

APPLICATION OF SPACE BENEFITS TO EDUCATION

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The Alabama Section of the American Institute of Aeronautics and Astronautics (AIAA) established a study group to determine reasons for the decrease of public interest in space activities, and to propose remedial measures. Recommendations called for deeper involvement of the community to create broader public awareness of the many identified benefits from space. Other engineering societies were invited through the HATS to participate in a lecture series, the organization of a space benefits congress, and workshops to be conducted as a joint venture with the local educational system, which would benefit greatly from new space knowledge, and the application of advanced technologies.

This paper presents information on the conducting of a teacher workshop. This educational pilot project updated instruction material, used improved teaching techniques, and increased student motivation. The NASA/MSFC industrial facilities, and the displays at the Alabama Space and Rocket Center (ASRC) were key elements of the program, including a permanent exhibit, at the latter, on selected benefits accruing from the space program.

The summer workshop was structured around anticipated broadcasts from forthcoming Apollo Lunar and Skylab Space Station missions. Engineers, teachers, and scientists are now defining requirements that these broadcasts will impose on teachers and the school systems of cities, counties, and states. The Skylab mission may show that educational broadcasts should be made a major element of future manned space missions, especially with proper support by well-coordinated classroom

activities. To assure maximum benefits to education from these Skylab activities, sourcebook-type data will have to be prepared and distributed to teachers and students. The value of technology, the systems approach, and the need for adaptability of any future system to changes were emphasized throughout the workshop.

Because of the positive response of teachers and students, follow-on workshops for educators from Huntsville and elsewhere are being considered. The workshop project will enable teachers to improve classroom education for life in the space age, recognizing that an understanding by youth of space-derived science and technology is a prerequisite for maximum progress in mankind's drive to improve life here on earth.

Introduction and Background Information

Public interest in the nation's space program has decreased greatly in spite of several successful lunar landings. The events of the Apollo XIII and XV missions revived this interest somewhat, but this does not appear to be a permanent improvement. This lack of support has become of great concern to the aerospace community. Accordingly, the Board of Directors of the AIAA's Alabama Section initiated a study of underlying causes and suitable measures to remedy this situation. This study concluded that this new knowledge is often only visible to a handful of scientists, although such information can aid in the solution of many of the problems facing the nation today. Unfortunately, it is widely

dispersed, existing in many governmental departments, in associated industries, and in universities and nonprofit organizations.

These facts have created a situation where space-oriented scientific and technological efforts have been criticized to be the least understood of ongoing national endeavors; the man-in-the-street does not understand the importance of space research to his standard of living, and he does not know of the advances already made. The benefits of space exploration have never been properly explained to the public, which is generally not aware of the fact that the space program has led to greatly improved global communications, including worldwide color television programming of major events and 3-day weather forecasts of good accuracy. The impact of the latter, alone, on sports events and recreational activities cannot be measured in simple dollars and cents, nor can a monetary value be placed on timely hurricane warnings that have saved many human lives.

Forthcoming contributions from the Earth Resources Satellites will be even more amazing. These flights will begin in 1972, and continue through this decade. Zero gravity will permit testing of previously unexplored natural phenomena and will improve our understanding of physics, chemistry, biology, and biotechnology. The greatest contributions have been or will be made to the application of advanced technology and program management to our multitude of worldly problems and their technology-oriented solutions.

To obtain active participation by other sectors of society, it was proposed to combine the efforts of the AIAA with those of nonaerospace-oriented organizations. Accordingly, HATS was approached for cooperation in such an undertaking. HATS consists of various professional and engineering organizations, most of which, on the national level, are not tied to the space program, although most Huntsville chapters do actively support space activities. HATS agreed to support efforts to make the public aware of the myriad of benefits from space, and a joint undertaking was started in late 1970 to organize and manage the various tasks involved.

Public Lectures on "Benefits from Space"

AIAA and HATS members determined that it was important to furnish credible answers to the following types of questions:

1. What are the future goals of the space program?
2. How do these goals compare with those of the Apollo program?
3. Why should the nation continue the space program in spite of the many pressing problems in other fields?
4. How have space technologies aided nonspace industries and endeavors?
5. What direct benefits have resulted, and predictably, will result from the space program?

