An Integrated Approach to Engineering Education in a Minority Community

Bill Taylor, Dale Ross
New Mexico Highlands University

Summary: Northeastern New Mexico epitomizes regions which are economically depressed, rural, and predominantly Hispanic. New Mexico Highlands University (NMHU), with a student population of approximately 2900, 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. These schools have gained electronic access to each other, to computer resources, to technical help at New Mexico Highlands University and have gained access to the world via the Internet. An outreach program was initiated in the fall of 1992 in an effort to attract and to involve minority students in Engineering and the related sciences. To date, we have installed 56 Kbs Internet connections to eight elementary schools, two middle schools, two high schools, a public library (servicing the home schooling community) and two preparatory schools. For another fourteen rural schools, we provided computers and free dial-up service to servers on the NMHU campus.

Internet training programs for pre-college teachers have been presented several times each year. Trained teachers, in turn, have become responsible for transmitting their Internet expertise to their colleagues and students. In the advanced Internet course, teachers create their own home pages and in the Internet administration course, selected teachers learn how to maintain their school's computer network and Internet servers. Computer networking provides the electronic backbone for 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 participate 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 USA are gaining access to the Internet, NASA has made this movement a reality in rural, northeastern New Mexico. Access to Internet enables 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.[1,2] This is especially significant to the school districts of northeastern New Mexico that too often find themselves isolated with marginal resources. Highlands University has established 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 in the hopes of improving science and mathematics education. We see this as a key component of an 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 provides a valuable curricular resource since lesson plans and appropriate guidance tools are proliferating rapidly in the Internet.[3]

Perhaps the biggest complaint teachers have about new technologies is that of having too little training on how to use the technology in the classroom. In recognition of this problem, we have 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 are (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 and (5) to provide access to information on colleges and universities. Internet connectivity provides a useful backbone for tutoring services. Elementary, middle and high school students have direct electronic mail contact with each other and Highlands University.

Parents are key partners in a successful program allowing student access to Internet resources. Accordingly, we conducted workshops for interested parents who wish to experience a "gentle introduction" to the Internet.[4] For those parents who home-school their children, we have provided computer access through the local public library. Whether at the public library or at a school library, we have 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 are 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. NMHU students serve as MESA tutors in the local middle schools and high schools and MESA pays the University students a stipend to help compensate their efforts. Special training on the uses of Internet is available to all interested Highlands students and our tutors are 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) have served as MESA mentors and as judges for regional MESA design competitions and the Northeast Regional Science and Engineering Fair. Lower division students are tutored by the upper division students and these, in turn, serve as tutors in the high schools. High school students tutor the middle school students and these, in turn, serve by tutoring elementary school children.

The NASA Educational Outreach Network (see URL http://vyne.NMHU.edu) gives Highlands University unprecedented access to the schools in the NMHU 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. Our

technical advisory group is the Educational Networking Support service of the Los Alamos National Laboratory Science Education Programs.[5]

Data circuits were leased from New Mexico TechNet and they sub-contracted with US West, our local telephone utility. This on-line frame-relay network operates at 56 Kbs, bundled with the T1 circuit servicing NMHU 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, the Armand Hammer United World College of the American West and the Native American Preparatory School. We leased routing equipment also for each site from New Mexico TechNet. Connectivity for outlying rural areas is provided through free dial-up access to Internet servers at NMHU Department of Engineering. We worked with US West to become a "first tier customer" first by contracting for long distance or "back haul" connections to the frame-relay office in Santa Fe for six months. Finally, in January 1996, US West installed frame-relay equipment in our community.

Engineering and Pre-Engineering Education: We have integrated two threads of engineering education: undergraduate research experience and precollege outreach. Each year, two undergraduate students participate in a summer internship at NASA Dryden Flight Research Center. During the school year, the student researchers worked with their faculty mentor in preparation for their summer research project. The summer program at NASA provides research experiences for two Engineering students and they work together on projects (e.g. interfacing a computer controller for a LASER positioning table).

During the school year we support the Young Astronauts program for middle school students and each summer, 30 middle-school students are selected for participation in a water ecology program. Two Highlands students work with the children who collect information about New Mexico's rivers and streams. On our annual Discovery Day, buses from all over northern New Mexico converge on Highlands University--since 1994. Students enroll in mini-workshops of interest which are conducted by Engineering faculty and students. Each participating high school student receives a NASA logo tee-shirt and an experience of the possibilities awaiting them in Engineering careers. We instituted a bi-weekly seminar series for student development. Speakers for the Engineering students have included former graduates from the Engineering program and also speakers from NASA, 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 in 1994. A visit from SHPE President and regional Vice-President helped in the formation of a local student chapter. Each year, we have helped student officers attended SHPE leadership conferences and office space was given to the SHPE student chapter.

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Biographical Information

BILL TAYLOR is the Principal Investigator for the NASA Educational Outreach Program entitled, "An Integrated Approach to Engineering Education in a Minority Community." Dr. Taylor is the past Chair of the NMHU Department of Engineering and served two years as the Director of the NMHU School of Mathematical Sciences and Engineering. He is also the PI of a NASA project entitled, "Fuzzy microcontrollers for CELSS applications."

DALE ROSS serves the NMHU Department of Engineering as an instructor in an innovative pre-Engineering program and is a Ph.D. candidate in Educational Technology. Mr. Ross has served as co-investigator for the project reported here for the past four years.