2006-6: A WEEKEND STEM ENRICHMENT PROGRAM FOR TRIBAL HIGH SCHOOL TEACHERS AND STUDENTS

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A Weekend STEM Enrichment Program for Tribal High School Teachers and Students

Abstract

Attracting high school students to college engineering programs has been recognized as a challenge by several engineering organizations. One of the reasons for the low percentage enrolment of high school graduates into engineering programs is that many math/science teachers and counselors lack understanding of engineering applications within the subjects they teach and prospects associated with engineering careers. The instruction at the school level is often criticized for not adequately emphasizing science and mathematics, especially connections with engineering applications. Many students have difficulty connecting math and science courses to common phenomena seen all around and to future careers. This problem is further aggravated on Indian reservations in North Dakota because of their isolated locations and distance from industries. The authors developed a weekend academic program, "Sunday Academy", carried out on four North Dakota Indian reservations, to stimulate Native American students' interest in science, technology, engineering, and mathematics (STEM), to attract to engineering programs, and to engage high school teachers and tribal college instructors in the process of developing engineering and applied science lesson plans. The academy consisted of a series of one-day academic sessions presented monthly to junior and senior high school students. The lesson plans for the sessions were developed collaboratively by a group of university and community college faculty and high school teachers. This project provided unique opportunities for engineering professors to work with high school students directly, to familiarize high school teachers and tribal college instructors with engineering concepts and approaches, and to be knowledgeable about and sensitive to Indian culture. To make it a successful program, the authors had to overcome various challenges, including selection of lesson topics and hands-on activities that are interesting and suitable for the students, and engagement of high school teachers and tribal college instructors in learning engineering concepts while respecting their expertise. In this paper, approaches used in the topic selection and lesson plan development, implementation of student activities, impacts on high school teachers and students, challenges faced by the collaboration, and lessons learned are discussed. The academy model is generic and may be applied to any high school student population.

Introduction

According to the National Science Foundation (NSF)'s 2004 Science and Engineering Indicators, only 328 American Indians and Alaska Natives earned bachelor's degrees in engineering in 2000. Although this number is impressively larger than the total in 1977 data when only 135 degrees were awarded, the number of American Indians and Alaska Natives earning engineering degrees remains abysmal. Native Americans are going into higher education in greater numbers. But for many, perhaps because of inadequate exposure and participation in advanced math and science courses in high school, the pre-college education does neither prepare nor motivate them to aspire to science, technology, engineering, and mathematics (STEM) careers. In addition, they are not being exposed to rigorous math and science courses in 7th through 12th grade from experienced certified teachers. The Native American population experienced tremendous growth

in the 20th century, increasing from 237,000 people in 1900 to 2.5 million people in 2000. Native American degree increases have failed to keep pace with their population growth (Babco, 2003). If college students in the STEM fields are the essential conduits to bringing about new and innovative scientific knowledge necessary for the nation's future, the pipeline issue of student entry into STEM disciplines in higher education and issues related to student persistence and graduation must take paramount importance, and no more so than for Native Americans wanting to participate (Tan, 2002).

North Dakota has four Reservations with a tribally controlled college (TCC) in each of them. These TCCs are vital links for higher education on Reservations. Most of the high school students on the Reservations aspiring to pursue careers in STEM areas are likely to enroll in the TCCs first and then move on to four-year universities.

This paper discusses a project that was implemented on North Dakota Reservations to offer additional mathematics and science exposure and opportunities to attract and prepare the Native American students for STEM careers. A weekend academic program, "Sunday Academy", was developed, implemented and refined over the past 6 years. Once in a month during the first 7 months of an academic year, the Sunday Academy was carried out simultaneously at four TCCs in North Dakota. High and middle school students on the Reservations were the targeted audience of this outreach effort. The instructional team consisted of high school teachers, TCC faculty, and university professors. Partners in this collaborative effort were North Dakota State University (NDSU), Turtle Mountain Community College, Sitting Bull College, Fort Berthold Community College, Cankdeska Cicana Community College, and Reservation Schools. This project contributed to a stronger team approach and engagement of teachers, TCC faculty, and university professors at all levels from the developmental stage to the implementation of session lesson plans.