It was recognized that these questions could best be answered first, through a series of lectures, presentations and discussions, and later, through teacher workshops. These requirements led to a series of lectures on "Benefits from Space" shown in Table 1. Ten subjects were presented to an audience of up to 100 persons per evening, gathered in the ASRC in Huntsville, Alabama. Since scientists and engineers were the speakers, the audience was normally rather sophisticated; usually about half the attendees were associated with aerospace activities. The remainder was made up of specially invited science teachers of public high schools, as well as senior high school and university students. Attendance by the general public was rather limited, but increased as the series progressed. Suitable and effective publicity appeared to be a major problem. A permanent result of these activities is a new exhibit at the ASRC on space benefits, which was dedicated at the beginning of the 1971 summer season.

Selected subjects have been furnished to the NASA Space Mobile organization and have been worked into presentations by its lecturers. They have been adapted to all school levels, but have particularly been oriented to the younger grades and their teachers.

Studies made following the initial lecture series have shown that a most important audience appears to be gathered in our schools, where we find a representative cross section of the general public. Education in the U.S. involves a sizable portion (25 percent - 30 percent) of the population. Our youth is greatly interested in and often highly informed about space flight. Their teachers, on the other hand, are often reluctant to discuss the space program, its challenges, and results in great part,

because they do not have relevant and easily understood material for teaching purposes. Suitable assistance from the aerospace community will enable the school system to teach about the new space knowledge, in general, and space benefits and dividends, in particular.

Education can probably benefit more and faster than any other profession, from space know-how and the application of advanced technologies. Concentrating on the teachers will optimize use of available resources, and also make good use of the "multiplier-effect," once the teachers start to apply the new knowledge in their classrooms. A few years hence, today's pupils and students will make up the majority of the general public. Through the teachers, the entire future population can be reached at impressionable ages and made aware of space program goals, technologies, and benefits.

Summer Teacher Seminar

To implement the conclusion of an Ad Hoc Committee for a teacher workshop program, HATS announced that a teacher seminar would take place in late summer, 1971, on the subject "Educational Benefits from Space." The 1-week seminar, held in Huntsville, Alabama, was oriented toward benefits from space. It discussed the uses and applications of the new information, gained during the first decade of space exploration. Also, plans for and expected results from future space flights were on the agenda. The seminar was enhanced by visits to appropriate MSFC laboratories, local industries, and the ASRC. The University of Alabama in Huntsville (UAH) assumed the responsibility for the actual conduct of the seminar under MSFC and ASRC support. Topics presented at the seminar, including speakers or lecturers, are listed in Table 2.

The seminar addressed broadcasts from NASA's remaining Apollo missions and the Skylab mission, presently scheduled to fly in the spring of 1973. The scientific objectives of the Skylab experiments and their expected benefits were discussed. Included were experiments on solar and stellar astronomy; earth surveys; biomedicine and biology; and space physics and chemistry, with demonstrations of the effects of zero gravity on all natural phenomena. This kind of space research appears to provide an ideal framework to discuss the benefits from space achievable from future NASA flight missions. It was expected that this type of seminar, as well as potential follow-on seminars given

elsewhere, would adequately prepare our educational system to obtain maximum benefits from the space program.

Seminar Extension by Teacher Workshop

Those teachers who were willing to spend an additional week for a greater in-depth study of the educational benefits from space were invited to participate in an exercise to use the workshop technique and the systems approach to prepare future classroom activities in support of forthcoming space flights. Additional visits to MSFC and other local facilities were a part of this extension, as well as discussions with associated engineers, scientists, and systems analysts and managers.

This workshop served a different intent than other aerospace workshops; it particularly responded to the findings of the previously described HATS efforts, which do not make other workshops obsolete but specify a precise role for them. This workshop highlighted means to apply the new space knowledge to our educational system. Expert engineers and scientists discussed the impact of the space age on mankind's future living conditions on earth, creating novel educational requirements. Teachers were provided with advanced scientific information, which has not yet been fed into the educational system. It is hoped that this speedup of the information flow to the teachers will also accelerate inputs from space into all our earthbound endeavors. In turn, early missions are expected to assure maximum benefits to everyone involved. Such a situation will generate an alert, informed and highly responsive public.

