Southwestern Indian
Polytechnic Institute

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College Bound American Indian Math & Science Enrichment Program (AIMS)

Final Report to the U.S. Department of Energy
for Grant No. FG03-94ER 75947/A003

DISCLAIMER

Final Report

College Bound AIMS Program

Background

Southwestern Indian Polytechnic Institute (SIPI), was founded in 1971 and is located on 164 acres in northwest Albuquerque, New Mexico in the center of New Mexico's agricultural and high-tech corridors. SIPI became accredited as a community college in 1993, serves Native Americans nationwide, and is governed by a nationally-tribally appointed Board of Regents (Jicarilla Apache, Joint Oklahoma Tribes, Mescalero Apache, Navajo Nation-Arizona, Navajo Nation-New Mexico, Ten Southern Pueblos, and Eight Northern Pueblos, Southern Ute, Inter-tribal Council of Arizona, and Oglala Sioux).

SIPI provides an educational environment that prepares Native American students either to pursue additional higher education or to compete successfully in the 21st century workforce, on or off the reservation.

In 1993, The U.S. Department of Education, TRIO Programs no longer funded the Southwestern Indian Polytechnic Institute (SIPI) Summer Math and Science Enrichment Program. However, with U.S. Department of Energy funding SIPI was able to continue service to the Native American community under the new title of College Bound American Indian Math and Science (AIMS) Enrichment Program. This new program continued the goals and objectives of the TRIO program with an expanded focus that included students from more Native American communities nationwide. The program also interfaced with a teacher enrichment program (Rural American Indian Science Education–RAISE) sponsored by the Bureau of Indian Affairs and Sandia National Labs (SNL).

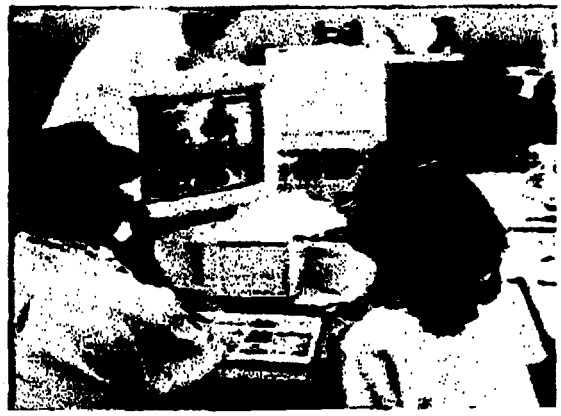
In November 1995, the U.S. Department of Education, TRIO Program awarded SIPI a five-year grant for an Upward Bound Program. When SIPI received this new funding, the U.S. Department of Energy no longer funded the project. The last funding period was from November 15, 1994 through November 14, 1995. U.S. Department of Energy requested an extension of 90 days and SIPI concurred.

Approach

SIPI in collaboration with Sandia National Laboratories and Lawrence Livermore National (LLNL) Laboratory established a mathematics and science enrichment program at SIPI for students attending rural high schools serving predominantly Native American populations. The primary goal of the program was to provide 9th - 12th grade students, mostly Native American, the skills and knowledge, interest and motivation, and strategies to remain in high school and pursue a college education in a math, science, or technology based field. Each year, the program included a six-week intensive residential summer program located at SIPI as well as academic year support activities at the student's high school. Teams of

scientists, engineers and educators using project-based, integrated learning methods taught math, science and technology. A smaller cohort of students spent one week working on the LLNL Supercomputer.

The SIPI pre-college programs have achieved recognition as highly successful enrichment programs for low income, minority students. A large part of this success has come about through the ability of the SIPI program coordinators to work closely with staff from SNL and LLNL to develop and implement cooperative, innovative and effective program components that draw upon the resources of the two national labs.



College Bound students using remote sensing technology.

One of these is the supercomputer workshop that has evolved into a cooperative effort with staff at both SNL and LLNL (NERSC). This particular part of the Math/Science program has been tremendously successful and has generated a great deal of interest in expanding other cooperative efforts between SIPI and the national labs. The local offices of the Department of Energy, the University of New Mexico and many of the high-tech firms in the Rio Grande research corridor have also supported the SIPI programs with commitments of manpower and resources. The Math/Science program has included more industry-based components with each succeeding year. This year, components were added which included Internet, fractals, computer-aided design, and remote sensing projects, all using the latest technologies available.

