, and emphasize benefits, examples of scientific and technical experiments, and potential educational experiments. Media sources could also be included to aid the sourcebook user in preparing talks, giving audio-visual presentations, and locating selected references of interest. It is proposed that an STS sourcebook be planned and initiated during the Phase II period.

The proposed sourcebook should be related to educational programs; it could be written, edited, and organized to assure its widespread usefulness to individuals and organizations at local, regional, national, and international levels. Because of its nature, the effectiveness of the sourcebook would transcend that of the traditional survey in that portions of its contents would be "repackaged" to direct the presentation toward many potential users. For example, school teachers could base instructional programs on material appearing in the sourcebook, even though their students might not use it directly. Industrial organizations could structure seminars on it, or prepare briefings based on experience gained elsewhere and recorded in the sourcebook. It would be especially valuable to NASA personnel in the support of lectures and speeches for Congressional briefings, and as a resource to aid researchers and writers interested in space educational programs.

Potential users of the sourcebook might be found in many types of organizations. Educational users, ranging from elementary schools through universities, would be concerned with teacher and student education, informal classroom presentations with audio-visual aids, and formal space science and applications curricula. Within governmental and civic organizations, the sourcebook could be useful for supporting presentations, public information programs, planning, and the like. Within industrial organizations, the sourcebook could be used by the educational planning and job training personnel, scientific and engineering staffs. Other users could be consultants and researchers, members of international coordinating organizations, communication and information management personnel.

A bibliography should be included containing articles and books (key listings with annotations), popular literature, scientific literature, and survey articles. Sources of educational materials and services could include:

- Audio-visual materials
- Exhibits, displays, and charts
- Teaching aids
- Workbooks
- Book source references
- Curricular and short course data
- Workshops and seminars
- Lecturer services

It would also be necessary to devote some effort to the development of a plan for increasing the scope, content, and utilization of the source material listings. Accordingly, a preliminary key word index should be assembled, a critical evaluation made of potential users, and a format for cataloging and cross referencing of materials are suggested for future consideration. This sourcebook format could also be expanded for other STS potential user sectors.

STS Information Van

Various forms and types of media and presentation material are needed to educate and inform all potential users about the STS and its capabilities. This can stimulate the thinking and "brainstorming" which leads to planning and action. For the educational market a mobile van could be designed for use at universities, schools, industries, meetings, conventions, etc. It could contain a reading area, STS source material, walk through exhibits, and audio visual packages for expanding awareness of the STS and its planned and potential applications. Clarity and simplicity of the media material would be most important for younger and general public audiences. Loose-leaf and current source material, current STS activities and plans, and detailed descriptions of its uses and benefits would also be needed for more sophisticated audiences. Likewise, a mobile telecommunications van, which could demonstrate "real-time" educational applications from satellites, might be considered as an additional unit worthy of development by NASA.

Perhaps several designs would be required to meet the needs of the educational community. They could be considered as larger and second generation versions of the successful NASA Spacemobile project. NASA has also developed a large exhibit van entitled "America...Living and Learning in Space" which contains a number of models, space hardware and photographs. This type of exhibit system could be helpful in the development of the proposed STS information van proposed above.

CVT Pilot Studies

Sampling techniques are needed to validate the methodologies that might develop from this study. Experimental testing or pilot studies for educational experiments could use the NASA Concept Verification Testing (CVT) concept. A preliminary user sampling effort through the use of such ground based simulation systems could be developed to provide direction and response to proposed STS educational experiments prior to their actual flight operation.

Contract Commitment for Education

An "Educational Utilization" contract clause, similar to the present Technology Utilization clause used in NASA contracts is needed to realize more educational value and to allow quicker dissemination of new knowledge to the educational community. In this way, researchers and principal investigators would be encouraged and motivated to include more academic considerations into their contracted activities.

Geographic Evaluations

Due to the geographic dispersion of NASA field and test centers, regional dissemination centers, and other activities, it is suggested that geographic evaluations be made to relate these NASA functions to the educational community. This would also include analysis of the prime locations for Level II institutions already involved in NASA experimental research. Location of major space museums and science and technology oriented museums throughout the country should also be included for potential sites in disseminating STS educational capabilities, opportunities and potential benefits to broad audiences. In this way, the development of interface systems between NASA and the educational community could be implemented more efficiently and on a broader scale.

International Cooperation

As already noted in Task 4, the research performed during this study could be expanded into international areas. Political restrictions and nationalistic constraints have so far prevented the development of a United Nations communications satellite as proposed by Arthur C. Clarke in the film, "The Promise of Space for Education", produced by Thomas Craven Film Corporation, New York, New York. However, the Spacelab development program and the Apollo-Soyuz link-up in 1975 are steps in the right direction for international cooperation in space. Educational experiments are planned for Apollo-Soyuz and emphasize the value of education as an element of cooperation and a bond of common interest between often conflicting philosophies. A space station program with an international crew and dedicated to ~~international crew and dedicated to~~ international cooperation through educational activities is suggested for the future. Global multilingual broadcasts of experiments and programs, with emphasis on solving those basic problems common to all mankind and elimination of the ignorance that breeds those problems is sorely needed and within the realm of the STS capabilities.

Additional Follow-On Ideas

The following ideas were considered of sufficient value to include in the final report. They are presented below for additional review and possible expansion.

- Investigate methods to gain broader involvement of the arts and humanities into the STS educational program. Artists, poets, and writers should be considered for planning and involvement in STS educational experiments and programs. Foundations in particular could be approached to consider financial support for this type of participation.
- Investigate the possible application of the ED-PLUSS study format, as developed in Phase I, for evaluation of other national goals. Such critical areas of current interest as energy and food development and environmental and medical care could be evaluated by using the same basic goal oriented approach which was developed for surveying and evaluating the educational community. Applying STS capabilities to meeting national goals should be a major concern of NASA.
- Develop methods for encouraging broader educational utilization of planned STS experiments. Principal investigators could be contacted for their opinions and possible participation. As a start, the various participants of the National Academy of Sciences Space Science Board (summer 1973 study) could be contacted for opinions and assistance in this effort. Of the 63 participants, over one-half are directly affiliated with a university and should have strong educational interests.
- Investigate techniques for improving communication and liaison between potential educational users of STS. Also, investigate methods to encourage funding support through the development of consortiums, joint ventures, and multi-user studies. Common mission analyses, "piggy-back", and "suitcase" educational experiments,

and broad-scale educational experiments involving student participation should likewise be investigated.

- Investigate the use of science fairs and student design competitions as breeding grounds for STS educational programs.* Opening the NASA facilities to more student tours might help in this effort. Also, a space oriented version of the familiar Civil Air Patrol (CAP) has been suggested by one of the UAH Research Advisory Committee members. A full Level I curriculum for space education programs, similar to the present aerospace (with emphasis on aeronautical) education courses, has likewise been suggested as a long term requirement for STS educational program development.

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*The Federation of Americans Supporting Science and Technology (FAAST) has submitted a proposal to NASA entitled " A National Clearinghouse for Student Space Shuttle Payload Ideas". This proposal suggests the need for a clearinghouse of ideas related to the STS payloads as developed from student design competitions and proposals. This proposal deserves further consideration and possible implementation at an early date.

TASK 6 RESPONSE TO NASA QUESTIONS

As the Phase I studies began, NASA expressed interest in the early consideration of Phase II and later implementation programs. To arrive at some guidelines for Phase II, each of the Phase I contractors was requested to consider the following request from NASA:

> "The scope and content of the implementation and refinement portion (Phase II) of the program plan will depend upon what we learn during Phase I, but we must begin now to think in general terms about Phase II. Accordingly, I would like for you to give some consideration to the following general questions and discuss your opinions to date on them."

It was difficult to arrive at final answers during the Phase I studies, but additional efforts will help to develop a more refined answer. The questions and tentative answers to them follow below:

1. Q: How soon is a New User Function (NUF)* needed?

   A: Two basic educational elements are required within the NUF. One concerns itself with education about space exploration and related STS capabilities. The other relates to applying the STS capabilities and technologies to all educational areas for the improvement of teaching and learning.

   The first element is needed immediately to develop wide-spread positive attitudes about STS and enthusiasm for its utilization. All potential users will be affected by this educational approach.

   The second element should begin as soon as the full capabilities of the STS for educational applications can be defined and disseminated.

*For the purpose of this study, the acronym NUF is defined as that organization and/or those activities subject to the policies and philosophy of NASA, which will actively pursue potential STS uses and users in the educational community. Such a function may be located within the structure of NASA or outside of it in the form of a "middle-man" organization, as described in other Phase I studies.

2. Q: What are the skills needed for the NUF? Where obtainable?

A: General research and marketing capabilities and a working knowledge of educational community are necessary here, as they are in the commercial sector. A listing of skills required and potential sources are listed below:

Skill Requirements	Where Obtainable?
• Administration	• NASA - Industry - Education
• Market Research and Planning	• Research Institutions - Consultants
• Educational Consultants	• Research Institutions - Education - USOE
• Futures and Planning Research	• Research Institutions - Universities
• Educational Systems Research	• USOE - Universities - Consultants
• Educational Technology Research	• Industry - Research Institutions - NASA
• Educational "Software" Research	• Industry - USOE - NASA
• Management Information Systems	• NASA - Industry - Universities
• Marketing	• Industry - Consultants
• Customer Relations	• Industry - Consultants
• Public Relations	• Industry - NASA - Consultants

3. Q: What is the nature of the NUF? What is needed to operate it?

A: The NUF should be a broadbased marketing organization designed to engage in research, liaison and coordinating activities with the educational community. Personnel, facilities, resources and a basic philosophy dedicated to the worthiness of education as an important user are needed.