Accordingly, the scope and the aims of this particular pilot workshop (and, hopefully, regular follow-on workshops) were as follows:

1. Important results of recent space events as well as goals of forthcoming space research were discussed with the highly motivated participants of this workshop, who will funnel this knowledge to the final user, the general public. Thus, everyone will quickly benefit from this information which can be applied to the solution of the many problems facing the nation today. This accelerated flow of educational knowledge will assure that space-based technology is properly considered in plans to solve the many local, national, and global problems. Such solutions are now being planned, managed, and implemented by persons who are not intimately aware of the tremendous potential that new management techniques,

new technologies, improved information systems, mass memories, and rapid computation methods will have on all future activities. It was the purpose of this workshop to complement the many individual and direct contacts between specific space efforts and associated scientists or experts by broadly based educational activities in many new fields. This first workshop was considered a pilot project for enlarged activities of similar nature, in the future, to bring the benefits from space to everyone.

2. This workshop stressed the answer to the question, "Why are we doing these things?" Other workshops have addressed the question, "What is being done?," describing hardware, programs and projects, systems (such as propulsion, guidance, control, air bearings), and similar subjects. These workshops should continue to lay a sound foundation in these fields. This new benefits-oriented workshop described the advantages that other nonaerospace-oriented fields of endeavor could reap from this new human capability to do things from outer space, unhampered by earth's gravity field. Our energy source, the sun, can be observed with visibility, unfiltered by the atmosphere. For the first time in man's history we also now have the capability to obtain a really vast overview of events down here on our globe, coupled with a tremendously improved communications system. These new capabilities will have an impact on the future life on earth, greater than anything that has happened heretofore. It is the task of our educational system to prepare our pupils for these years. A joint NASA/university/industry/education effort will be required to accomplish this goal, and only a first step in this direction has been taken.

3. The intent of this workshop was to prepare teachers for forthcoming space missions, such as two more Apollo flights, an extended Skylab program, future Space Shuttle flights and Space Station operations, and eventually, a large-scale earth orbital system of activities. It also made the teachers and the educational system aware of needs for new equipment, new educational material, and a well-trained and prepared teacher corps capable of meeting the new requirements. This need for enhanced education for the space age will be there, regardless of the role the U. S. is eventually going to play in the application of space capabilities and/or the exploration of the universe. Life on earth will be greatly affected, in any event.

4. This workshop was also to initiate a two-way channel of communications between the needs and

desires of our educational system and the potential of space exploitation. NASA and industry scientists learned firsthand about the problems in teaching; the educators were made to understand the capabilities and constraints of space flights. It is hoped that a working-group relationship can be established and maintained for maximum mutual benefit.

It was also expected that particularly relevant and meaningful suggestions from the workshop participants would be considered for broadcasting from Skylab, particularly if no equipment changes are required — only modifications of the "scenario" and some Skylab operations. In any event, hardware modifications are practically impossible because of the advanced development status of the Skylab. A much more basic definition of educational broadcasts from space stations and experiment modules is possible and will be pursued. The University of Alabama in Huntsville is coordinating an effort with this goal in mind.

5. This workshop was also used to demonstrate the usefulness and applicability of a little-understood byproduct of the space program: a greatly enhanced system management capability. The workshop was organized in conformance with a sound system approach, which was applied by the teachers to their analysis and implementation of a series of television tapes produced to demonstrate the benefits from space. This firsthand experience underlined the value of systems management, and encouraged the teachers to apply system engineering to classroom education, overcome existing hurdles, and restructure educational methods and procedures. Moreover, a greatly increased necessity for continuing (adult) education would have to emphasize the new space-generated requirements. It was believed that only a thorough, system-oriented study and properly devised total system management would provide an acceptable answer as to how these requirements should be fulfilled.

6. The workshop also defined associated supporting activities needed in the schools. The new technological inputs have to be analyzed for their effect on classroom activities and the need for amplified teacher training. Additional teaching material would have to be prepared in the form of a space benefits sourcebook. The manner in which this new information is presented would require that new types of equipment be obtained and installed, and operators for its use and repair would, of course, have to be trained.

The Sourcebook

One of the most important tasks to be accomplished in the program to apply space benefits to education is the systematic accumulation and organization of space benefits information for teachers and students. This information would appear in the form of a sourcebook that would be used to enhance educational programs tied to actual space broadcasts, to provide a channel through which space-generated science and technology could be assimilated by teacher and student alike, and to supply a single fountain of data on the application of space knowledge to all fields of endeavor. Extensive sourcebook-type material is already available for review, discussion, and use. Indeed, the workshop used some of it, while at the same time, working up recommendations for follow-on improvements that would lead to a full-scale sourcebook on space benefits, supported by literature citations, teaching materials (e.g., charts, slides, filmstrips, films, and filmloops), and the like.

