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Benefits to Mankind

PCs in Space : **Priming the Next Generation Astronomers and Scientists**

Abstract

Not since the Apollo era has student and teacher interest been more focused on space science. Mankind's curiosity to solve space mysteries led to the development of the Hubble Space Telescope. Just as the Apollo missions expanded space science knowledge and inspired our civilization towards greater technological feats, Hubble is expanding our understanding of the universe.

The PCs in Space program, a NASA spin-off, is a national teacher enhancement program for elementary and middle school teachers, keying off the excitement created by the new discoveries of the Hubble Space Telescope. This excitement has opened up space and earth science acceptance into elementary and middle schools. PCs in Space uses NASA's latest technologies and discoveries to enrich geography, math, physics and English topics. The incorporation of space and Earth science into existing curriculums assists in the creation of a future generation of astronomers, engineers and scientists.

PCs in Space is a different approach to reaching children. The primary goal is to give teachers and students free space and Earth science information. The space and Earth science is distributed to schools by leveraging resources from commercial, education and government institutions. PCs in Space has been incorporated in schools nationally through this very effective approach, especially in the face of limited school resources, budget reductions and concerns in Congress over taxpayer dollars.

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PCs in Space Project
Jackson and Tull

Hubble Space Telescope effects on civilization

In 1969, the Apollo project successfully landed man on the moon. This national achievement accomplished five major phenomena for our civilization.

- It established United States supremacy in space exploration
- The Apollo project pushed technology and helped established the long term survival of the space industry
- Landing on the moon captivated our civilization's attention.
- The Apollo project romanticized space exploration
- The TV images inspired children and parents and affected many career choices and decisions.

Similarly in 1997, the Hubble Space Telescope has also accomplished five major phenomena for our civilization.

- The Hubble Space Telescope once again established United States supremacy in space exploration
- The Hubble project pushed technology in the face of national fiscal constraints.
- The Hubble images have consistently captivated civilization's attention.
- Hubble discoveries have changed mankind's understanding of the universe.
- Hubble is inspiring teachers to include space science in their curriculums, thereby inspiring children to learn more about space science.

There are many parallels that can be drawn between the successful Apollo mission and the discoveries of the Hubble Space Telescope, regarding the effects on civilization.

PCs in Space leverages Hubble's scientific success

The primary goal of *PCs in Space* is to make up-to-date space and Earth science information available for use in today's classrooms. *PCs in Space* has learned from working with over 25,000 students and over 8,000 teachers.

I consider my earliest activities on *PCs in Space* as helping to generate a *PCs in Space* Bill of Rights. The *PCs in Space* Bill of Rights was designed to protect the needs of teachers and students. Later activities incorporating *PCs in Space* nationally increased in my educational awareness. Finally, establishing the software nationally has resulted in several successful implementation strategies.

Lack of resources:

My first endeavor to write educational programs started when Dr. H. John. Wood, optical expert for the Hubble Space Telescope project, asked me to write some software programs for a Space Camp at Bowie State University, in Maryland. After many late hours and weekends, I finished some software programs for operating the Hubble Space Telescope. Dr. Wood reviewed the scientific discoveries for accuracy, as did several other experts at Goddard Space Flight Center. I used actual Hubble telemetry pages, Mission Control Script, Hubble photographs and logic models to give students the ability to operate the Hubble. The three programs were; running the Hubble during battery and solar charging operations, operating the Command and Data Handling system, and taking images with the Wide Field Planetary Camera.

After looking at the resources available at the Space Camp, I ran into one problem right away. The Space Camp didn't have 486 computers, with 8 Meg of Ram, and a windows environment. To solve this problem, I was able to convince Jackson and Tull to purchase computers, which they could use at the space camp for the summer. I had to convince our company of the benefits of reaching younger students. I had to make them see that these young people would ultimately be the ones who would support NASA's budget. I was only able to succeed with the support of Mr. Tull, president of Jackson and Tull, who has a strong background in education.

I chose a commercial data acquisition system we were using at NASA to develop some of the satellite ground stations. The software was developed by National Instruments and is called Labview. The software requires knowledge of electronics, software, and computers to be able to use successfully. I didn't know if it would work until about two weeks before the summer classes started.

Not teacher friendly

Once classes started I immediately ran into another difficulty. The operation of the Hubble Space Telescope is no easy task. To get the students through the lesson plans, I had to talk the entire 45 minutes of each class. Talking continuously for 45 minutes to 32 children was extremely tiring. Especially when students did not follow the mission plans, which resulted in the Hubble Space Telescope "safing". The safing condition is what the spacecraft enters when it senses a problem or mistake. I didn't envision many teachers wanting to use this program, since I was exhausted after three classes.

No consistent student interest

The third major problem discovered was a result of the student surveys. The Space Camp gave student surveys each week to all 250 students. They ranged from second through seventh graders. After about four weeks the survey had a classic bell curve approach. Half the second and third graders, 80 to 90% of the four, fifth and sixth graders and half the seventh and eighth graders liked the software. The consensus was that the software was too complex for the younger students, okay for fourth, fifth, and sixth graders, and too constrictive for older students. The older students didn't like to be told how to use the software.

