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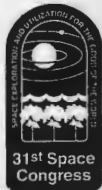
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SPACE EDUCATION SESSION

WHY SPACE INTIMIDATES TEACHERS

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Space Education: Why Space Intimidates Teachers
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BACKGROUND

Post World War II saw the advent of social changes of major proportions. Television became ubiquitous, with violence a major feature; for young people, the daily dose of tube time and video games has largely supplanted reading and homework. Permissiveness has replaced discipline. Violent crime has risen 560 per cent since 1960, and has invaded our schools. SAT scores in high schools have dropped 75 points in three decades. William Bennett, former Secretary of Education, calls this cultural rot. In this setting experimental educational techniques were implemented for the grand purpose of improving U.S. competitiveness in future generations. Sight reading replaced phonics, and the "new" math replaced the traditional course of study. These methods, and others such as open classrooms designed to promote freedom of movement and creativity, and remedial education for students who underachieve, have resulted in a society plagued by illiteracy. [1]

In recent decades, we have observed a public outcry to academia to "return to the basics". Basic education, with emphasis on math and science, is again considered to be the strongest foundation for higher formal education in preparation for all careers, and is particularly necessary in science, technology, and space. Strong programs leading to sustained student learning directly result from the efforts of motivated and well-trained educators guiding the student through inquiry, critical thinking, and problem solving.

"Lessons learned" from the trial-and-error secondary school educational methods of the last 40 years relate to our own human nature:

- Performing a task enables the student to retain what was learned.
- Practice makes perfect.
- One picture is worth a thousand words.
- Teaching a subject is the best way to learn it.
- Practical application relates to what the student already knows.

Young people today need to be literate in the traditional sense...as well as math literate...computer literate...technology and science literate – to survive clear of the welfare rolls and enjoy a reasonable quality of life.

Applying these lessons to successful learning programs in secondary schools in the 1990's, educational institutions have at their fingertips methods of motivation to generate enthusiasm through hands-on experiences. The student is allowed to learn by doing, and through team projects or discussion groups, whereby each student is able to teach the others what he or she knows. Obvious additional benefits to the student are social interaction skills and a higher retention rate.

These "not-new" teaching techniques have been hailed as revolutionary approaches brought on, in part, by the computer age. Technology has overwhelmed the teaching profession as well as the rest of society, but the responsibility for preparing future generations for future technology is that of total society, not just academia.

For this paper, selected secondary school teachers and educators at various levels were interviewed in an attempt to discover the common elements of their successful student learning programs. We sought to identify the reasons that many educators feel at a disadvantage when teaching about space.

Some now well-known student space-based learning programs have incorporated the previously mentioned teaching techniques with a high degree of success. The **Challenger Center's** 18 locations in the U.S. and Canada generate student enthusiasm by offering hands-on opportunities to crew a simulated space shuttle mission. Throughout the mission, students are required to work math problems, to make decisions that will affect the success of the mission, and to work as an integral part of the team. Besides shuttle missions, other current space tasks are simulated. Project Earth involves a scenario in the year 2008 when earth observation satellites are rendered inoperable by solar flares, and the student team is given the tasks of continuing Earth observations, and repairing the satellites. Marsville is a series of projects in which teams of students use their creativity to create habitats from simple materials. Operation Mini-Mission invites parents to participate with their children in mission simulations. Besides utilizing the successful elements identified earlier, Challenger Center draws the parents into the educational process, thereby gaining parental support. [2, 3, 4]

International Space University (ISU) has grown from the dream of three young Harvard and MIT graduates in 1986 into a popular and well-known institution of higher space education geared toward graduate level studies. ISU began as a 10-week summer course offered in a different country each year, using top-level international faculty and guest lecturers, permanent academic staff, and a major design project. While continuing the summer program, the university is now creating a permanent campus in Strasbourg, France, which is preparing to grant a one-year Master of Space Studies degree. ISU attracts graduate and doctoral level students from 35 countries. The conduct of each session makes use of the identified common elements: hands-on learning, and teamwork on a richly international basis. More than 700 space professionals worldwide have completed the summer curriculum. [5]