4. Q: What are the market categories? What are the differences in NUF for these categories?

A: The educational market categories have already been broadly defined in Task I of the study. In addition to the basic needs common to all levels, each category has certain unique problems. A variety of methodologies and staff approaches will be required for each of the levels. NASA might consider the possibility of using three separate staffs, each dealing with a separate educational level.

5. Q: How can NUF tell when to stop or accelerate pursuit of use or user?

A: For educational innovations to be accomplished, the proper climate for change must be established. Constant research and value judgments will help to determine when the Congress and public, as well as educators, are ready for change and innovations.

The entire social climate in academic, governmental, and industrial sectors will need to be assessed and close liaison between them will be essential. As the sampling functions of the developed methodologies are used, a clearer understanding of the opportune time for program implementation can be realized.

6. Q: What are the time phase actions to implement NUF?

A: The prioritized implementations of the NUF are addressed in Question I. NASA decisions about the STS capabilities and overall marketing policy are the key factors which can determine answers to most of these questions. By providing a high priority to educational programs and encouraging early implementation of these programs in the STS mission and payload operations, it is believed that user interest and applications can be enhanced and enlarged in all potential user sectors.

ED-PLUSS STUDY CONCLUSIONS

The research efforts of the ED-PLUSS team have led to the following conclusions concerning the educational community and its potential relationship to the STS.

- Based on a study of the number of people involved, the amount of money expended, and the many basic needs of education, it is concluded that the educational community can be a substantial user of the STS capabilities.

- Evidence from the study of the literature shows that both industry and government participate in and benefit from education. This relationship is so close that education could be said to be the base on which the others rest. Consequently, any implementation of a high priority program for education should increase interest in STS in all sectors of American life.

- A basic constraint to innovation in education is the long time span required to bring about a major change in methods and curriculum. The present lead time in the development of the STS is compatible with this condition and presents an opportunity for NASA to accomplish two goals - develop significant educational applications and develop the market at the same time.

- The study has identified the educational community as a huge and complex entity. All levels, particularly Level III, need a more detailed in-depth study for potential uses and users than was possible in this Phase I effort. Level III apparently has the largest potential number of applications and available resources for STS payload capabilities.

- Education is very diverse and complex in nature. There are so many different possible uses and combinations of users that it appears necessary to develop a series of methodologies to link specific STS capabilities to specific educational objectives and requirements.

- As stated before, education can be a substantial potential user of the STS capabilities. The size of the user community will depend on the number of capabilities developed and the depth of understanding the educational community has of their applicability.

ED-PLUSS STUDY RECOMMENDATIONS

Any conclusion derived from a study can be a basis for a valid recommendation. These recommendations relate directly to the foregoing conclusions. The ED-PLUSS team recommends:

- that NASA should immediately begin an effort to include education as an integral part of the STS program.
- that educational applications of the STS capabilities should receive high priority from NASA, as both a key user and a catalyst for all STS user sectors.
- that development of educational applications (particularly telecommunication and educational utilization programs) for STS capabilities should begin immediately.
- that NASA should initiate an in-depth study of Level III and its potential as a significant user of the STS.
- that NASA should develop a series of methodologies to link specific STS capabilities to specific educational objectives.
- that NASA define all possible STS capabilities and initiate programs to broadly disseminate these capabilities to educational institutions.

APPENDIX A

IDENTIFICATION OF

POTENTIAL EDUCATIONAL USERS OF STS

Appendix A

Identification of Potential Educational Users of STS

In order to formulate a methodology that will enable the organizational structure of NASA to interface more effectively with educators, a clear picture of the diversity and scope of the educational community is necessary.

The organizational structure of education represents an unusual dichotomy. Administratively, it is tightly bound to a rigid structure determined by the legislatures of the various states and must operate within these limits. Functionally, it is fragmented into an almost bewildering variety of local, state, regional and national purposes, goals, and needs which shift and change with the dynamic society surrounding them.

In order for a methodology to be effective it must take into account all pertinent characteristics of the level for which it is designed. The purpose of Task I is to define these levels and their characteristics in such a way that the methodology will function more effectively.

During 1973 some 63 million people were involved in education on a full-time basis in the United States.[5;15*] These people were working or participating in two general educational levels, which have been identified in this study as Levels I and II. Level I includes all organized programs through the secondary schools (students of age 3 to age 18), and a Level II consisting of junior, technical, and community colleges, and four-year colleges and universities. (See Figure 7). All other people and all other schools or programs of learning of various types are identified as Level III. Theoretically, this would include most of the remaining two-thirds of the population of the United States. See Figure 8 for a listing of typical categories of institutions in these levels.

On the average, 26% of a person's life is spent in Level I, about 7% is spent in Level II (assuming higher education attendance), and 67% is spent engaged in Level III educational activities (based on 70 year life expectancy). In Level III,

* This refers to the reference number and the pages cited.

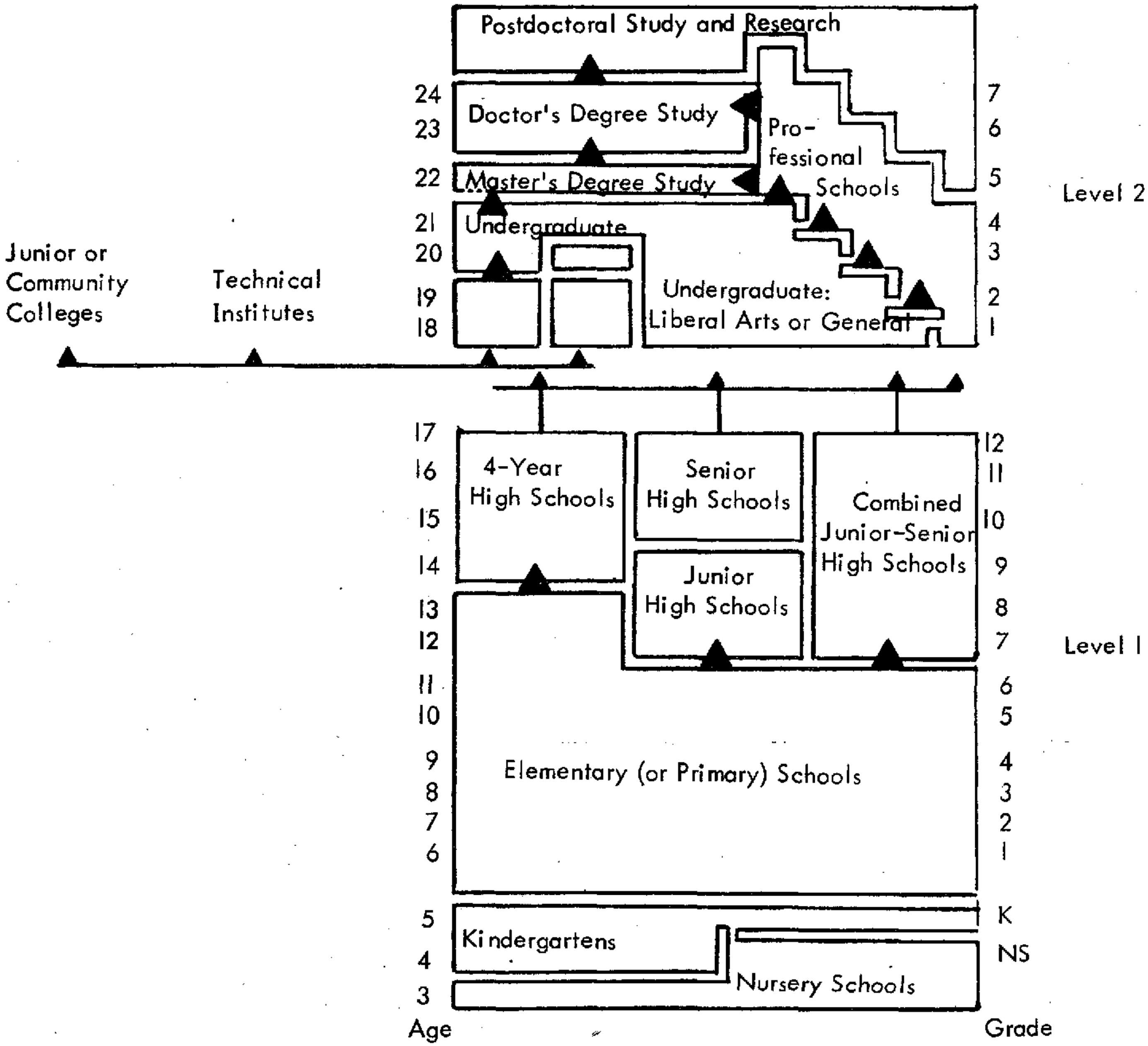

Figure 7. The Structure of Education in the United States.

GRADE SCHOOLS (LEVEL I) PUBLIC AND PRIVATE

- EARLY CHILDHOOD
- ELEMENTARY SCHOOLS
- MIDDLE SCHOOL
- SECONDARY SCHOOL

HIGHER EDUCATION (LEVEL II) PUBLIC AND PRIVATE

- JUNIOR COLLEGES
- TECHNICAL INSTITUTES
- COMMUNITY COLLEGES
- LIBERAL ARTS COLLEGES
- LAND GRANT COLLEGES
- MULTIPURPOSE UNIVERSITIES

OTHER (LEVEL III) PUBLIC AND PRIVATE

- ADULT/CONTINUING EDUCATION
- VOCATIONAL/TECHNICAL EDUCATION
- CORRESPONDENCE SCHOOLS
- MILITARY TECHNICAL SCHOOLS
- EDUCATION IN INDUSTRY

Figure 8. Educational Levels and Typical Categories

people may acquire educational activities such as: 1) on-the-job training for career development, 2) retraining for career changes and/or advancement, 3) broadening knowledge about one's roles and relationships within a dynamic world system, and 4) enhancement of existing skills and development of new skills and interests in support of leisure time activity.

