

# **An Integrated Approach To Engineering Education in a Minority Community**

*Final Technical Report*

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## **Summary**

Northeastern New Mexico epitomizes regions which are economically depressed, rural, and predominantly Hispanic. New Mexico Highlands University (NMHU), with a small student population of approximately 2800, offers a familiar environment attracting students who might otherwise not attend college. An outreach computer network of minority schools was created in northeastern New Mexico with NASA funding. Rural and urban minority schools gained electronic access to each other, to computer resources, to technical help at New Mexico Highlands University and gained access to the world via the Internet. This outreach program was initiated in the fall of 1992 in an effort to attract and to involve minority students in Engineering and the Mathematical Sciences. We installed 56 Kbs Internet connections to eight elementary schools, two middle schools, two high schools, a public library (servicing the home schooling community) and an International Baccalaureate school. For another fourteen rural schools, we provided computers and free dial-up service to servers on the New Mexico Highlands University campus.

Internet and computer training programs for pre-college teachers were presented several times each year. These trained teachers, in turn, became responsible for transmitting their Internet expertise to their colleagues and their students. In our Advanced Internet course, teachers created their own home pages and in the Internet Administration course, we selected teachers who then learned how to maintain their school's computer network and Internet servers.

Computer networking provides the electronic backbone for our integrated Engineering outreach activities: Young Astronauts and MESA tutoring for middle school students, Supercomputing Challenge and Discovery Day for high school students. Each summer, two university Engineering students participated in internship experiences at NASA Dryden Flight Research Center. This NASA grant has also funded such student development projects as the establishment of student SHPE and AISES chapters, local research symposia and travel for student presentations at national conferences (SACNAS and NCUR).

## **Network-based Connectivity for Local Schools**

As ever more schools in the nation are gaining access to the Internet, NASA has made this movement a reality in northeastern New Mexico. This is especially significant to the school districts of northeastern New Mexico that too often find themselves isolated with marginal resources. Access to Internet has enabled students and teachers to become part of an international community of researchers, educators, and students and makes available resources that no single school district or community could provide. Accordingly, it was our task and pleasure to establish a computer network comprising the two school districts in the Las Vegas area linked to the NMHU local area network.

We created this network for the elementary, middle and high schools of Las Vegas in the hopes of improving science and mathematics education. We see this as a key component of the ongoing effort to bring more students into the Engineering pipeline at the college level. Teacher training in science and mathematics at the elementary education level tends to be lacking, especially in New Mexico. Internet access and concomitant training of teachers provide a valuable curricular resource since lesson plans and appropriate guidance tools are proliferating rapidly in the Internet.

We conducted regular training sessions for teachers and selected students. Perhaps the biggest complaint teachers have about new technologies is that of too little training on how to use the technology in the classroom. In recognition of this problem, we provided extensive training on the basics of Internet and on how to use the capabilities of Internet to promote learning. Internet is only a tool and, as such, can be used both effectively and ineffectively. Our immediate goals for promoting the use of Internet as a classroom tool were,

- (1) to teach problem-solving skills,
- (2) to support group and individual research and exploration efforts by students,
- (3) to create larger communities of young scholars by allowing students who might otherwise feel isolated to reach out across the Internet to other students with similar interests,
- (4) to allow teachers easy access to educational materials for the classroom,
- (5) to provide access to information on colleges and universities,
- (6) to provide a useful backbone for tutoring services, and
- (7) to provide direct electronic mail contact between elementary, middle and high school students and Highlands University.

Parents are key partners in a successful program allowing student access to Internet resources. Accordingly, we conducted workshops for interested parents wishing to experience a "gentle introduction" to the Internet. For those parents who home-school their children, we provided computer access through the local public library. Whether at the public library or at a school library, we made it the responsibility of the librarian to maintain student and teacher accounts and also security. Issues of net etiquette, copyright law and parental consent were dealt with at this level.

If computer connectivity is the backbone of this project, tutoring and mentoring are its flesh and blood. The New Mexico MESA (Mathematics, Engineering and Science Achievement) program sponsors tutoring at participating schools. MESA is designed to attract the top 10 percent of minority students into Mathematics, Engineering and Science fields. University students have been serving as MESA tutors in the local middle schools and high schools. MESA gave our University students a stipend to help compensate their efforts. Special training on the uses of Internet was available to all interested Highlands students and our tutors were especially encouraged to take advantage of this training.