The mission of the **United States Space Foundation** is to promote national awareness and support for America's space endeavors. The Foundation's education department focuses on generating excitement about space through educators. The **Space Discovery Adventure Workshop** is an exciting program that includes space history, the space shuttle, the solar system, toys in space, and a tour of the Jim Irwin Museum for school groups grades K-12. Other youth groups, such as boy scouts and girl scouts, are encouraged to attend. [6]

Spaceport Florida Authority in Cocoa Beach, Florida provides a **mobile suborbital launch system** in a Launch Control Van for use by student groups to launch payloads to an altitude of 250,000 feet above the earth's surface at a speed of more than 3,750 miles per hour. The Rockets for Schools program in 1992, sponsored by the Office of Commercial Space Transportation, enabled high school students to launch small payloads into the upper atmosphere. This successful launch system is now used by university researchers. As in the previous examples, the common elements of hands-on experiences and teamwork prevail. [7]

The **U.S. Space Camp**, established in 1984 at Alabama's U.S. Space & Rocket Center in Huntsville, offers an outstanding program of hands-on space basics and astronaut and mission training. Courses are three to eight days in length for young

people aged seven through high school age. The Space Academy offers courses tailored for educators and for other adults. Full-scale space shuttle and space station simulators and space hardware are used. Participants wear astronaut-type multi-zippered flight suits with mission patches, and win wings on graduation. Surveys of Space Camp alumni have indicated 60% take additional math or science courses, and 90% report greater interest in science and technology and in space, science, or technical careers. [8] Most major U.S. aerospace corporations also provide support to space training for teachers or space education.

Successful learning programs can often be characterized by the depth to which an interdisciplinary approach is used. Space as a unifying theme to stimulate interest in the basics is a proven approach of potentially great success over a broad spectrum of subjects. The actual breadth and diversity of space suit this technique well. Logical applications of this method are science, math, space transportation, and astronomy, technology, physiology, and earth science. Branching out from this combination, a teacher may tie in economics, technical writing, sociology, and business. A teacher may not see an interdisciplinary benefit to tying foreign languages, home economics, and creative writing to space studies. Surprisingly, teachers interviewed reported high school students were taught specialized courses that made little use of a broad interdisciplinary approach. Elementary school courses of study lend themselves more readily to merging one subject with another because the teacher usually teaches all the assigned subjects to a single class.

To carry out successful student learning programs, teachers require not only budgetary support, but guidance as to sources of curriculum material, facilitated access to such sources, and opportunity and funded access to teacher training and knowledge in up-to-date subject matter such as space. One rural high school science teacher interviewed recently had been assigned the new course, "Principles of Technology I & II". Without prescribed instructional materials in the first year, the teacher sought all related and unrelated teacher training opportunities throughout the state, and wrote his own lesson plans. His level of discomfort in teaching this new course was high. Before the second year, a state-developed program was provided with specific teacher training and lesson plans. Following sufficient training and preparation, this teacher was comfortable with his subject.

At the recent National Congress on Aviation and Space Education held in Norfolk, Virginia, April 6-9, 1994, Mr. John D. Moore, a New Jersey high school teacher, presented a paper proposing a program using applications of remote sensing satellite imagery in science education intended to spark student interest in practical uses of space technology on earth. He observes that the hands-on, computer-oriented, and visual nature of satellite direct broadcast has proven to be a highly effective means of teaching technical subjects and enhancing technological literacy. Students with access to such a system can readily develop basic lab projects in ecology, forestry, oceanography, and meteorology. The message for secondary school educators is that for a relatively low price, teachers and students can avail themselves of 'high tech' information that they have complete control over. Moore states that remote sensing satellites, which monitor the weather and photograph Earth's surface at various wave lengths, can play a valuable role in the classroom, especially in the areas of Earth science and geography. Imagery from these satellites can demonstrate how such forces as volcanism, earthquakes, ocean currents, and weather patterns work together to shape the environment. They can reveal patterns of human land use, agriculture, pollution, deforestation, and military activities. Few remote sensing curriculum materials exist, however, and printed images and other visual images are usually expensive. About 2,000 U.S. schools have data receiving equipment and student-made antennas capable of monitoring satellite transmissions in real time. [9]

NASA is also promoting the use of remote sensing data in the classroom (K-12) through a Cooperative Agreement Notice (CAN) soliciting agreements to make broad public use of earth and space science over the Internet. In addition to education, the CAN identifies 14 other application areas where access to remote sensing data can be of value to the public. [10]