Level I Description and Characteristics

This level consists of four rather well defined categories. Each of these categories will be given a cursory description followed by some of the pertinent characteristics as they relate to this study.

Categories in Level I - The four categories are presented in order from the lower to the upper age limit as found in the emerging organizational pattern.

- Early Childhood Education - This is a pedagogical specialty dealing with children in their youngest, formative years. The upper age limit is generally recognized to be six years, by which time the child has entered the formal educational process. Because of the ages of the children involved it appears likely that most education of this group will take place outside formal school groupings, although many public school systems have kindergarten classes for five year olds. The kindergarten program will continue to expand. The home, day care centers, and nursery schools are the centers for education most likely to have the greatest expansion in early childhood education. Nursery schools, kindergartens, and in-home experiences are organized for the purpose of providing children of pre-school age valuable learning experiences. These are intended to make entrance into the first grade easier and help promote a pattern of success in school work. This is especially important in the first grade where many patterns of success or failure are formed. It must be noted that not all states and school systems have early childhood programs. The national trend is in this direction, however.

- Elementary Education - With the emergence of the middle school concept, grades one through five are becoming known as the elementary grades (also referred to as primary grades). Many schools, though not all, separate this category's programs from the others because of the particular physical, psychological, and social needs of these children. Here we find the beginning of structured activities which form their learning patterns, and broaden their social horizons to include the world and its people.

  Individualization of instruction in the abstract (such as reading and arithmetic) is emphasized. Diagnostic and prescriptive teaching styles lend support to information delivery systems which are designed to cope with the learning pace of the child. Special education programs to meet multi-variant needs of all elementary age children is still an unrealized goal that has been given more realistic attention in the last decade.

- Middle School Education - This emerging category includes children in grades six through eight. The name "Middle School" is replacing the "Junior High School" and includes one and in some cases two of the former elementary grades, namely five and six.

  The onset of puberty brings physiological and psychological changes that present different educational challenges and objectives. Usually, but not always, plans are made to give these children separate facilities designed to enhance educational programs to assist the learner in this period of transescence. The general recognition of the inadequacy of programs to cope with the traditional adolescent (pre to post puberty) period has brought this about.

- Secondary School Education - Grades nine through twelve are considered as the high school or secondary school. The comprehensive high school provides a variety of educational opportunities for the student in academic, industrial, vocational, and career pursuits. Other secondary programs provide separate schools (industrial and vocational) to meet specific educational needs and goals.

Students in this category are quite mature. Their needs and interests more closely approximate those of adults. Many of these students are actively involved in their career goals while others are exploring career opportunities.

Population: Status and Trends

For an overview of the population trends in Levels I, II, and III, see Figure 9.

- Early Childhood Education - In October, 1972, there were about 10.16 million children eligible for some form of early childhood education. Of those eligible, over 4.23 million were enrolled in an organized program. [1;2]

  In the Western states 48.2% of those eligible were enrolled. In the North Central and Northeastern states 43.4% of those eligible were enrolled. Of the eligible children in the Southern states 35.4% were enrolled in early childhood education programs. (See Figure 10). Eligible children seem to be concentrated in suburban and rural areas, with enrollment highest in urban centers. Since 1964 the percent of three to five year old children enrolled in early childhood education has increased steadily. [1;2]

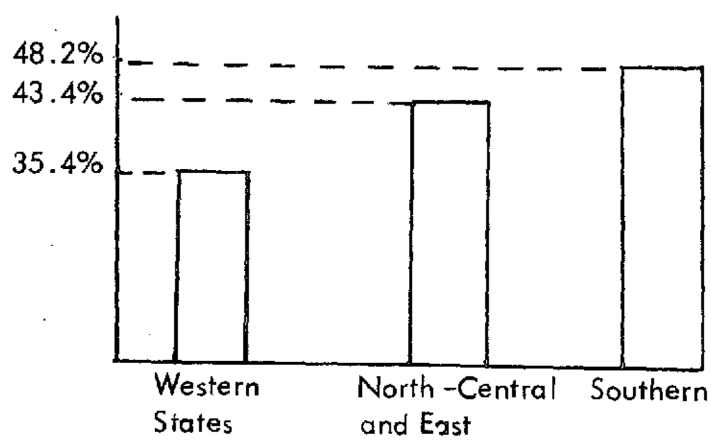

Figure 10. Percentage of Eligible Children Enrolled in Early Childhood Education Programs by Region.

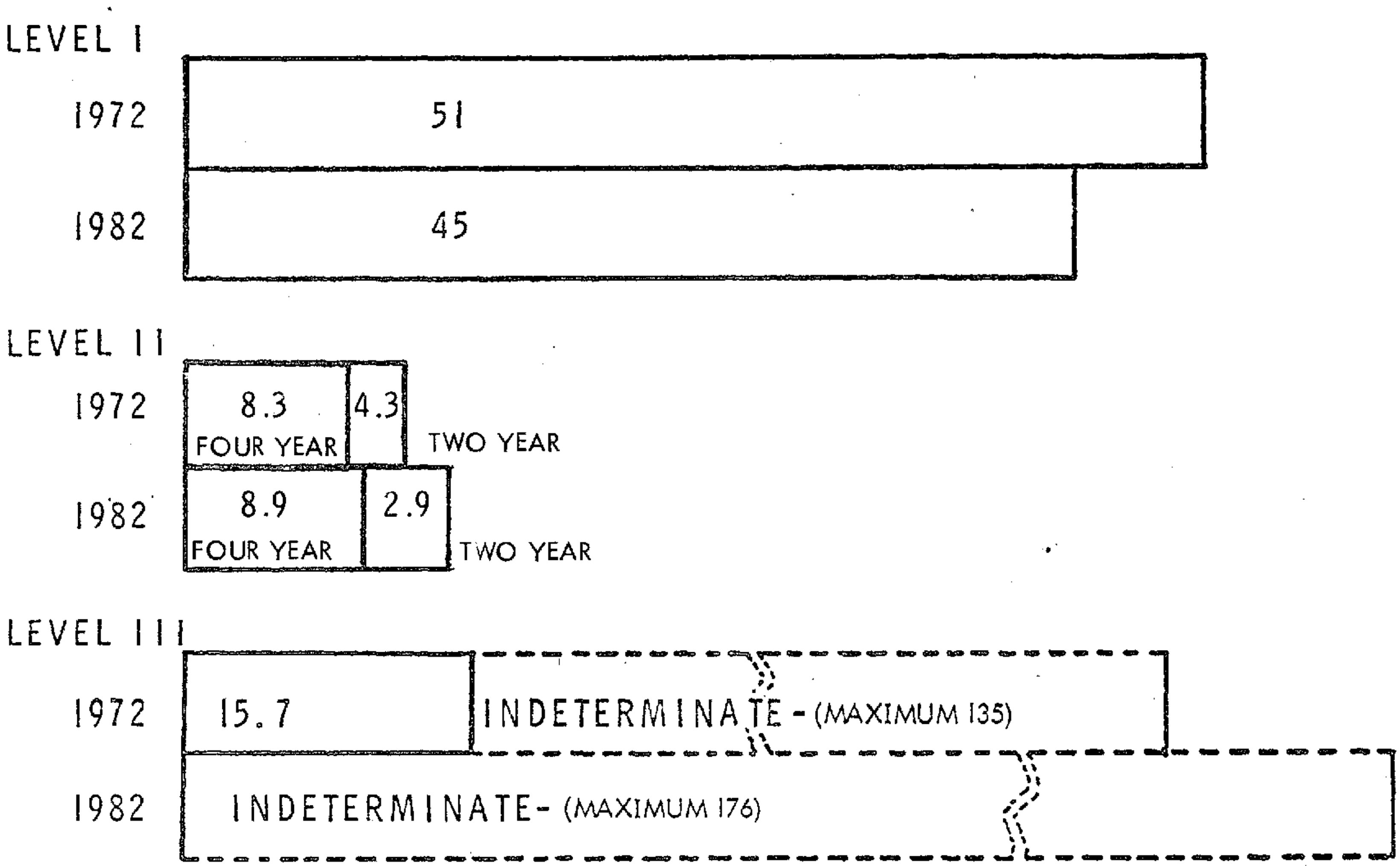

Figure 9. U.S. Participation in Levels of Education
(In Millions of People)

Publicly controlled programs are shown to be of particular importance at the kindergarten level. More than 80% of all children enrolled in kindergarten attended public schools. In contrast, nearly 70% of the children in prekindergarten attend nonpublic programs.[1;4]

The lower rate of participation of five year olds in early childhood education in the South is related to the small number of public kindergarten programs in the region. Enrollment rates of three and four year olds in the South are relatively comparable with three and four year olds in the other regions.

Due to the unique nature of early childhood education programs, the potential user community consists of 1) the preschool children themselves, 2) their parents, and 3) the teachers of preschool children. Early childhood programs are usually designed to include each of these three audiences.

- Elementary through Secondary School Education - The elementary and secondary school population was near 45 million in 1962. It peaked at approximately 51 million in 1972, and is projected (if present trends continue) to drop to 45 million by 1982.[13] Of the 51 million in 1972, approximately 20 million children* were in elementary grades one through five; some 13 million children were in middle school grades six through eight; and about 18 million students were in secondary school grades nine through twelve.[14;18]

  As a result of economic, social, and medical programs related to family planning and population control, we find that 1974-75 is the first year of significant decline in first grade population. If the U. S. economy cycles toward economic recession, or depression, these trends may be accelerated.

  As would be expected, the greatest number of school children are concentrated in the more industrialized areas where most adults are located, as shown on the following page:

*Includes available kindergarten statistics.