Needs of Improving STEM Education in Reservation Schools

In a recent survey of K-12 teachers, most responders surveyed said that they and their students would benefit from increased engineering exposure in their classrooms, 39.1% strongly agreed and 51.2% agreed with the statement, "Understanding more about engineering can help me become a better teacher," and 28.2% strongly agreed and 55.8% agreed that their students would be interested in learning engineering (Douglas et al., 2004). Using the results of the survey, Douglas et al. developed guidelines for K-12 engineering education which emphasize the importance of *hands-on learning, interdisciplinary approach, standards, using/improving K-12 teachers*, *making engineers "Cool"*, *creating partnerships*. Engaging more K-12 teachers effectively in outreach efforts are highlighted in these guidelines.

Minority students tend to have fewer opportunities to excel in sciences and mathematics due to budget and resource restrictions (Bombaugh, 2000; Darling-Hammond, 1998). In North Dakota, there are approximately 30,000 Native Americans distributed geographically in 5 reservations throughout the State according to their tribes. Although they represent about 4.9% of the total population of North Dakota, the number of Native American students at NDSU is 1.0% (Office of Institutional Research and Analysis, 2005) of total students while on average 1% of B.S. graduates of the Engineering College are minority (all groups) (College of Engineering and

Architecture, 2001 and 2002). Based on standard test scores, less than 5% of students at the Turtle Mountain High School, one of the reservation high schools in North Dakota, are proficient in mathematics compared to an average of 33% for North Dakota (North Dakota Department of Public Instruction, 2004).

Teacher shortages and improper training in new technologies; a lack of facilities, resources and technical support; and inappropriate curricular designs have contributed to lower achievement of Native American students in STEM related content areas. Most teachers at North Dakota reservation high schools are highly loaded on their teaching assignments and are inadequately prepared and equipped to explain science and engineering concepts. Native American students have not traditionally been drawn to higher level math and science courses. In activities such as science fairs, only a few selected students participate. It is essential to offer additional math and science exposure to all students to attract and prepare them for math, science and engineering careers. Enrichment activities need to be designed and delivered with the potential of reaching out to those teachers and students. If done collaboratively by the university and tribal college faculty and teachers, these activities are more likely to be designed and delivered better.

The Weekend STEM Enrichment Program

One of the difficulties experienced by students entering college level STEM programs is their inability to connect mathematics and other basic sciences to problem solving. The academy sessions need to be designed to relate mathematics and other sciences to problem solving with carefully selected examples. The instructors may introduce mathematics, physics, chemistry, biology, geology, and computers, all in problem solving contexts. In programs of this type it is important to show students how mathematics and science are used to solve real world problems. While there is no way of disregarding the need for knowledge of mathematics and sciences to pursue STEM careers, it is important to emphasize that it can be fun to learn mathematics and sciences in an engineering and science context. As an alternative to the commonly used one-day-a-year sporadic enrichment activities, a series of weekend one-day sessions was designed to generate interest among the high school students in mathematics, science and engineering. It was thought this approach might help better sustain the interest and motivation of the students to pursue college education in STEM areas. Students were presented with practical day-to-day problems involving simple mathematics, physics, chemistry and engineering, requiring them to think, analyze and seek solutions. The sessions were designed to be informal and friendly to the students. High school teachers and the university and tribal college faculty worked together to develop and implement lesson plans. Great care was taken in the selection of topics and hands-on activities to be included. Relevance of the topics to the Native Americans was emphasized in the lesson plans wherever appropriate.

Each weekend enrichment session was conducted on the same day at the four TCC sites where the students assembled for the day's activities. All the sites were also connected through an Interactive Video Network (IVN) system for the students and teachers to share their results and experiences. At least one NDSU professor traveled to each Reservation to facilitate the session. Typically 2 TCC faculty members, 1-2 teachers, and 1 NDSU professor were involved in the instruction and advising hands-on activities at each site.

The overall objective of the program is to generate among the high school students interest in mathematics, science and engineering and to attract them to pursue college education in engineering. On completion, the academy activities are expected to generate in the attendees:

1. an awareness of the STEM professions and career prospects;
2. an awareness of skills necessary for problem solving,;
3. an understanding of the importance of STEM in problem solving; and
4. an interest to pursue college education in STEM.