Other components of the summer program include:

Workshops – Introduction to PC hardware – Solar Technology – Interview Skills – Speechmaking – Career Goals – Natural Resources Mini Camps – Supercomputer Workshop – Ham Radio Technology and Applications – Forest Service Fire Fighting – WIPP Tru-Pac Toxic Waste Transportation and Storage – Solid Waste Management – Water Quality Testing – SAT Tutorial.

Projects – Environmental Testing – Astronomy via Remote Imaging – Toxic Waste Container Design – CAD Designs in Virtual Reality – Fractals – Satellite Imaging via Remote Sensing – INTERNET Applications – Countdown to Supercomputing – Media Literacy – Marketing Simulations – Economics of Recycling – Desktop Publishing Applications.

Presentations – Careers – Chemistry – Portable Computers – Robotics – Micro-electronics – How to Give a Presentation – Self Esteem and Staying in School – Career Development – Statistics at Work – Technician to Engineer – Education Across Cultures – Research Skills – Goal Setting – Traditional Healing and Medicines – Substance Abuse – Self Esteem and Tradition – Legal Issues – Careers in Architecture – College Application Procedures – Financial Aid Location Services.

Academic Classes – Math Topics – Math With Calculators (each student was given their own scientific calculator plus instruction in the use of a graphing calculator) – Earth Science Environmental Science – Physical Science – Technical Writing – Communications – Geography – Study Skills – Word Perfect – Desktop Publishing – Success Skills – Computer Science – and Computer-Assisted-Instruction in all disciplines.

Tours – UNM, Highlands, New Mexico Tech and Stanford – Ethicon, EG&G, Intel, Lovelace, Digital and Honeywell – Sandia, Sandia Livermore, Lawrence Livermore and Los Alamos National Laboratories – National Atomic Museum – San Francisco Science Exploratorium – National Weather Service – UNM GIS Technical Applications Center – Albuquerque Publishing Company – J.C. Penney Data Center.

Students tour San Francisco after a day of working at Lawrence Livermore National Labs Supercomputing facilities.

Cultural Activities – Isleta Pueblo Feast Day – Natural History Museum – Maxwell Museum – New Mexico Museum of Indian Arts and Culture – Institute of American Indian Arts Museum – Great American Indian Dancers – Puye Cliffs National Monument.

Recreational Activities – Ice Skating – Swimming – Zoo - Sandia Tram- Movies – Dances- Fun Runs – Basketball – Archery – Volleyball – Softball – Bingo – Arts and Crafts – Aerobics – Weightlifting – Dukes Baseball – Fireworks – Computer Games and Competitions – Writing Contests – Tennis Lessons – Pool and Ping Pong Tournaments – Picnics, Cookouts and an Awards Banquet – Hot Air Ballooning – White Water Rafting.

The student participants are closely supervised seven days a week, with classes and activities planned so that each day (including weekends) is full.

1993-1994 Summer Program

Introduction

Southwestern Indian Polytechnic Institute (SIPI), in collaboration with SNL and LLNL, provided a mathematics and science enrichment program, focusing on environmental science, during the 1993 summer session. Additionally, a series of enrichment workshops were provided for science teachers from many of the students' home schools. These Teacher Training Workshops were a joint venture with the Rural American Indian Science Education (RAISE) project funded by the Bureau of Indian Affairs (BIA).

Student Component

Seventy-three students representing fifteen tribal affiliations and seventeen schools located throughout the nation completed the six-week summer session.

Ninety-eight percent of the students were low-income (38% from families with an income less than $10,215), and most came from families where neither parent had earned a four-year college degree.

On weekday mornings, all students attended classes in mathematics, science, communications, critical thinking, remote sensing, and health/fitness. In the afternoon students worked in groups on projects led by Sandia scientists who in addition to providing technical assistance, served as role models.

Astronomy and Culture, Water Quality, Waste Management, Weather Station, Virtual Reality, and Supercomputing were the projects for this summer's program.

A new approach this summer was to include twelve SIPI college-level students as interns. The interns assisted College Bound students in academic and personal settings. They received a small stipend and became eligible for five $1,000 scholarships when they transferred to a four-year institution. Funds from the New Mexico Alliance for Minority Participation paid for this new activity.

Students learn basic chemistry principles.