California	-	4.66 million
New York	-	3.47 million
Texas	-	2.68 million (sheer size affects this)
Ohio	-	2.38 million
Penn.	-	2.31 million
Illinois	-	2.26 million
Michigan	-	2.01 million 3;xx

Financial Resources: Status and Trends

For an overview of the financial resources in Levels I, II, and III, see Figure II.

- Early Childhood Education - Funding for most early childhood education programs originate at the state or local level and is not readily comparable between or within states. Many centers for these children are privately owned or sponsored and are most frequently located where public supported programs are not available.

  In 1973 the Federal government, through the Office of Child Development, funded early childhood education projects at a level of 230 million dollars. 12;66 Only federal funds, with a possible assist from foundations, will be able to finance national programs, which seem to be the least expensive in terms of per-child cost. This is because of the total number and areas served. Many proponents believe federally funded programs may be necessary in order to combat effectively the numerous social problems in dealing with children from exceedingly diverse ethnic and economic backgrounds.

  With the exception of national funding, the basic source of financial support is derived from tuition and fees paid directly by the parents involved.

- Elementary through Secondary School Education - The increasing cost of education in this category is evident in the spectacular rise in expenditures during the last decade. From 22 billion dollars in 1962, the annual cost has risen to 57 billion in 1972. In terms of 1972-73 constant dollars, it is expected to rise to 70 billion dollars per year by 1982-83 in spite of an expected drop of nearly

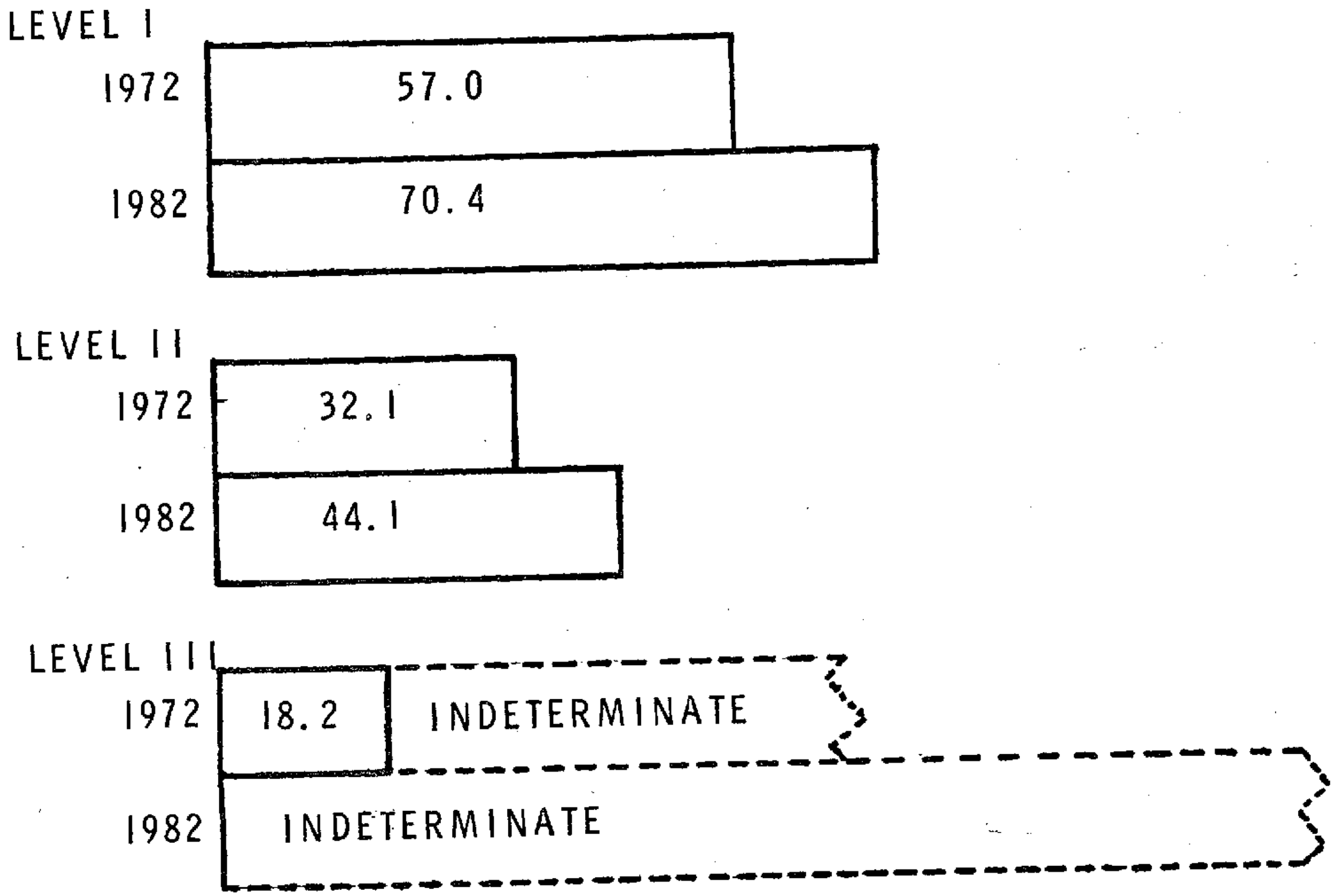

Figure II. U.S. Expenditures For Education
(In Billions of 1972 Dollars)

11% in student enrollment.[13] This increase in cost with declining enrollments reflects new programs, new and different technology, and expenditures of more dollars per pupil for a better education.

Financial support of elementary and secondary schools by various sources of funding is indicated by the approximate percentage of contributions from each source: 1) Local governments, 49.3%, 2) State governments, 37.8%, 3) Federal government, 8.6%, 4) foundations, 3.1%, and 5) personal gifts and bequests, 1.2%. (See Figure 12).[16;21]

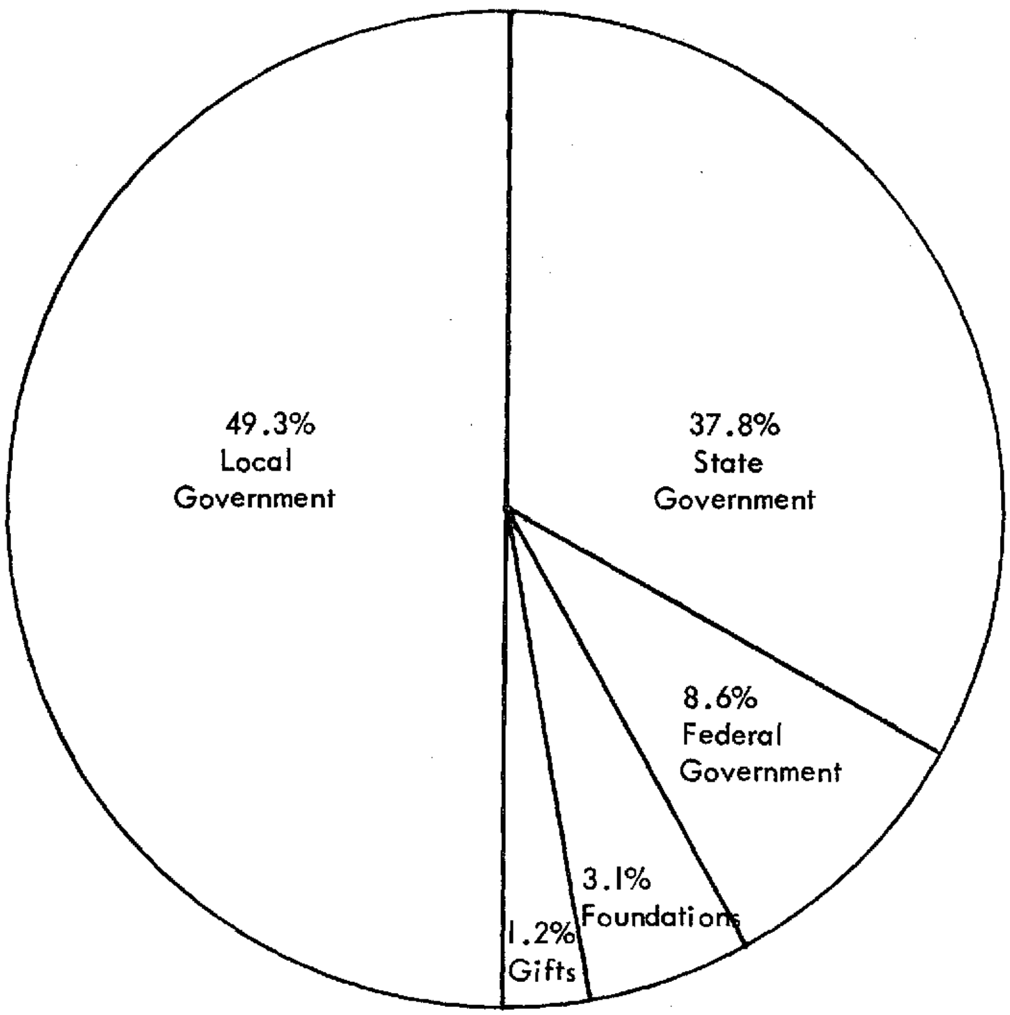

Figure 12. Sources of Funding for Elementary and Secondary Schools.

State governments usually are only obligated to provide a certain minimum of funding. There is no limit on the contribution of local governments to their schools. There is a trend in the country, begun in recent years, toward a more equitable distribution of local tax income between rich and poor schools in each system, and a tendency for federal pressure toward the same redistribution within or between states. The effect of this development on the total public funding of schools in the future is difficult to ascertain, but where trends toward providing more equal educational opportunity have shown increasing support from local to the state level, the future portends a trend from state to national funding.

Human Resources: Status and Trends

- Early Childhood Education - Both parents and teachers are intimately involved in early childhood education. Approximately 785 thousand kindergarten teachers and the parents of the 4.2 million children are the primary adult population playing a strong role in early childhood education.[1;2] Other staff members of these programs include administrators, paraprofessional aides and volunteers; information on numbers of these people is unavailable.