Topic Selection

The topics for the sessions were selected after detailed discussions with the community college faculty and high school teachers by the NDSU faculty. The NDSU team consisted of professors from the departments of Mathematics, Physics, Chemistry, Civil Engineering, Mechanical Engineering, and Electrical Engineering. The input from the high school teachers was extremely beneficial to weed out the topics already covered by them in some detail and to decide at which level the topics were to be presented even if they had covered them in school to some degree. Out of several suggested topics seven were selected each year based on the following criteria:

1. Must be exciting to students;
2. Must have reasonable science and/or mathematics content at the appropriate level;
3. Must have interesting applications in industry or day-to-day life; and
4. Must be able to provide doable hands-on activities within a timeframe of a few hours.

Dr. Gilbert, a Native American educator, argued that Native American students will have more positive attitude toward learning science topics if the curricula included Native cultural knowledge (Gilbert, 2000). This idea also was promoted by the participating TCCs in developing the weekend academy lesson materials. As a result, cultural connections were considered during topic selection and were incorporated in all the lesson plans. Some of the Sunday Academy topics are presented in Table 1.

Lesson Plan Development

After topics were selected, lesson plans and hands-on activities were developed with a team approach. Each team, responsible for a lesson, was led by an NDSU professor with 1 to 3 members from TCCs or tribal high schools. The lesson development can be typically divided into the following steps: (1) literature search for contents and hands-on activities; (2) writing the lesson plan; (3) developing and testing hands-on activities; and (4) preparing presentation materials. Members of each team usually start their collaboration via e-mail communications, and the lesson plans are finalized during a summer camp in which professors, instructors and teachers spend up to a week together to work through the steps. This process of lesson plan development turned out to be a learning process not only for the TCC faculty and tribal high school teacher, but also for NDSU professors. Several arrangements were experimented to create a better process and working environment for effectively engaging the high school teachers and TCC instructors, and for improving the quality of lesson plans.

Table 1. Selected Sunday Academy Topics

Topic	STEM focus	Cultural Connection
Why do Some Objects Float and Some Sink	Physics, mathematics, engineering	Native American canoe making
Science of Pizza Making	Microbiology, food science	Native American cooking methods
Water and the Environment	Water quality and environmental science	Nature and the American Indian Culture
Ciphers and Codes	Mathematics	World War II Navajo code talkers
Forces and Rockets	Physics, mechanical engineering	Traditional Native American hunting tools and methods
Soil is Down to Earth	Soil science	Relationships between Native Americans and their land
Straw Bridge and Towers	Mathematics, physics, civil engineering	Traditional Native American house structures.
Conic Section	Mathematics	Use of circle and other shapes in Native American culture

Professors develop the lesson plans and then train the teachers and instructors. This was an approach adopted first with the logic of using the expertise of science and engineering professors to expose teachers and instructors to new concepts and methods, therefore improving their teaching capabilities in different math and science areas. Although the teachers and instructors were asked to provide comments and suggestions after they were trained on each topic, their involvement in lesson plan and hands-on activity development were limited. This method was easy for project management to check and assure enough math and science contents were included in each lesson. However, the concepts and activities in these lessons often turned out too hard for the students and sometimes the teachers as well. Some teachers showed great interests in learning new concepts and method when the topics are closely related to their teaching, but in many cases they showed little interest in what professors considered interesting. Because teachers and instructors felt almost no ownership of these lesson plans, they appeared less enthusiastic in deliver the lesson plans to their students. Professors had to carry the most loads in advising high school students on hands-on activities. Very quickly professors realized

that they did not have proper knowledge on students' math and science levels and had no experience teaching high school students.