Student members of AISES (American Indian Science and Engineering Society) and SHPE (Society of Hispanic Professionals and Engineers) served as MESA mentors. SHPE and AISES students served as judges for regional MESA design competitions and the Northeast Regional Science and Engineering Fair. Lower division students were tutored by the upper division students and these, in turn, served as tutors in the high schools. High school students tutored the middle school students and these, in turn, served as tutors for elementary school children. We sponsored competitions among MESA students working toward their Senior Incentive Trip by sponsoring awards for the best papers on the use of Internet in Space Science and Engineering.

The NASA Educational Outreach Network (see <http://vyne.nmhu.edu>) gives Highlands University unprecedented access to the schools in the University's service area. It is precisely this opening-up of the Mathematics and Science classroom to inspiration and the outside world that sets the stage for the development of a competent scientific and technical workforce.

Data circuits were leased from New Mexico TechNet whom, in-turn, contracted with the telephone utility, US West. This on-line frame-relay network operates at 56 Kbs, bundled with the T1 circuit servicing the University and includes the following sites: West Las Vegas High School, Robertson High

School, West Las Vegas Middle School, West Las Vegas Valley School, Memorial Middle School, Carnegie Public Library and the Armand Hammer United World College of the American West. Also, we leased routing equipment for each site from TechNet. Connectivity for outlying rural areas was provided through free dial-up access to our Internet server at Highlands University.

## **Engineering and Pre-Engineering Education**

We have integrated two threads of engineering education: undergraduate research experience and precollege outreach. Each year, two undergraduate students participated in a summer internship at the NASA Dryden Flight Research Center. During the school year, the student researchers worked with their faculty mentor in preparation for their summer research projects, such as interfacing a computer controller for a LASER positioning table.

During the school year we supported the Young Astronauts program for middle school students. Each summer, 30 middle-school students are selected for participation in a water ecology program. Two Highlands students worked with the children who collected information about New Mexico's rivers and streams. On Highlands' Discovery Day, buses from all over northern New Mexico converged each year on Highlands University. Students enrolled in mini-workshops of interest which were conducted by Science and Engineering faculty and students. Each participating high school student received a NASA logo tee-shirt and an experience of the possibilities awaiting them in Science and Engineering careers.

Other successful activities included a tutoring program for engineering undergraduates which we established. We hired two of the top senior students in this capacity for evening tutoring in an **open** Engineering Building. Also, we instituted a biweekly seminar series for student development. Inspirational speakers have included former graduates from the engineering program and also speakers from NASA/Dryden, the National Laboratories, as well as from private industry.

A student chapter of the Society of Hispanic Professionals and Engineers (SHPE) was formed with our assistance. A visit from SHPE President and regional Vice-president helped in the formation of a local student chapter. Each year, we helped student officers attend SHPE leadership conferences and office space was allocated for the SHPE student chapter.

## **Project Dissemination**

The following presentations were made to the academic and international Internet communities to disseminate the results of this NASA training project:

B Taylor and D Ross, "An Integrated Approach to Engineering Education in a Minority Community," presentation at the ASEE annual meeting in Milwaukee, May 17, 1997.

W Summers and C Sollohub, "Bringing The Internet to Northern New Mexico: a Cooperative Effort," presentation at the Tel-Ed Conference in Mexico City, December 1997, (see <http://jaring.nmhu.edu/bringing.htm> )

## **Final Project Year Expenditures**

The following expenditures were approved on April 23, 1997 and represent all activities on this NASA training grant during the final year of the project entitled "An Integrated Approach to Engineering Education in a Minority Community."

<b>Category</b>	<b>Original Budget</b>	<b>Approved Budget</b>	<b>Actual Expenditures</b>
Personnel: Includes Principal Investigator, Co-investigators, Technicians, Secretary & Fringe	40,818	40,809	40,639
Student Support: Includes student labor for all Internet Days at schools	26,000	20,000	23,136
Project Leaders	2,000	2,000	3,213
Internet Training	4,000	4,000	3,740
Dryden Travel	3,400	1,400	1,400
Conference Travel: Includes TelEd and ASEE presentations	2,000	2,000	2,024
Supplies: Includes Tee-shirts for Discovery Day	2,000	2,000	3,428
Computer Leases	19,488	22,273	22,273
Internet Connections	36,700	41,925	35,930
Indirect Costs: Highlands University DHHS rate	17,761	17,760	18,247
<b>TOTAL</b>	<b>\$154,167</b>	<b>\$154,167</b>	<b>\$154,030</b>

## Conclusion

We are grateful for the opportunity NASA has given us to find ways to realize our common desire to increase the numbers of individuals of traditionally under-represented minorities who pursue careers in mathematical sciences and engineering.