- Elementary through Secondary School Education - There were 2.5 million professional persons employed in the public and private elementary and secondary schools in 1971. These included principals, supervisors, librarians, guidance and psychological personnel, and classroom teachers. Of the total number, 91% were classroom teachers.[2;63] The number of public elementary and secondary school teachers is expected to rise from an estimated 1.8 million in 1971 to around 2.2 million in 1982.[13] The trend in non-public elementary school is downward, with the number of secondary teachers remaining constant.

  The total demand for additional public elementary and secondary teachers includes additional teachers needed to allow for enrollment changes, for lowering teacher-pupil ratios, and for replacement of teachers leaving the profession.

Level II Description and Characteristics

Level II is composed of two identifiable categories. First, there are Junior, Technical, and Community Colleges. Second, there are four-year Colleges and Universities. Each category will be described and identified, along with some characteristics.

In the United States there are 2,665 institutions of higher learning (based on 1973 statistics). Of these institutions 964 offered curricula for at least two years, but less than four years beyond high school.[6;90] The remaining institutions offered four or more years of advanced study. The distribution of these institutions parallels the distribution of population. California, New York, and Illinois have the largest number of colleges and universities.

Categories in Level II

- *Junior, Technical, and Community Colleges* - Occupational training after high school, or at the post-secondary level of instruction, has increased in availability with the rapid growth of the junior college. The increased prevalence of these institutions is perhaps due to their growth as a continuation of public school systems, thus giving rise to the term "community college", although junior colleges may be privately controlled. A junior college is considered an institution of higher education which offers divergent instructional options to students. College courses which are transferable to senior colleges, and liberal arts education courses are available in most junior colleges. In addition, terminal vocational training in technical and semi-professional programs are also available.

  Junior college instruction is usually for two years duration. These institutions do not grant baccalaureate degrees although they do award associate degrees or certificates of completion for occupational programs.

Another choice for the post-secondary vocational student is the technical institute. This category provides vocational/technical training in one or more areas of specialty at the post-secondary level.

- Colleges and Universities - In order to offer the highest degree of professional certification possible and to provide education and services to the people of this nation, the following three types of colleges and universities have evolved:

  - Liberal Arts Colleges - The liberal arts college has the deepest roots of all institutions of higher learning anywhere in the world. In medieval days, its curriculum consisted of the traditional liberal arts. With the passage of time, the curriculum has been altered by social change, absorbing selected aspects of the humanities, the social sciences, and the natural sciences.[15;362]

    Liberal arts colleges in the country total approximately 800. Most are privately controlled; proportionately fewer are publicly supported. Enrollments in liberal arts colleges are typically small, running in most instances from 200 to 500 students. Until the turn of the nineteenth century, the liberal arts college was a dominant force in higher education in the United States. Since that time, however, the public university has assumed preeminence.[15;362]

  - Land-grant Colleges - Like the junior college, the land-grant college is an institution native to the United States. The Morrill Act of 1862 brought it into being. Under provisions of the act, the federal government granted to each state for each congressman 30,000 acres of land, or the monetary equivalent thereof, with a stipulation that the proceeds be used to establish Agricultural and Mechanical Colleges. The governing principle was that higher education should be practical as well as theoretical, and should be for immediate as well as ultimate application. Some of the evolving institutions became independent state colleges; however, most of these later became specialized universities. Others emerged as parts of all-purpose state universities. A second Morrill Act, in 1890, led to establishing colleges for Negroes throughout the South.

- The Multipurpose University - The multipurpose university is an academic community that embraces within its confines a number of independent schools and colleges. The nucleus of every university is a liberal arts college that functions both autonomously and contiguously. It is autonomous in that it functions as a college in its own right. It is contiguous in that it serves the general education needs of a university's specialized schools and colleges. In the larger universities these schools and colleges include the following: agriculture, architecture, business, dentistry, education, engineering, hotel management, journalism, law, medicine, music, nursing, public administration, speech, and graduate studies.

Population: Status and Trends

In 1962 about 54% of the total population entered college; in 1972, the figure was nearly 58%. This percentage is expected to decline slightly to approximately 57% by 1982.[13] It is considered unlikely this percentage will increase much more, because of the existence of alternative sources of learning. As costs of higher education in colleges and universities increase, alternatives will become more attractive and the possibilities for space related communication technologies may likewise become more feasible.

- Junior, Technical, and Community Colleges - There are 964 two-year colleges operating in the United States. The estimated enrollment, including vocational-technical students, is 2.9 million.[2;28-32] The majority of vocational/technical students are enrolled in courses specifically designed for career preparation. The majority of the total student population is enrolled in distributive education, clerical curriculums, technical fields, and industrial trades.

By 1981, the number of students in two-year colleges, excluding vocational/technical institutions, is projected to increase to 4.3 million.[21;28-32] This figure includes both degree and non-degree candidates. Approximately one-half will be female students. Statistics indicating projections of student enrollment in vocational/technical institutions are not currently available.

- Colleges and Universities - In the United States there are 1,542 four-year degree granting institutions. Of the four-year colleges, 355 are publicly supported and 1,187 are privately operated. There are 159 universities of which 94 are publicly supported and 65 are privately operated.[6;90]

  In the fall of 1973, 8.3 million students were enrolled in courses leading toward a degree. By 1982, this figure is projected to expand to 8.9 million. According to a 1972 study approximately one-third of the students were female. By 1982, the female percentage is projected to increase to one-half of the student population.[2;26-30]

Financial Resources: Status and Trends

In the HEW source Projections of Educational Statistics to 1981-82, statistical and fiscal information for Junior, Technical, and Community Colleges and Four-year Colleges and Universities are combined for purposes of projection into the 1980's.

Three categories of expenditures by institutions of higher education of value to STS are identified:

- Student education - Includes general administration, instruction, and departmental research, extension and public services, libraries, operation and maintenance of the physical plant and sponsored activities such as training institutes and related sponsored activities which were specifically financed by outside sources.

- Organized research - Includes all sponsored research and other separately budgeted research. Does not include expenditures of federally funded research and development centers.

- Related activities - Includes expenditures for such categories as laboratory schools, medical school hospitals, dental clinics, home economics cafeterias, agricultural college creameries, college operated industrial plants connected with instructional plants but not actually a part of them, and all other expenditures for educational and general activities which are not specifically identified as expended for "student education" or organized research. (Figure 13). [2;99-101]

	1971-72	1981-82 (projected)
Student education	16.6	29.2
Organized research	2.6	4.0
Related activities	.8	1.5

Projections of expenditures in higher education
(in billions of dollars)
Figure 13.

Human Resources: Status and Trends

In the HEW source, Projections of Educational Statistics to 1981-82, statistical information for Junior, Technical, and Community Colleges and Four-year Colleges and Universities are combined into a single category labeled "Higher Education" for purposes of projection into the 1980's.

In the fall of 1971 there were an estimated 479 thousand full-time equivalent instructional staff members in all institutions of higher learning. In the fall of 1981 this figure will reach 635 thousand. [2;75]

Level III Description and Characteristics

During the search for information on Level III education, a lack of uniform demographic data was evident. Even an organization like the National Industrial Conference Board of the National Association of Manufacturers was unable to provide data on industrial education activities. The representative interviewed cited, among other reasons, the reluctance of business to provide information they considered proprietary. As a result, U.S. Government statistics quoted in a recent NASA study conducted by Washington University, St. Louis, Missouri, provided a major source of data for this study. Also, the format for this section was somewhat altered, as compared with Levels I and II.

Adult Continuing Education

The U.S. Government estimates that approximately 13.2 million Americans participated in adult education activities for the year ending in May, 1969. This was the last year for which statistics could be located. Geographically, adult enrollment is heaviest in California, Florida, Illinois, North Carolina, and Texas.

Adult education classes are offered at a variety of locations, including prisons, hospitals, churches, community centers, schools, and on-the-job facilities. A great deal of adult education, though not of a formal type, occurs in the home via the Public Broadcast System and numerous state and regional educational television (ETV) networks. Commercial programs and documentaries, such as the coverage of the space programs, give much information of an educational nature to American adults.

Adult education encompasses a broad range of educational experiences that may not lead to a formal degree. Educational activity for adults may take the form of a workshop, a course pursued for personal enjoyment or interest, or a lecture series, to itemize only a few of the options. The duration of the experience may be a few hours, a few days, a few sessions, or a defined period of time (i.e., a semester).

In 1966, the National Center for Educational Statistics conducted a survey of noncredit, adult activities offered through Level II schools. The survey found 6.5 million registrations for activities of this nature, but cautioned the reader that the data were very often affected by underreporting. Particular reference was made to radio and TV instruction, offerings of urban and community affairs, bureaus, refresher courses, short-term professional seminars, offerings of religious institutions, and activities of university extension services. Since the tally was made of registrations rather than individuals, there is also the possibility of having an individual registered for more than one activity.

State grants are the means of converting federal expenditures into program facilities, including curricula, staff, and additional essential services. During FY 1972, federal appropriations for state grants equaled 51.1 million dollars. Teacher training grants are for institutions training adult educators and other related personnel. During FY 1972, teacher training grants totaled 3 million dollars. Special project grants are let to local educational agencies, including ETV stations, for programs providing a coordinated approach to the target audience or for innovative approaches to adult educational activities. Funding available for special project grants during FY 1972 equaled 7 million dollars. The combined federal expenditure for adult education during 1972 was 61.3 million dollars.[16,49]

Vocational/Technical Education

Vocational/technical education has widely scattered target audiences; potential students may not be within the formal school structure but are often isolated from resident learning centers, disenchanted with formalized education, or home-bound for an assortment of reasons.