Teachers and instructors are responsible for lesson plan development with the guidance of professors. To engage the teachers and instructors more in the lesson plan development and to make them take the responsibility of the lessons, they were put on the drivers' seats. In this approach, teachers and instructors were responsible for writing lesson plans and developing hands-on activities. The professors would then comment on the lesson plans for revision and assist in the testing of hands-on activities. To certain degree, this is like advising graduate students. This approach was well accepted by the teachers and instructors. However, new problems appeared as the process moved forward. Several professors suggested they were not satisfied with the lesson plans, but their suggestions were not accepted by the teachers and instructors. It is believed that the problem came from the fact that high school teachers normally prepare their lesson plans based on specific textbooks with the support of well-developed materials. When they were asked to develop new lesson plans, often beyond their teaching areas, they tended to rely on one or two sources that they had easy access to but might not fully understand the concepts. On the other hand, teachers are used to take charge in their classrooms. It might be important for them to show students their authority in what they teach and in running the class. When questioned by professors on the materials they developed, they felt that their knowledge was challenged. Instead of opening up to new ideas or concepts, they usually became passive and protective.

Professors develop the outlines with suggestions from teachers and teachers develop lesson plans with input from professors. It was realized that to positively engage the teachers and instructors in lesson plan development, proper procedures must be followed to provide teachers with sense of ownership and responsibility, and to provide professors with proper ways to interact with the teachers. Success of the program requires good quality lesson plans. It is even more important to have enthusiastic and well-trained teachers to run the program. To overcome the difficulties encountered in the first two approaches, professors were asked to develop outlines and suggest hands-on activities for each selected topic. Each professor would then seek comments from his team members for suggestion. After the outline was agreed upon by everyone in the team, the teachers and instructors took the responsibility of developing the lesson plan and the procedures for hands-on activities. In the meantime, professors set up their labs and prepared materials for testing of the hands-on activities. As a result of this more interactive setup, professors were able to provide initial suggestions using their expertise, and teachers and instructors, who had the responsibility of developing the details of lesson plans, felt the ownership. The professors also were able to use the testing of the hands-on activities to further stimulate the interests of the teachers and to address the concept behind each activity.

A three-day workshop for the community college faculty and high school teachers was organized in the preceding summer at NDSU to train them on all the topics. Each team took turns to present its lesson plan and to direct the hands-on activities carried out by other participants. This provided authors of the lesson plans an opportunity to practice before presenting the lesson to students. At the end of each session, comments and recommendations for lesson plan and hands-on activity improvements were sought through lively discussions.

Implementation of the Weekend STEM Sessions

Student recruiting was carried out by participating tribal high schools. In order for the weekend academy sessions to be successful, the partnering high schools must make a strong commitment to participate in the activities. Since this is an activity designed for attracting students to engineering disciplines and for helping them to develop problem-solving skills, no specific criteria for selection were prescribed. An interest and curiosity toward STEM should only be the pre-requisites to participate. A brochure/application form was developed and distributed to career counselors of the targeted schools.

In each session the problem for the day was introduced to the Reservation high school students from one of the tribal colleges over the IVN. Cultural connection to the topic of the day was presented first by a tribal member. The problem description, background principles in terms of mathematics, science, and/or engineering, application to real life processes and products, and the questions to be answered were then presented by one of the lesson plan authors. Then, the IVN was switched off. Two Tribal College faculty members and two high school teachers supervised the hands-on activities of the students at the site.

Students worked in groups of three or four on the assigned hands-on activities with guidance from the designated community college faculty and high school teachers and at least one university professor. The work consisted of gathering data from experiments, recording them properly in tabular form, computing required results, and preparing graphs and other presentation material. Towards the end of the session, the students came on IVN to present and discuss their solutions. Each group made a formal presentation of the experimental procedure and results. Each presentation included time for questions and answers. Students maintained a journal of all the work they did in all of the sessions. At the end of the session a simple questionnaire was used for surveying the students for their evaluation of the session. Another questionnaire was used for the high school teachers. The feedback from the students, teachers, and faculty was helpful in improving later sessions. Also the university faculty met regularly before each session to plan and fine-tune the lesson plan and after each session to review and improve later sessions.

Outcome of the Program

Participation in various project activities are presented in Tables 2, 3, 4, and 5. This program has made positive impacts on many Native American high school students, as well as participating teachers, instructors, and professors.

Impact on students: Number of students participating in the weekend academy increased steadily over the years. Last year, more than 100 students attended each session, averaging 20 to 30 students at each site. Some students stayed with the program for 4 years. Some students also convinced their younger brothers and sisters to participate. One former student, who joined U.S. army after graduation, called from Iraq during a session encouraging students to stay with the program. Although many students showed interest in attending NDSU or other 4 year colleges, the actual number of them successfully attending universities remained low for various reasons.