Through a competitive application process, twenty students were selected to work on the supercomputing project. The students were split into teams to design their projects. The teams traveled to Lawrence Livermore National Laboratory to use the supercomputer to finish conducting their research. While in California, students also toured Stanford University, Sandia/California, the Exploritorium, and San Francisco.

Students created a video introducing the College Bound Program and highlighting the summer's events.

The pre- and post- test scores from the standardized Stanford 8 test battery indicate slight academic gains.

Comparison of Pre/Post Scores

Of the Stanford 8 Test Battery

Grade Level		n	Mean	Median	S.D.	Range
9		18				
	Pre		8.23	7.7	2.33	5.5-12.1
	Post		8.35	7.9	2.41	5.4-12.0
10		14				
	Pre		8.83	8.5	2.11	5.7-12.0
	Post		9.21	8.7	2.03	6.0-12.0
11 & 12		40				
	Pre		9.05	8.9	2.38	5.0-12.0
	Post		9.27	9.1	2.28	6.3-12.3

It is important to state clearly that standardized test scores in general, and grade level equivalent scores in particular, have limitations and are difficult to interpret. However, if these scores are found to be valid and reliable for this population, it should be of great concern that these students score quite poorly for their enrolled grade level. On average, the students are at least 6-9 months behind for grade achievement, even after the slight gains from the summer program.

Impact on self-esteem was measured using pre and posttest scores from the Culture-Free Self-Esteem Inventory.

Comparison of Self-Esteem Pre/Post Test Scores

Classification	Pre	Post	Change
Very High	2	8	+6
High	8	8	0
Intermediate	37	34	-3
Low	18	15	-3
Very Low	6	6	0
Total Students	71	71	

Comparing the categories of low and very low, it looks as if three students improved their self-esteem. In addition, the category of "very high" gained six students. It looks as if the program raised scores of those students whom already indicated "intermediate or higher self esteem" and raised them to even higher levels. It may be more difficult to improve students in the lower categories.

Tracking and follow-up of the 18 seniors who attended this summer's program continued. By September 1993, six of the eighteen seniors had completed our survey and confirmed that they enrolled in college.

Teacher Component–RAISE (Rural/American Indian Science Education)

Again, the Bureau of Indian Affairs and Sandia Labs funded RAISE. Thirty-two teachers from schools with predominantly American Indian population (several from the home schools of College-Bound students) attended the RAISE teacher training project this summer where they learned new science and math concepts and how to integrate what they had learned into their curriculum.

- Curriculum for RAISE included activity kits developed and provided by Sandia Labs and the SCIAD Program.
- Sandia provided instructors for the math and science sessions.
  - → Attending teachers were divided by groups into fields matched to their area of specialization, with one group aligned with science activities and the other with math activities.
  - → Science activities were drawn from the topics of microbiology, environmental science, chemistry, human anatomy, physiology, and physical wave motion.
  - → Math workshops consisted of ratio and proportion, geometry, spatial visualization, fractals, and the use of algebra titles.

All participants received a stipend and paid expenses. Nineteen of the teachers elected to receive graduate credit for their participation.

At the conclusion of the summer workshop for teachers at SIPI, six teachers remained in Albuquerque for the remainder of the College-Bound Program to implement the activities they were exposed to during the workshop.

Twenty-three of the teachers planned on using their training to present in-service workshops to their colleague[illegible]hen they returned home.

1994-1995 Summer Program

Students attending the SIPI College Bound Summer Session took the PSAT as a pretest on June 19 and as a post-test on July 20.

The difference in total number of items correct from pretest to post-test was calculated for each subtest for each student and the average gain in number of correct answers is reported by team/group, by grade level, and by the total group for each subtest. Results reflect positive gains overall. Students answered more questions correctly in all subtests after having participated in the summer session.