In 1970, according to HEW statistics, there were nearly 8.8 million students enrolled in vocational/technical education programs at all instructional levels. Approximately 2.7 million students were involved in Level III programs.

During FY 1972, a grand total of approximately 2.7 billion dollars was spent by government agencies on vocational/technical education. Of this, .47 billion dollars was spent by the federal government and 2.2 billion dollars was spent by state and local governments.[16;vi] Approximately one-fourth of the 2.7 billion dollars was expended in Level III.

Correspondence Schools

Those students receiving instruction at home are most likely to be correspondence school students. Correspondence schools may be either extension services of colleges and universities or privately owned schools operated for a profit. However, a variety of institutions have employed the correspondence technique; the military, private business and industry, agencies within the federal government, and, to a lesser extent, labor unions.

The three biggest suppliers of the home-study market are the military, proprietary correspondence schools, and extension divisions of institutions of higher education. A 1965 survey conducted by the Correspondence Education Research Project, based upon figures furnished by institutional suppliers, showed 60.2% of the home-study market was for military correspondence schools, with 8.2% for extension divisions of colleges and universities. The U.S. Armed Forces Institute (USAFI) was listed separately from the armed forces, apparently because USAFI is described as offering educational courses for the benefit of the military personnel. Due to the tenuous nature of the statistics of correspondence school enrollment, no accurate figures are available, but it is predicted to be large.

Industrial Education

This category can be defined as the education and training of industrial employees for the purpose of improving their job performance. It is sponsored and funded by the employer and takes place either in classrooms provided in the plant or company premises, in local educational institutions, or by some form of correspondence study. The course content is selected for its applicability to the solution of company problems. For example, an engineer might be given a course in advanced calculus to enable him to improve the design of a product. A janitor might be sent to school to expand his knowledge of safety methods in the plant. Top administrative personnel might take courses designed to improve their ability to manage. Normally, only job related courses are funded by the company.

An estimated 15 billion dollars was spent by industry on all forms of education in 1972.[5,15] This is probably a conservative figure since it is very difficult to get companies to divulge exact educational expenditures, if indeed, it is possible for such figures to be accurately determined.

Perhaps the best way to describe a typical industrial education program is to analyze one in existence. A good example would be the Self-Development Program of the Rocketdyne Division of Rockwell International Corporation.

In the mid 1960's, it was determined that additional employee educational assistance was desirable to meet company objectives. It is interesting to contemplate why such programs had not been instituted before this time in so large a company. Perhaps increased demands due to larger commitments to the aerospace industry and shortages of experienced engineering talent brought the need to a head.

The program was launched in 1965. Company conference rooms were converted to classrooms. Courses were designed around the specific needs identified by the company. A review of course titles reveals the aerospace oriented nature of the business of Rocketdyne. For example, one of the courses, "Combustion Theory Applied to Liquid Rocket Engines", is typical of the orientation of the curricula. Surveys were made of the employees to locate potential instructors already working at the plant; many were identified, and selected individuals were given instructional responsibilities. Classes were held after hours, and attendance, while not compulsory, was encouraged for anyone whose job related to the course offered.

Twelve fields of study were opened to employees which related directly to the solution of company problems. In time, the education program expanded and the company made use of local educational institutions whenever possible. The cost of tuition was borne by the company and the cost of materials by the individual. Much of the training took place at local colleges or adult education centers because of their low or free tuition.

After the on-premises programs were established, the company presented a series of seminars designed to bring engineers and other personnel up to date on the latest technology and "state-of-the-art" developments. These seminars attempted to reduce the time lag between the development of new knowledge and its use in the company.

A Programmed Instruction Laboratory was also established where employees could study at home or in the plant. As these self-teaching courses were developed and introduced, the company found that cost savings were realized due to the reusability of materials and the reduced need for instructors.

In one local educational center, 250 Rocketdyne employees attended classes in one fiscal year. In 1969, the company reimbursed employees for more than 1000 courses taken at local colleges.

The management of Rocketdyne has expressed a high level of satisfaction with their Self-Development Program. They have also recommended that any company contemplating such programs make extensive use of local educational institutions and provide what classes are necessary on the company premises, along with correspondence and programmed instruction offerings.

Companies having many widely scattered divisions and branches are likely to find that techniques of instructors and quality of instruction varies considerably from place to place. Some of the remotely located employees of these large companies, such as oil company drillers located on drilling rigs at sea, might need course work that would require considerable interaction between instructor and student and not have access to a classroom. It would seem probable, therefore, that large companies may benefit from the utilization of educational programs broadcast by satellite telecommunication systems which the STS could help to provide.

The discussion of Level III describes in very general terms the educational characteristics of industry and the military as a part of a general adult education market. The sources of material did not address themselves to how industry, business, and the military might meet their needs to: 1) train new employees, 2) re-train and up-grade older employees, and 3) to give employees at a distrance from the home plant an equal chance at training in terms of telecommunications.

Large industries, both national and multi-national, businesses with multiple branch offices, and military organizations have certain communication needs that could be considered educational:

- Need to transmit operational data between branch offices and the home office
- Need to transmit training programs between branch offices and the home office
- Need to connect management for conferences between branch offices and the home office.

Future capabilities of STS are not clear at this time, but presently conceived capabilities include the placing in high earth orbit satellites large enough to permit this kind of communication on a global scale.

The possible applications of satellites to these needs include 1) a dedicated educational satellite system serving all three identified levels on a purchase-of-time arrangement, 2) each enterprise provided a satellite (at its own expense), or 3) each user being responsible for purchasing time from a commercial satellite system.

Military Education

Another significant proportion of the Level III population is receiving education and training in some branch of the military service. Much of this is done in Level II schools for degree credit and thus is a part of Level II information. The rest is done in service academies, military training centers, and service technical schools.

Interviews with Department of Defense personnel have established the fact that this department has prepared STS mission models which include educational applications. As a result, the study of military schools for potential utilization of the STS is considered to be outside the scope of this report.

References

1. Barker, Linda A., Preprimary Enrollment. Elementary and Secondary Surveys Branch, National Center for Educational Statistics (N.C.E.S.), Dept. of H.E.W., Washington, D.C.: Government Printing Office, 1973.

2. Simon, Kenneth A., ed., Frankel, Martin M., ed. Projections of Educational Statistics to 1981-1982, N.C.E.S., Office of Education, Dept. of H.E.W., (O.E.) 73-11105, Washington, D.C.: Government Printing Office, 1972.

3. Williams, Jeffry, Warf, Sally. Education Directory, 1973-1974 Public School Systems, N.C.E.S., Dept. of H.E.W., (O.E.) 74-11701, Washington, D.C.: Government Printing Office, 1974.

4. Du Molin, James R., Morgan, Robert P. An Instructional Satellite System for the United States: Preliminary Considerations, Washington University, St. Louis, Mo., July 16, 1971.

5. Matson, Wayne R. "Aerospace Education: An Overview", Aerospace, V. 12, No. 1, February, 1974.

6. Grant, Vance W., Lind, George C. Digest of Educational Statistics, N.C.E.S., Office of Education, Dept. of H.E.W., Washington, D.C.: Government Printing Office, 1973.

7. De Young, Chris A. American Education, New York: McGraw-Hill Book Co., 1960.

8. Horrocks, John E. The Psychology of Adolescence, Atlanta, Ga.: Houghton Mifflin Company, 1962.

9. Poole, Hazel C. Education Directory - Higher Education, N.C.E.S., Office of Education, Dept. of H.E.W., (O.E.) 74-11404, Washington, D.C.: Government Printing Office, 1974.

10. Van, Til, William. Education: A Beginning, Atlanta, Ga.: Houghton Mifflin Company, 1971.

11. Demerath, Nichols J., Daniels, Lois A. "How to Make the Fourth Revolution", Human Factors in the Adoption of Electronic Instructional Aids, Washington University, St. Louis, Mo., December, 1973.

12. Rothenberg, Donna. Early Childhood Education: Status, Trends, and Issues Related to Electronic Delivery, Washington University, St. Louis, Mo., May, 1973.

13. U.S. Department of Health, Education, and Welfare, Statistics of Trends in Education 1962-1982. Washington, D.C.: Government Printing Office: 19740-531-114, 1974.

14. Foster, Betty J. Statistics of Public Elementary and Secondary Day Schools Fall 1972, N.C.E.S., Office of Education, Dept. of H.E.W., (O.E.) 73-11402, Washington, D.C.: Government Printing Office, 1973.

15. Inlow, Gail M. Education: Mirror and Agent of Change, Atlanta, Ga.: Holt, Rinehart and Winston, Inc., 1970.

16. Rothenberg, Donna. Vocational/Technical and Adult Education: Status, Trends and Issues Related to Electronic Delivery, Washington University, St. Louis, Mo. January, 1973.

APPENDIX B

REPORT OF EDUCATIONAL CONFERENCE HELD AT

JOHNSON SPACE CENTER, HOUSTON, TEXAS

Appendix B

Report of Educational Conference Held at Johnson Space Center, Houston, Texas

Submitted by Dorothy K. Culbert,

National Science Teachers Association

The conference was organized by the National Science Teachers Association at the request of the National Aeronautics and Space Administration. The invitees included the twelve NSTA regional chairmen for the Skylab Student Project, plus other key educators, NASA personnel, and contractor personnel.

The broad objectives of the conference were:

1. To evaluate existing Skylab educational materials;
2. To make suggestions for future materials;
3. To make recommendations for incorporating these materials into the curricula with special attention to the methods used for distribution.

The agenda is attached to this report.

The conference was conducted informally. This report will group and summarize the points made on the various topics. The most important overall recommendations of the group form the conclusion of this report.