Table 2. Student Participation in Sunday Academy Activity at Different Sites

Program Year	*TMCC*	*SBCC*	*LHCC*	*FBCC*	*UTTC*
1999-2000	21	n/a	n/a	n/a	n/a
2000-2001	30	28	n/a	n/a	n/a
2001-2002	23	22	15	n/a	n/a
2002-2003	55	18	20	15	5
2003-2004	60	18	15	18	9

Table 3. Student Participation in TCCC Summer Camps at Different Sites

Program Year	*TMCC*	*SBC*	*LHCC*	*FBCC*	*UTTC*
2000	31	n/a	n/a	n/a	n/a
2001	21	21	n/a	n/a	n/a
2002	26	18	18	n/a	n/a
2003	30	22	20	15	n/a
2004	60	39	27	16	n/a

Table 4. Student Participation in NDSU Summer Camp

Program Year	*TMCC*	*SBC*	*LHCC*	*FBCC*	*UTTC*
2000	4	n/a	n/a	n/a	n/a
2001	3	2	2	1	n/a
2002	4	4	2	1	n/a
2003	11	3	2	1	n/a
2004	7	3	1	3	n/a

Table 5. Faculty/Teacher Participation in Sunday Academy/Summer Camps

Program Year	*TMCC*	*SBC*	*LHCC*	*FBCC*	*UTTC*	*NDSU*
1999-2000	2	n/a	n/a	n/a	n/a	6
2000-2001	4	3	3	n/a	n/a	7
2001-2002	3	3	4	1	1	7
2002-2003	4	3	3	1	1	7
2003-2004	4	4	3	3	1	8

Impact on high school teachers and TCC instructors: Some lesson materials and equipment acquired through the program were used by teachers in their regular classes. One of the high school science teachers decided to pursue her Ph.D. in education focusing on Indian education. One of the TCC faculty members recruited among the participating high school students for a research project. He supported several students during the summer conducting field study of an invasive plant species.

Impact on professors: Learning the American Indian culture proved to be very beneficial to the participating professors. In addition to being more sensitive to the cultural differences among students with different backgrounds, most of them became active in advising Native American students and their organization. One of the professors even spent one academic year at one of the

TCCs rejuvenating its pre-engineering program. Some collaboration with TCC faculty on research projects was established. Collaborations with tribal high schools and TCCs have gone beyond this program helping some professors win nationally competitive federal funding.

Lessons Learned

- NDSU faculty gained a better understanding of the Native American culture.
- Visits of NDSU faculty to the reservations and face-to-face meetings are essential at least at the beginning stages of collaborative projects.
- Also it was essential for the TCC faculty and teachers to visit the NDSU campus and have meetings for them to feel comfortable in collaborative activities.
- High school teachers have various academic backgrounds. They teach many different subjects. In some of those subjects they are barely qualified to teach.
- TCC faculty and high school teachers need to be engaged from the beginning stages of the lesson plan development all the way to lesson delivery. If the lesson plans are developed and given to them, although happy initially, they do not seem to be happy implementing them as intended.
- Tribal school teachers need to be reminded that one needs to be at least couple of levels above the students in any subject to teach with confidence.
- Tribal school teachers need to feel the ownership of the lesson plans developed.
- Hands-on activities need to be tested out before hand to develop confidence. They have a tendency to believe it will work once conceived on paper. So is the case with organizing materials needed for hands-on activity. There is a tendency to take it for granted.
- Wherever possible the lesson topics if connected with the Native American relevance seemed to get the attention of students better.
- Hands-on activities need to be included and supervised properly to develop problem solving and analytical skills. It should not be just an information gathering activity.
- Inviting parents into on-going hands-on sessions provide opportunity for the parents to observe their children involved in science activities. It seemed to work well. Quite a few parents did attend such occasions and that seems to motivate them to encourage their kids to go to these special programs.
- Stipends are important to attract students because of poverty in Reservations

Conclusion

The low enrolment of NA high school graduates in college level engineering programs and their high rate of dropout may be due to several reasons. Often, enrichment activities are offered as the only solution. In fact several factors affect the mobility of the NA students along their pathways to enter and complete engineering programs. Lack of financial resources, lack of parental encouragement, different learning style, hesitation to move to universities, ill-equipped schools, inadequate teacher preparation in STEM areas, and teachers' attitudes can have a significant effect. A multi-pronged approach to address these factors comprehensively may be necessary to facilitate smooth flow along the pathways. The overall project, of which the Weekend Academy program was only a component, accommodated many, although not all, of the above factors. The factors addressed, strategy used, and outcomes are presented in Table 6.