Future Activities

Parallel to the actual conduct of the seminar and workshop, responses from city, county, private, and state educational institutions were obtained. Initial responses were favorable and indicated the readiness to amplify education on space in city, county, and state instruction, in the form of selective courses. A recent questionnaire sent to Alabama schools by the state education system indicated great interest to implement aerospace instruction as an elective subject. It is believed that this same situation exists throughout the country. To make such instruction as meaningful as possible, we must continue to generate up-to-date and interesting information for use by the teachers.

In support of this situation, the AIAA Alabama Section and HATS were asked to take the lead in the establishment of a Space Education Advisory Council, to advise the Board of Education in the definition of courses for aerospace education, to organize assistance from UAH, NASA, private industry, ASRC, state and city government, and possibly, other in-

stitutions. Full support has been assured by UAH, as well as the granting of teacher credits and an interest in establishing a regular workshop program in support of aerospace education.

Besides these purely educational activities, it should also be tried to optimize information management as related to the U.S. educational system. University personnel cooperated with NASA and private industry to determine the impact of educational requirements on information management systems of future Space Stations and Space Shuttle flights. The presently foreseen Space Station will orbit in a flightpath which is ideal for education broadcasts, since it can address a majority of the people on the globe. It appears that a minor investment in educational information systems will enhance worldwide education tremendously. Drastic advances in educational technology seem to be required to make broad progress in continuing adult education economically feasible. Early Skylab broadcasts and geosynchronous educational satellites were considered as a pilot project for future space-oriented education, which would require supporting ground efforts prior to, during, and after the space broadcast. A pilot effort to study such possibilities in regard to future earth orbital systems activities is presently being researched by UAH and will be proposed to MSFC shortly. It can be shown that educational broadcasts from geosynchronous space can aid in the quick, efficient, and effective distribution of any information. Manned participation will be required in the conduct of many sophisticated space experiments, but will initially be limited to low earth orbits. A lecture room can be set up in these low earth orbits to demonstrate the physical, chemical, and biological behavior of various materials, living things, plants, and even the human operations. These same broadcasts can also explain the immediate benefits of earth surveys and earth resources management, as well as the long-range benefits of better understanding and improvement in our basic knowledge, which we can obtain from solar and stellar research. Once we have managed to arrange for such a far-reaching educational program from space, we have made a giant step toward the actual application of space benefits to all our daily activities.

TABLE 1. SPACE BENEFITS LECTURES AND SPEAKERS

1. Benefits from Space Stations	Dr. K. Ehricke R. Holmen	North American Rockwell Corp. McDonnell Douglas Astronautics Co.
2. Skylab Experiments and Objectives	C. De Sanctis	Marshall Space Flight Center
3. Dividends from Space	Prof. F. Ordway	University of Alabama, Huntsville
4. The Systems Approach - A Space Lesson	J. Aberg and others	Marshall Space Flight Center
5. Results from Lunar Exploration	G. Heller	Marshall Space Flight Center
6. Sound, Noise, and SST	I. Vatz	Teledyne - Brown Engineering
7. Nuclear Energy for Power	R. W. Hunt Dr. J. B. F. Champlin	Westinghouse Electric
8. Weather Satellites and Meteorology	W. Vaughan and others	Marshall Space Flight Center
9. Space Exploration for World Peace	Dr. Mercieca	Alabama A&M University
10. Why to Explore Space?	Dr. Stuhlinger	Marshall Space Flight Center

TABLE 2. LISTING OF SEMINAR TOPICS AND SPEAKERS

1. Registration - Introduction	C. Hammett
2. NASA's Educational Program	E. Collins
3. Dividends from Space Technology - An Overview	D. Christensen
4. The Systems Approach - A Space Lesson	J. Aberg
5. Skylab Mission and Concept	L. Belew
6. Skylab Experiments and Objectives	C. De Sanctis
7. Earth Surveys	Dr. McDonough
8. Weather Satellites and Meteorology	O. E. Smith
9. Space Manufacturing	H. Wuenschel
10. Application of Space Remote Sensing to Solution of Ecological Problems	A. Adelman
11. Results from Lunar Exploration	B. Jones
12. Information Management	Dr. R. Vachon
13. The Space Shuttle	T. O'Connell
14. The Lunar Roving Vehicle	S. Morea
15. Space Exploration for World Peace	K. Dannenberg
16. Why to Explore Space?	Dr. E. Stuhlinger