Prior to the conference each NSTA invitee was sent a set of the 7-volume NASA Skylab Experiment Series:

1. Physical Science, Solar Astronomy
2. Remote Sensing of Earth Resources
3. Materials Science
4. Life Science
5. Astronomy and Space Physics
6. Mechanics
7. Living and Working in Space

The meeting opened with a discussion of these publications. These volumes were prepared to provide a catalog of the science that would be available from Skylab so that the educational community could know what they could draw on. They were designed as supplementary materials. They were also prepared for the use of NASA itself. Some 80,000 were printed initially and then another 10,000 were printed for sale by the Government Printing Office. Most of these were distributed by NASA to their regular lists of people in the educational community, such as those who requested Skylab entry materials.

It was agreed that the books contained a wealth of valuable new materials which would enliven and enrich classrooms in the sciences, social sciences, mathematics, etc., but that a number of changes should be made in the materials in order to make them usable in schools today. When preparing materials for school use, it is desirable to keep in mind very clearly the purpose of your endeavor, how you perceive the materials are to be used, and one must be really familiar with what is going on in the classroom today.

It was suggested that a more appropriate distribution system be devised. It is essential to print the price of anything to be sold since a school purchase order cannot be written without a fixed price.

There is too much technical material in each book and they are too long to be used by most teachers. Teachers are interested in results as opposed to the mechanism of data gathering. The salient facts should be pulled out and presented in language all can understand. A sixth grade reading level is desirable to use. It is preferable not to label materials with a grade level since that limits use unnecessarily. If no level is designated, the market is extended into the college level. There is a great need for materials for adult education, continuing education, junior colleges, non-science majors, etc. There is a great need to get to the non-science people. Most importantly, to be useful, all supplemental materials should be aimed at the student, not at the teacher. In everything produced, aim to simplify rather than to increase concept difficulty.

There is little space in present-day science curricula for extra material. Therefore, new materials should be prepared with all those things in mind. They should stress a few things at a time, in language anyone can understand, and make use of some of the exciting results now available. It was urged that the services of a good textbook editor be utilized and that teacher evaluation be part of the preparation phases of any future work. A good teacher's guide with a series of leading questions, needed definitions, and answers to questions certain to arise would make these materials more useful and attractive. The present volumes will continue to be excellent reference materials for advanced students.

The situation in regard to Skylab Data was then reviewed. Data are coming out and will continue to come out for some time to come. Skylab investigators have the rights for first publication of most results, for a limited time. NASA plans for publishing include such things as a 16-page NASA Facts-type publication, a 14-page "Exploring Earth from Skylab," a spectral chart, and single topic publications on such topics as "The Sun."

It was recommended that NASA get review and feedback on any proposed publications from knowledgeable teachers on an individual basis. Publish new publications only with editorial advice. Further, explore new avenues for making these data available to teachers, such as through NSTA journals. NASA should also make an effort to get this new material to textbook publishers and stress that the material is in the public domain so that the new material will become incorporated into textbooks.

Astronaut Owen Garriot then joined the group and showed one of the five demonstration films he made on Skylab and answered questions about them. They are aimed at high school science classes. The topics are: "Magnetic Effects," Conservation Laws," "The Gyroscope," "Life Sciences," and "Fluid Behavior." Teachers' Guides are being prepared for each. Future guides could be improved by following some of the suggestions in this report.

The Marshall Space Flight Center has prepared a series of sixteen programs for Educational Television cooperatively with the Alabama State Department of Education.

These all relate Skylab activities to science education. The group viewed one of the early tapes. Marshall people feel that they learned a great deal from making the first series and that the new series will be improved.

The Johnson Space Center collection of materials was discussed. An index of scene titles is available and is being extended. The group viewed some of the available footage, a collection of clips put together by the Johnson Space Center to show the group the kind of thing available.

The comments on the audio-visual materials are again grouped. Owen Garriot was good on the film. He comes across well. If other astronauts project as well, they should be utilized in similar ways. More such films should be made. The materials from Garriot's films could be adapted to make brief pamphlets and perhaps super-8 loops to work into present-day courses.

The Johnson film clips were exciting. There are obviously such quantities of materials available that it was suggested that teams of teachers, chemistry teachers for example, be brought together on contract to go through the resources and select materials useful to their discipline. Teams of resource people would be required to do justice to all the footage. NASA expressed concern about time. The teachers felt that as far as the schools are concerned there is all the time in the world to utilize Skylab information.

How to get information from NASA centers is a problem to many people. The Marshall Center is under contract to produce an index of what is available. Educators can write to the Johnson Center and request photographs, negatives, etc. The letter must be on school letterhead and state that the pictures are to be used for educational purposes.

In all audio presentations, NASA was urged to be extremely careful in its handling of girls and minority students. Again, previewing by a sensitive teacher would avoid such pitfalls.

Suggestions for further new materials that would be desirable:

Work on getting data out where it can be used.
Determine a format for the use of data now, so it can be a continuing service.
Prepare a pamphlet for non-science students showing them the benefits derived from space exploration.
Make a 20-40 minute film on a general topic. This would appeal to as wide an audience as possible. Augment this film with shorter single topic films.

Whatever is done, do in bite-size pieces that can be used comfortably in one day to two weeks time in the classroom.

Better distribution of materials was discussed at length. NASA was urged to try a variety of routes and to explore new ways of getting the word out. In addition to the regular means in use at present, NASA was urged to use the Council of State Science Supervisors, The National Science Supervisors Association, Teacher Education Institutes, Directors of Teacher Institutes, such as those sponsored by the National Science Foundation, The U.S. Registry of Science and Mathematics Teaching Personnel maintained by the National Science Teachers Association, professional journals, and the newsletters of State Science Teachers Organizations.

Wider utilization of Skylab information could be achieved by greater involvement in NSTA State Chapter meetings, Drive-in Conferences, etc. Offers of free materials for such meetings would be welcomed as would offers of films so that a film festival could be held concurrently with such meetings. NASA could agree to furnish speakers and/or plans, and resources for such meetings or seminars. Efforts to work more closely with the meetings and publications of other professional groups, beyond science teachers, might prove fruitful.

The subject of promotion by a government agency always presents difficulties. However, NASA was urged to investigate buying space in professional journals to present some of this valuable material rather than hoping to have pages furnished free of cost. NASA was also asked to rethink its present policy in regard to press releases. Many Skylab releases would be better utilized in schools than they presently are in journals.

Specific recommendations were made in regard to the Skylab Student Project. NASA is preparing publication of the data from the student experiments to come out later this year. One of the students is preparing an article for submission to The Science Teacher. More of the students should be encouraged to write their own reports. Frank Tallentire is preparing an official report of the Student Skylab Project and will send the draft of his report to the chairman to review before it goes into final form.

The group went on record as supporting a student project as part of any future space program, in order to continue the momentum already built up by the Skylab project.

Members of the group offered their services for reviewing materials in the developmental stages. In addition specific persons agreed to send more complete reference lists to Frank Tallentire for his use:

Wiper	Biology
Noeske	Environmental Sciences
Ledbetter	Chemistry
Summerlin	Chemistry and Biology
Stein	Physics and Physiology

A formal expression of appreciation to NASA was made by the group for all the work already done on behalf of the education community, for the wealth of material available, for their interest in getting it out to the schools, and for their objective acceptance of the criticisms made of some of the materials already prepared.

Overall Recommendations

The most important considerations in the preparation of any new NASA materials are these main points which were made many times during the conference:

1. Materials should be student oriented, not teacher oriented.
   - (a) Any further materials prepared should be geared to the average child, not to the elite student. Sufficient material is already available for the elite. Teacher manuals should be prepared to accompany all materials and they should be complete.
   - (b) This requires careful attention to reading level so that both school children and the man on the street can understand them.
   - (c) Concentrate on themes that will help all to understand the input of the space program to everyday life.
2. Materials should be bite-size so that they can be integrated into present curricula (one day to two weeks maximum).
   - (a) Relevant materials are desirable.
   - (b) Format should be simple.
   - (c) Materials should be flexible and adaptable to a wide variety of educational situations. For example, social studies classes need materials to help them discuss intelligently the economic, political and ethical considerations of space science.
   - (d) These remarks apply to all materials printed materials, audio-visuals, project ideas, charts, etc.
3. The developmental stages of any further materials should include several important aspects:
   - (a) The target group should be included in testing before publishing.
   - (b) Editorial expertise at the level of entry into the market should be consulted before final publishing.
   - (c) Inner city people need both consultation and representation.

APPENDIX C

APPALACHIAN EDUCATION SATELLITE PROJECT (AESP)

REGIONAL PRESS CONFERENCE VIA SATELLITE

August 19, 1974

Appendix C

Appalachian Education Satellite Project (AESP)

Regional Press Conference via Satellite

On August 19, 1974, the Appalachian Education Satellite Project (AESP) held a regional press conference that involved live two-way communication via satellite between project personnel at the University of Kentucky and participating audiences at the five RESA sites throughout Appalachia (from north Alabama through New York State).

The AESP-TARESA press conference was held at the Madison County Technical Center at Huntsville, Alabama, beginning at 8:30 a.m. on August 23, 1974. The Top of Alabama Regional Education Service Agency (TARESA) is one of the five regional education service agencies in the Appalachian region selected to participate in this experimental satellite teaching program. Each RESA provided three learning sites. The learning sites are presently utilizing live television broadcasts from the University of Kentucky via the applications technology satellite system. These sites are located at the Madison County Technical Center in Huntsville, the Marshall County Technical School in Guntersville, and at Northeast Alabama State Junior College in Rainsville. During the summer of 1974, 74 teachers attending classes at the three TARESA sites completed graduate credit in reading and career education programs.