Table 6. Factors addressed and Outcomes of the Project

Factors addressed	Strategy used	Outcomes
Lack of financial resources	Scholarships at TCC and University levels	20 TCC students and 14 NDSU students benefited
Lack of parental involvement and encouragement	Parents are invited to attend opening and closing activities	High percentage of parent attendance
Different learning style	Various hands-on activities were designed and used	High student retention rates and many students attended the program for multiple years
Hesitation to move to universities	Summer camp at NDSU and mentoring programs	Increased number of students attending 4 year colleges although moderate
Inadequate teacher preparation and attitudes toward learning new knowledge	Summer camp for teachers, opportunities to work with professors	Teachers from 8 tribal high schools attended and high retention rate
Lack of teaching equipment	Secured funding for lab equipment	Provided various lab equipment to TCCs. Some of them are frequently used in regular classes

The weekend STEM enrichment program designed and delivered by the authors in collaboration with the tribal college faculty and reservation school teachers has all the ingredients of the guidelines developed by Douglas et al. (2004) for K-12 outreach.

This project has impacted the North Dakota Tribal Colleges in the following ways:

- The Tribal Colleges continue to develop infrastructure required to address Science, Mathematics and Engineering (SME) at the tribal college level.
- The reservation high schools have become aware of the academic needs of Native American students who desire to pursue SME careers and will be able to put programs in place to nurture those students.
- The participating university faculty became aware of the educational needs and learning styles of the NA students.
- A core team of Tribal College and NDSU faculty and Reservation high school teachers has evolved and the working relationship will continue nurturing NA students to seek SME careers.
- More collaborative proposals to strengthen the Native American pathways to SME careers are being developed.

References

Babco, Eleanor L. (2003) Trends in African American and Native American Participation in STEM Higher Education, Commission on Professionals in Science and Technology, 1200 New York Ave., NW, Suite 390, Washington, DC 20005.

Bombaugh R. From citizens scientists to engineers. J Prof Iss Eng Ed Pr 2000;126:64.

College of Engineering and Architecture, North Dakota State University. Source-Newsletter for Alumni and Friends 2001.

College of Engineering and Architecture, North Dakota State University. The Source-Newsletter for Alumni and Friends 2002.

Darling-Hammond L. Unequal opportunity: race and education. The Brookings Rev 1998;16:28.

Douglas, Josh, Eric Iversen, and Chitra Kalyandurg (2004) Engineering in the K-12 Classroom: An Analysis of Current Practices & Guidelines for the Future, A Production of the ASEE EngineeringK12 Center, The American Society for Engineering Education 1818 N Street, NW Suite 600, Washington, DC 20036.http://www.engineeringk12.org

Gilbert, W.S. (2000) The Native Science Connection: Bridging Native Cultural Science Knowledge into the Existing Science Curriculum, The American Indian Science & Engineering Society 22nd Annual Native Conference and Career Fair, Nov. 9-11, Portland, Oregon.

National Science Board (2004) *Science and Engineering Indicators 2004*, NSB 04-01, National Science Foundation, Division of Science Resources Statistics, Arlington, VA.

North Dakota Department of Public Instruction. State of North Dakota, North Dakota School Plant Profile 2002-2003-Turtle Mountain Community High School 2005.

Office of Institutional Research and Analysis, North Dakota State University. Factbook index; http://www.ndsu.edu/oia/inst_analysis/factbook/contents.shtml. Accessed on December 6, 2005.

Tan, David L. (2002) Majors in Science, Technology, Engineering, and Mathematics: Gender and Ethnic Diffrences in Persistence and Graduation, Presented at the 42nd. Annual Association for Institutional Research (AIR) Forum in Toronto, Canada on June 3-6, 2002.