The PCs in Space Bill of Rights

The surveys and feed-back showed several limitations. I therefore decided to rewrite the programs, gearing for one program that could be used for all classrooms. The program had to be simple, non-constraining and contain more images. After about six more weeks I came back with Exploring the Solar System, using Hubble and Voyager images. The first thing I noticed was that after three to five minutes of explaining the instructions, I didn't need to talk until the end of the class to give students a final recap of the major discoveries. I also noticed the excitement of the students, and the smiles on their faces, something I still see each time students use these programs. I only had surveys for the final three weeks, but they were phenomenal. Over 90% acceptance in all grades, from second through seventh. My feeling was that if Atari, Nitendo, and Sega could reach such a wide girth of students, so could educational software.

Local Educational awareness

The following school year, I was able to get an assistant, Ulysses Manley, to take PCs in Space to 20 schools in the District of Columbia and Maryland. Mrs. Brenda Tull, Jackson and Tull's treasurer, contacted principals in the district. Her community ties enabled access into inner city schools and teach children who don't normally have access to computers. We talked to science coordinators in other Maryland schools to pinpoint schools with good computer resources.

Local Educators always highlight the good

Many educators from science supervisors, to school principals always told us how good their school systems were and how they had up-to-date computer labs. Disappointingly, most of these schools did not have up-to-date computer systems. We found that most educators would pick out one school with great computers, but fail to mention the other 99 schools. In most cases, educators and principals two years ago did not have a realistic sense on what type of computers they had in their schools. The first twenty schools all required us to bring 486 computers. Four of the schools were able to order the 4 Meg Ram upgrades for their computers after we left. Over half had at least one good multimedia computer in their library.

Schools had mixed technologies

After working with many schools I soon realized that the IBM software was not consistent with many schools in Maryland. They required MAC software. Later I would learn that the commercial software I used needed a new version for PowerPCs. I therefore ordered commercial software for other platforms, to reach more of the schools in Maryland and D.C.. Two years ago, most schools did not have 8 Meg of ram, windows based operating systems, and access to new computers. In fact, most of the computer people for schools had no idea what type of computers they had. We found ourselves educating schools about coprocessors, Ram and Windows based software.

Getting Teachers to use computers

After one year of testing, we took PCs in Space to our first National Science Teachers Association conference in Philadelphia. We were able to set up eight computers and get volunteers from many companies. We ran training classes every 15 minutes. In four days we instructed about 1,000 teachers on PCs in Space. The teacher surveys, that year and the next were extremely

rewarding. I was surprised to notice that a fair amount of teachers had never used a computer before. However, after 15 minutes, most were actually enjoying themselves and had to be literally kicked off the computers. Our emphasis shifted during these conferences. If the teachers didn't feel comfortable with the software, the students would never use it.

Target existing curriculums

Even though the United States has maintained its superiority in space exploration, this has not translated into better rankings in international science scores. Nationally most emphasis on space and earth science has been on developing new curriculums. This generally requires a large amount of overlapping resources to gain acceptance in a single county or state. A much more cost effective approach is to include space and Earth science into existing curriculums. PCs in Space combines that with the ability to copy, transport and develop national software programs. PCs in Space can be used immediately to enhance existing subjects. This is a very effective use of resources, especially during budget reductions and concerns in Congress over taxpayer dollars. By targeting younger students, many who determine their careers at an early age, PCs in Space makes a lasting impression.

Leveraging Resources

We started leveraging PCs in Space against the wide acceptance and popularity of the Hubble Space Telescope. The visual images from the Hubble are a natural training tool for children. In addition, children and adults love to learn new things. The new discoveries of the Hubble enabled PCs in Space to show never before seen images to students and teachers. We then expanded PCs in Space to cover the sun, universe, earth, states and Hubble Servicing Missions. PCs in Space was able to tap into technical expertise from different projects at NASA and using the commercial resources of Jackson and Tull and other companies to bring out technically correct information.

At the local level, I realized that if I wrote one program which was a common curriculum item, it could be used nationally. The key was finding information which could be used to enhance existing curriculums. If the software enhanced an existing curriculum, large amounts of resources would not be wasting on peer review or document generation or approval. This way PCs in Space would be a benefit to the teacher, not a new curriculum item or a detriment.

At the state level, we targeted universities. Universities have the resources to run the programs now and to educate the next generation of teachers.

Nationally, we made the software available on internet to maintain free distribution. After 40,000 copies of the software had been distributed, internet enabled the program to continue to emphasize product development. In addition, changes to the programs could be redistributed quickly will little cost. This was much more effective than using conventional school books.

Politically, we show that a commercial company can produce free educational programs which benefit teachers and students nationally. That PCs in Space is a "free" program which enhances existing curriculum.

Commercially, we explained to companies that the space industry relies on the acceptance by the general public. If communities, schools and individuals see direct benefits to their individual needs, they will support specific government programs.

Internationally, making the software available on internet has created a large international demand.

Conclusion

The Hubble Space Telescope's benefits to PCs in Space are three-fold. First, the inclusion of NASA's latest technologies into geography, math, physics and English topics has generated a tidal wave of teacher and student interest. Second, Hubble images helped fill the gap of up-to-date space science information available in classrooms nationally. Finally, Hubble images have profoundly changed our understanding of the universe, and captured the attention of our civilization. PCs in Space's incorporation of Hubble images into school curriculums, has inspired the next generations of students to learn more about space science.