SIPI College Bound AIMS 1995 Summer Session

Pre-Post Test Results

(Average Gain in Number of Items Correct)

Pre and Post of the PSAT in Vocabulary and Math

	Vocab I		Math I		Vocab II		Math II	
	29 items	% Gain	25 items	% Gain	29 items	% Gain	25 items	% Gain
A (n=12)	3.92	13.50%	1.17	4.68%	3.00	10.35%	3.17	12.68%
B (n=10)	4.60	15.86%	8.40	33.60%	7.60	26.90%	6.50	26.00%
C (n=11)	6.27	21.62%	5.27	21.08%	5.82	20.07%	6.91	27.64%
D (n=9)	9.33	32.17%	5.67	22.68%	8.67	29.90%	8.56	34.24%
E (n=10)	1.00	3.45%	0.00	0.00%	1.00	3.45%	1.20	4.80%
F (n=9)	0.67	2.31%	-1.44	-5.76%	0.78	2.69%	0.89	3.56%
G (n=8)	0.13	0.45%	1.00	4.00%	-0.38	-1.31%	4.13	16.52%
H (n=7)	-0.14	-0.48%	-0.57	-2.28%	0.00	0.00%	1.71	6.84%
	Vocab I		Math I		Vocab II		Math II	
	29 items	% Gain	25 items	% Gain	29 items	% Gain	25 items	% Gain
9th (n=33)	4.91	16.93%	4.73	18.92%	5.39	18.59%	5.42	21.68%
10th (n=9)	9.33	32.17%	5.67	22.68%	8.67	29.90%	8.56	34.24%
11th (n=19)	0.84	2.90%	-0.68	-2.72%	0.90	3.10%	1.05	4.20%
12th-13th (n=15)	0.00	0.00%	0.27	1.08%	-0.20	-0.69%	3.00	12.00%
	Vocab I		Math I		Vocab II		Math II	
	29 items	% Gain	25 items	% Gain	29 items	% Gain	25 items	% Gain
Total Group (n=76)	3.45	11.90%	2.61	10.44%	3.55	12.24%	4.22	16.88%

Students answered an average of 3.5 more questions correctly in the vocabulary sections, which reflects a 12.07% increase in verbal skills. They answered an average of 3.4 more questions correctly in the mathematics sections, which reflects a 13.66% increase in mathematical skills. The numbers listed in the chart, which are in parenthesis, show the number of students in that grouping.

Summary/Highlights

The supercomputer workshop using the Cray computers at Lawrence Livermore National Laboratories (LLNL) was a very successful component of our summer camps. Each year 20 students attended this weeklong workshop. More than 100 students submitted applications via electronic mail based on their desire to develop a project and attend the workshop. SIPI's computer science instructors chose the finalists. With the emphasis on environmental science, the project focused on environmental simulation software on the supercomputers.

Other equally attractive components were added to the program for those students who did not go to LLNL. The components were Microstation, a computer-aided design package; Internet, a national electronic mail network; fractals--a self-replicating math equation which draws designs emulating nature's geometry; and Climoman, an environmental simulation program. All components were project based with an emphasis in environmental science. The components used supercomputer processing telecommunications and the research resources available. Each component culminated with field trips to organizations involved in work related to the project-based component. Microstation was done in conjunction with Sandia National Laboratories (SNL) and culminated with the CAD model developed by the students being placed in SNL's virtual reality research facility. The students went to SNL and were able to experience their model in a virtual reality environment. Students working with fractals took a trip to Los Alamos National Laboratory, which is on the forefront of research in this area. Those working on the Internet component took a field trip to New Mexico Technet, and spent time using their learned skills with the Internet.

All the components were project based. The students used state-of-the-art technology to develop their hands-on projects and to experience industries' application of these technologies first-hand. All students used telecommunication and computer /supercomputer technologies extensively to develop their projects.

All students were involved in remote sensing technology. Environmental Science students projects were built around the acquisition and analysis of satellite images of the earth. Students assembled and mounted the satellite dish, and then used computer hardware and software to acquire images from orbiting satellites. This gave them a whole new perspective on our world. They could see a storm form and move into the area before it was experienced, and they began to see the patterns and interrelations of weather from a global perspective. For example, they began to understand how pollution in one country could affect other countries not responsible for the pollution, so that pollution must be of worldwide concern. An important goal of the program was to relate the math and science taught in the classroom to the application of current and future technologies.

For the second year in a row, two students from the program were selected to attend the National Science Foundation National Conference in Washington, D.C. on "Diversity In The Scientific and Technological Workforce".

"Once in a while things go really well. It is because the team worked well together. It was fun and it was successful. Comments on the evaluation forms were positive and encouraging. Informal comments were equally full of praise and thanks for a job well done. It is with great joy I tell you thanks for all you did to be part of the College Bound Team effort." *--Program Coordinator*