Bringing this type of technology and the resulting data into the classroom is exciting to the student. However, thoughtful and experienced guidance from a confident, well-prepared teacher is essential. Without appropriate curriculum materials and training, teaching about remote sensing from space becomes a forbidding subject. Teachers will not readily accept a challenge of this magnitude without sufficient resource support. More acceptable for the educator than raw remote sensing data is the processed information disseminated by NOAA weather radio, FAA Flight Service Stations, and value-added remote sensing companies that support such presenters as the Weather Channel on cable TV. Accu-Weather's 'DataShare' program provides students with the opportunity to network and exchange environmental data with other students on a national scale. Classrooms can come alive with real science and technology, and engage students in seeking solutions to global environmental problems of both the present and the future. [9]

ANALYSIS

Problems Identified:

In an attempt to discover the extent of space education in the secondary classroom, several selected high school teachers were interviewed. The age group of 15 to 17 was targeted, including advanced, average, and remedial levels were studied. It was found that the level of student enthusiasm about the subject of space correlated to higher learning levels. Space careers appealed to the advanced group, while consumer technology from space was of more interest to average and remedial levels. Teachers typically introduced space studies as a part of the science unit, and as a source of new knowledge. Advanced level students were exposed to career opportunities in the space industry, and lower levels were interested in space as a source of higher quality of life for people on earth. A majority of teachers introduced space only during "space units"; there was no attempt made to use an interdisciplinary approach. Hands-on activities were considered to be the most successful learning technique. When asked about their feelings of readiness to teach their first unit on space, all teachers interviewed confessed to a high level of discomfort. Specifically, they felt their knowledge of current trends in the space industry was felt to be inadequate. Some teachers had received NASA materials from various sources, including the Education Resource Center of the National Air & Space Museum, and the Young Astronauts Council, but others had no knowledge of space resources often located within 100 miles. Some still relied totally on textbooks, which they considered inadequate. *Most teachers (other than those encountered in a space education setting) suggested real reluctance to expose themselves to student questions on space they might not be able to answer.*

Additional teaching materials desired included learning lab modules, projects, computer software, and visual aids, including videos. Rural teachers were less likely to organize field trips than urban teachers. All teachers interviewed were eager to receive additional training in space education to help them provide more hands-on activities in

the classroom. Rural teachers interviewed had received none. Teachers agreed that space studies should be tailored for the level of the students, and that projects would be an appropriate method of testing.

Teacher readiness to tackle the subject of space depends on resources and training. Readily available resources are effective only if the teacher knows they exist, and knows how to acquire them. Even though NASA has a comprehensive outreach program, the word is still not getting to a significant number of teachers. Textbooks still being used in schools have been known to be so out-of-date that they refer to the Apollo mission as a current event. Space programs reaching the grassroots of the United States, such as the efforts of Buzz Aldrin, the National Space Society, and Space Week International in Houston to promote the 25th Anniversary of the Apollo 11 mission, could open the door for many teachers to a heightened awareness of space resource and training opportunities. [11] At the recent National Science Teachers Association convention (Anaheim, CA March 30-April 2, 1994), attended by more than 15,000 teachers, teaching techniques using space science was a prominent topic.

Teacher training and development have become buzzwords of the education industry, much to the delight of teachers. Expecting teachers to be experts on all the subjects they are asked to teach has become impractical. School administrators recognize the benefits of continuing education for teachers. The study of space, unless specifically included in the curriculum as a separate course, is treated as a unit of study within science class.

Teacher utilization of technology is dependent on experience and knowledge of that technology. Before the first computer with CD-ROM is made available to a student, that student's teacher must be proficient in the operation of the hardware and software. Remote sensing data transmitted into the classroom requires sophisticated teacher knowledge about the means of transmission, and interpretation of the data. Using tele-education and Internet requires that the teacher knows how to handle the technology, then how to incorporate meaningfully the technology into a lesson plan. [12] The need for effective teacher training has not been met. This need is growing exponentially.

Possible Solutions and Recommendations

Throughout this study, the authors have interviewed urban-, suburban-, and rural-based secondary and elementary school teachers. The focus of the study was on teacher resource availability, teacher training, and teacher competency in the face of the technology explosion. Broader use should be made of resources now available.