The press conference was attended by the ED-PLUSS research team and Mr. Charlie Johnson (COR) from the Marshall Space Flight Center. Participating in the press conference was a panel from the University of Kentucky in Lexington, consisting of four members. They were Mr. Kevin Arundel, Assistant Project Officer (NIE); Mr. Harry Teter, Executive Director (ARC); Dr. Harold Morse, AESP Director (ARC); and Mr. John Thole, Project Engineer, ATS (NASA).

The welcome was extended by Dr. Matthew Hall, Superintendent of the Madison County School System, and Mr. Dean Matthews, Executive Director of Top of Alabama Regional Council of Governments (TARCOG). Following the opening remarks by Mr. David Marxer (AESP Advisory Council Chairman) and Mr. Charles Nickel (AESP Director of TARESA), a film, "A Promise of Space...Fulfilled", was shown. The film depicted the use of Applications Technology Satellites for educational purposes in developing countries.

The panel speaking from the University of Kentucky presented a discussion of the AESP program. A general expression of confidence was voiced that the program had succeeded in meeting its objectives. Future programs beamed directly to home receivers were considered feasible by using lower frequencies and lower cost receiving equipment. This opportunity has been made possible because of the increased size and power of the ATS-6. The STS capabilities will provide for even larger and more powerful satellites in the future. Consequently, an almost unlimited potential for two-way educational programming exists.

Following the discussion, a question and answer session was held between the panel members and participating viewers in the various regional centers. This interchange demonstrated the effectiveness of two-way telecommunications in a learning situation.

Teachers who had completed the reading and career education programs discussed their experiences and views with local news reporters, AESP representatives, and members of the ED-PLUSS research team. They were pleased with the various aspects of the program, especially the video tapes of local classrooms in which demonstrations of techniques taught in the course were presented. Comments ranged among, "Fantastic" and "the best course I have ever taken". A conclusion can be drawn that the response of teachers to the program suggests a bright future for educational telecommunications program development. Additional follow-on demonstrations of this type could be pursued by NASA in joint cooperation with regional or educational associations for the purpose of informing educators and students of the potential in the STS development.

APPENDIX D

EDUCATIONAL SATELLITES

Appendix D

Educational Satellites

Communication satellites offer a system that can provide unobstructed contact with large geographic areas, broadcasting to entire regions or selectively beaming information to specific areas for particular users. Remote, dispersed or mobile populations can be reached by these systems with an efficiency approaching that available for much denser populations. Educational applications for these capabilities have been closely evaluated by educators.[1] Demonstration programs are now being performed which may greatly expand potential educational applications for the STS.

Typical problems of educational systems in some areas of the United States and in developing countries include:

- scarcity of resources including funds, teachers, teaching aids and adequate community and transportation systems.
- schools are usually few and far between with little communication between them.
- in some regions and countries, mail systems are limited, electricity is unavailable in many areas, and multiple language dialects and customs may hamper the feeling of national unity.
- students are often apathetic, depending on memorization of materials with little innovative or critical thinking being required.
- teachers are in short supply in some areas and often lack adequate training.
- curricula is often outdated and/or irrelevant to the needs of the student.

Educational communication satellites can provide:

- systems to cover large geographic areas and to link them together.
- regional and statewide area broadcasts.
- broadcasts to restricted areas and isolated populations thus increasing the effectiveness and scope of "master educators".

- broadcasts to selective types of users, e.g., medical students.
- assistance to highly-trained and poorly-trained teachers alike.
- varied, high-quality educational programs to supplement routine teaching and allowing convenient, two way tutorial instruction between teachers and student.
- information and skills to children and adults alike far from urban centers.
- community-type information to a diffused audience.
- governments with up to date information on demographic characteristics of a nation or a region.
- decentralization of educational resources and processes through existing educational networks.

Educational satellites can incorporate radio and television broadcasts, two-way telephone services, and facsimile transmission of hard-copy materials. Also, high-speed transfer of data from computer to computer can be realized. These transmission modes can provide such benefits as:

- broadcasting of cultural events.
- library information transfer.
- teleconferences for special groups.
- group instructional broadcasts.
- remote computing services.
- management of educational processes in remote areas.

Satellites with selected channels can be developed for:

- Network distribution - typically relays TV signal to a ground terminal from where the signal can be rebroadcast by conventional stations at VHF frequencies to home TV receivers
- Limited broadcast - transmission from satellites to less expensive receivers from where the information can reach schools as well as isolated villages or community centers
- Direct broadcast - transmits directly from satellite to a home receiver. (Broadcast frequencies are available which could permit low cost receiving systems costing some $300 to $500. NASA is currently using this band for experimental purposes. It could possibly be made available for widespread educational use).

The hardware required for educational communication systems should be easy to operate and maintain, and be reliable. The software should be relevant, effective, and appealing. It should have wide teacher, administrator, and political support, and people must be trained to develop and to use it. Instructional materials are costly and time-consuming; but via satellite, such material can reach wide audiences. However, they must meet local needs if the total system is to be accepted.

Typical educational applications for communication satellites could include the following:

- Instructional presentations could be broadcast from centrally located schools or universities direct via satellite into community receivers or individual classroom receivers in remote areas.
- A teacher's aide could formally conduct classes to relieve the teacher's load.
- If questions or problems arose, an experienced teacher or resource person could be contacted for assistance.
- If classes had 40 pupils each, and there were five classes on a party line to a given resource-teacher, some 100,000 students could be handled by 500 resource-teachers. Thus, one highly qualified teacher could reach 100,000 pupils instead of 40.
- A satellite network can bring training programs to teachers and teachers' aides working in the field, as is being done by the ATS-6 demonstration program. Doctors widely scattered in remote areas can also be reached effectively for professional training and updating of skills (also on ATS-6 application). Teachers of teachers could likewise be updated in the same way.
- Remotely located teachers could contact an educational center after class, getting assistance in diagnosing student difficulties, suggestions for remedial or extra work, classroom or school management, and the like. Facsimile equipment could process requests and transmit printed matter, photos, drawings, examination questions, etc., during the night so that teachers would have them in the morning.
- Awareness of national and international activities would be enhanced by having satellite TV receivers in remote locations.

The operational phase of the ATS-6 educational satellite has demonstrated many of the capabilities cited in this outline. Due to its large size and broadcast power, the size and complexity of ground stations has been reduced. And further demonstrations are planned to further develop educational satellite applications for the future.

Full scale, operational telecommunication systems for national educational applications and costing hundreds of millions of dollars are now being proposed.[2] These could include the establishment of a National Telecommunications Authority having direction and representation from members of the educational community. Implementation of this plan could also have a broad impact on the development and operation of the STS.

References

1. Grayson, L.P., "Education Beyond the Horizon", Science, Vol. 170, December 25, 1970, pp. 1376-1382.

2. Curtis, John A., "Needed: A National Telecommunications Network for Education", Engineering Education, May 1974, pp. 567-571.

SELECTED BIBLIOGRAPHY

SELECTED BIBLIOGRAPHY

"Alaskan Seminar By Satellite", Today's Education, Washington: D.C., Vol. 62, No. 5, May, 1973.

American Institute of Aeronautics and Astronautics. New Space Transportation Systems, An AIAA Assessment, ed. by J. Preston Layton and Jerry Grey, January 9, 1973.

Carpenter, Polly. Cable Television: A Guide for Educational Planners, Santa Monica, California: The Rand Corporation, May, 1973.

The First Ten Years, Report to The President and The Congress. Communications Satellite Corporation (COMSAT) Washington: D.C., July 31, 1973.

Helvey, Charles T., Ordway, Frederick I., Smith, Delbert D., Christensen, David L. "Applications of Satellite Technology to the System of Global Education", Journal of Educational Technology Systems, Farmingdale: N.Y. Baywood Pub. Co., Winter, 1972.

Jamison, Dean. "Planning The Use of an Instructional Satellite", Educational Broadcasting Review, Vol. 4, No. 5, Dept. of H.E.W., October, 1970.

Latvala, Eino K. and Young, Robert L. 19th Congress of the International Astronautical Federation, New York: N.Y., October 13-19, 1968.

Lewis, Philip. "Trends in Educational Technology", National Elementary Principal, Washington: D.C., Vol. 52 No. 1, Spetember, 1972.

Marland, Sidney P. "Educational Telecommunications, The Future is Now", Educational Broadcasting Review. Dept. of H.E.W., Vol. 5, No. 6, December, 1971.

Morgan, Robert P. and Singh, J. P., A Guide to the Literature on Application of Communication Satellites to Educational Development, (Documentation Cited), St. Louis: Mo., Washington University, April, 1972.

NASA, Shuttle Utilization Planning Office. Program Development, GMSFC, The October 1973 NASA Mission Model: Analysis and Economic Assessment, January, 1974.

Norwood, Frank W. "Switchboards in the Sky", Audiovisual Instructor, Vol. 14, No. 10, Joint Council on Educational Telecommunications, December, 1969.

"Satellite Communications 1963-1973", Vectors, ed. by Shell Bonnewell. Hughes Aircraft Co., Culver City: California, Vol. XV., Sum./Fall, 1973.

Satellite Television - International Tariff Information Handbook. Marketing Division, Communications Satellite Corporation (COMSAT) Washington: D.C. January, 1974.

The Space Applications Program, 1974. With Appendices, Office of Applications, NASA, (Includes: earth observation, earth and ocean physics, communications and navigation, space processing, future applications, STS and Spacelab, overview of economic analyses, program resources) May, 1974.

Space for Mankind's Benefit, ed. by Jesco Von Puttkamer and Thomas J. McCullough, NASA S.P.-313 Washington: D.C., 1972.

"Space Resources for Teachers", Space Science, Washington: D.C., NASA, Developed by Columbia University, 1969.

U.S. Congress, Senate Committee on Aeronautical and Space Sciences, Space Missions, Payloads and Traffic for the Space Shuttle Era, Hearing, 93d Cong., 1st Sess., October 30 and 31, 1973.