Education Resource Centers (ERC)

- **NASA Office of Education** in Washington, DC provides access to print, audio, video, and computer software teaching materials. Printed materials include lesson plans, posters, satellite, remote sensing, and Hubble telescope photos, puzzles, games, cut-outs, model paper space shuttles, newsletters, etc., geared toward all grade levels K-12.
- More conveniently, **NASA Centers** around the country offer the same types of teacher resources in their **Education Centers**. Surplus equipment is now available free.

- ERCs, Air & Space Museum, Washington, DC, and Virginia Air & Space Center, Hampton, VA also offer the same materials.
- Aviation Education Resource Centers sponsored by the Federal Aviation Administration; (the 100th center recently opened in Kitty Hawk, NC) offer a variety of space-related teacher resources provided by NASA. [13, 14, 15] in addition to aviation materials from FAA.

Teacher Training Opportunities

- Challenger Learning Centers, headquartered in Alexandria, VA provide students an opportunity to participate in space mission activities. Teachers attend a training seminar at a Challenger Center prior to accompanying their classes on the mission.
- United States Space Foundation, Colorado Springs, CO provides Getting Comfortable Teaching With Space, a graduate course designed to assist K-12 educators to integrate space and aviation into all areas of the curriculum to stimulate student interest and achievement. [6]
- Space & Rocket Center, Huntsville, AL provides week-long adult programs at the Space Academy. Teachers are eligible to attend a specialized teacher training program for which they can earn college credit through the University of Alabama.

Teacher Technology Competency

The above Education Resource Centers and Teacher Training Opportunities significantly contribute to educators' ability to teach the subject of space with a feeling of comfort. Educator computer literacy and technology competence are issues that are currently addressed by school administrations, or by the teachers themselves.

Many training opportunities exist to become computer literate in every area of the U.S., rural as well as urban and suburban. Continuing education classes at local colleges and night schools provide this service. The cost of home computers is decreasing, enabling teachers to own a computer, thereby becoming more adept.

Training falls short in more sophisticated technologies, such as handling remote sensing satellite readout equipment in the classroom, and interpreting the data. Educational opportunities abound for this technology, but teachers must be trained to understand its complexities. Soon to be available to many classrooms is tele-education technology. [12] Teachers must understand how to fully utilize the system in order to maximize the students' sustained learning.

Elements of Successful Learning Programs

High technology is no longer for the scientist only. Education technology should not be intended only for math and science courses of study. Today's technology must be used to educate in all disciplines. Technology is the tool that complements the techniques and methods identified above. Hands-on study using technological tools in discussion groups and teamwork projects promoting inquiry, critical thinking, and problem solving will be the classroom of the future. Notice that the tried-and-true learning techniques of 100 years ago have been coupled with today's high technology to produce a generation with a finger on the pulse of the universe.

In order to seize this important opportunity, educators must be educated. Recommendations for implementing the identified elements of successful learning programs in the classroom begin with this message to school administrations:

- Educate the teachers in the practical applications of the high technology that will be used in their classrooms.
- Assure that all teachers are computer literate.
- Provide regular opportunities for teacher development at no cost to the teacher.
- Communicate other available training opportunities to teachers to be paid for by them.
- Provide lesson plans, materials, and equipment in support of the course of study.
- Create a database of sources of instructional materials that teachers can access.
- Take advantage of Internet capabilities to facilitate resource access.
- Train teachers to utilize Internet capabilities to its maximum potential.

Given the training and resource access possible today, many more teachers will willingly help build student interest in science, math, and technology through space education.

CONCLUSION

The influence of space and space-derived products and services is everywhere in modern life, and is largely taken for granted. [16] But because this influence is close at hand, in world-wide television, satellite weather pictures, and the like, space has the potential to be a powerful interdisciplinary tool in motivating students in K-12. For this approach to be effective, we must take measures to arm the teachers with the knowledge, resources, and comfort level that will give them confidence to convey to their classes something of the opportunities of modern life that can be unlocked through studies in math, science, and technologies. Special focus must be placed on enabling access to such training and resources for teachers in rural areas. Internet and tele-education provide one means for enhancing the resource inventory of teachers in remote areas, in the United States and abroad.

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