A Middle School Program to Attract Native American Students to STEM Higher Education

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ABSTRACT

A 3-year collaborative project between the Turtle Mountain Community College, North Dakota and the Department of Civil Engineering and Construction, North Dakota State University, "A Reservation Collaboration Initiative for Pre-college Excellence in Science, Technology, Engineering and Mathematics (RECIPE)" funded by NASA completed two years and is in its third year of activities. The project focuses on five components that are essential to realize an increase in the Reservation student participation in science, technology, engineering and mathematics (STEM) disciplines to pursue college education in those areas: informational activities, instructional activities, interaction with industry, interaction with Native American STEM professionals, and a collaborative framework among the University, Tribal College, and Reservation schools. Some of the project activities are: after-school enrichment sessions, weekend academy, summer camp, Tribal College gateway course improvements at TMCC, student meetings with Native American and other STEM and NASA professionals, and informational sessions about university and college campuses. In the first two years, ten middle school teachers and thirty Native American middle school students were impacted through the after-school enrichment activities. Selected NASA-developed lesson plans were modified and adapted for enrichment sessions collaboratively by the University, Tribal College, and Reservation middle school teachers. The state NASA resource person was frequently consulted during the project period. We expect to impact additionally five teachers and fifteen students in the third year. We have identified mathematics, chemistry, and biology gateway courses to be improved. Mathematics course was reviewed and improved first. Chemistry and biology courses are selected for review and improvement this year.

BACKGROUND

North Dakota is a sparsely populated State with few urban centers and a vast rural area. There is a sizable NA population concentrated in the Reservations of the State. Each Reservation is served by a tribal community college (TCC) to meet the higher educational needs of the tribe members. There are five TCCs in the State: Turtle Mountain Community College (TMCC), Belcourt; Cankdeska Cikana Community College (CCCC), Fort Totten; Sitting Bull College (SBC), Fort Yates; Fort Berthold Community College (FBCC), Newtown; and United Tribes Technical College (UTTC), Bismarck. Typically Reservation and surrounding high schools feed the TCCs. There are two major universities in the State that draw students straight from the Reservation schools and from the TCCs. The tribal colleges and the universities have historically worked together on several educational projects in the past. A recent project funded by NAVY provided opportunities for the North Dakota State University (NDSU), TCC faculty and Reservation school teachers to collaborate[1]. The NASA-sponsored project discussed subsequently in this paper is an outgrowth of the above-mentioned NAVY project.

The Turtle Mountain Community College (TMCC), located on the Turtle Mountain Chippewa Reservation in North Dakota, has been making great strides toward creating educational opportunities for the youth of the Reservation. However, there is concern with the low numbers of students who attempt or succeed at careers, which require higher-level science, technology, engineering, and mathematics (STEM) skills. North Dakota State University, as one of the premier educational institutions of the State, for its part has often collaborated on educational initiatives with the TCCs in the State in the past fulfilling its land grant responsibility.

Turtle Mountain Reservation is located in north central North Dakota and is home to about 13,000 members of the Turtle Mountain Band of Chippewa Indians. The Reservation consists of a six-by-twelve mile tract of land. According to the 2000 census, about 41% of the population on the Reservation is below age of 20. A recent Bureau of Indian Affairs Labor Force survey found that 69% of the labor force is unemployed on the Turtle Mountain Reservation.

Most of the children of the tribe attend schools on the Reservation, with the largest school jointly operated by the State of North Dakota and the Bureau of Indian Affairs and serving approximately 1500 students in grades K through 12. Turtle Mountain Community High School has about 600 students in grades 9-12 and 450 middle school students in grades 6-8. Surrounding schools K-12 population is 1400. Surrounding participating schools and the number of Chippewa students in them are: Ojibwa Indian School (336), Dunseith Day School (157), Dunseith Public School (528), St. John Public School (203), Rolla High School (136), and Rolette Public School (37).

The 3-year project, “A Reservation Collaborative Initiative for Pre-college Excellence in Mathematics, Science, and Engineering for Native American Students (RECIPE)”, described in this paper is a collaborative effort between the Turtle Mountain Community College, and the College of Engineering and Architecture, North Dakota State University (NDSU). The possible educational pathways that Native American students on the Turtle Mountain Reservation take are shown in Figure 1. Though entire pathways are shown in the figure, this project concentrates on the intervention activities at the pre-college level (to the left of dashed line on Figure 1) to make a seamless passage to college education in STEM disciplines and to introduce the students to NASA careers. The activities include academic sessions dispersed throughout the academic year and some concentrated events such as summer camps and informational sessions oriented towards NASA careers using educational aids prepared by NASA. The activities of the project are designed to better prepare Native American youth from the Turtle Mountain Chippewa Reservation, for science, technology, engineering, and mathematics (STEM) education at college levels and to make them aware of possible careers in NASA. The activities are expected to stimulate the Indian youth from Turtle Mountain Reservation to pursue careers in areas such as engineering involving higher level STEM skills and thereby increasing the flow along paths A and/or C in Figure 1 and then on to careers in NASA. The project expects a systemic reform of curriculum to occur at Reservation schools.

NATIVE AMERICAN STEM EDUCATIONAL NEEDS

There is concern among the Native American (NA) educators nationally about the lack of NA participation in science, technology, engineering and mathematics (STEM) careers. Recent declines in engineering enrollment among the underrepresented minorities are disproportionately higher than the decline among non-minority students. Resource limitations in the pre-college education of underrepresented minority students suggest the need for a variety of strategies including enrichment and intervention programs. Regardless, programs to increase NA participation and successful completion of engineering degrees are needed[2-8]. This would involve instituting programs not only to motivate the NA middle and high school students to pursue college education in STEM areas but also to guide and nurture them through their academic pathways till graduation. Furthermore, in order to sustain these activities, we need to include the TCC faculty and the mathematics and science teachers of the Reservation schools in the development and delivery of these activities[9-10].

NEED FOR INTERVENTION

Statistics on freshmen intending science and engineering majors nationally by race/ethnicity in Table 1 clearly shows that the declines in NA numbers are disproportionately higher than the non-minority students[11]. Although NAs account for more than 5% of the population in North Dakota, only 130 students out of more than 12,000 students attending NDSU are NAs. This is only about 1.1%. Among these NA students, only 7 are studying mathematics or sciences as majors and 7 enrolled in engineering departments.

Reservation's high schools do not offer complete pre-college math and science experiences due to remoteness, inadequate facilities, and limited staff. In activities such as science fair etc., only students of gifted programs participate. It is essential to offer additional math and science exposure to these students to attract and prepare them for math, science and engineering careers. Activities need to be designed and delivered with the potential of reaching out to those teachers and students beyond those participating in selected gifted programs. Intervention activities are certainly needed at the pre-college level. If done collaboratively by the university and tribal college faculty and teachers, these activities will be designed and delivered better.

NASA SPONSORED TMCC-NDSU COLLABORATIVE PROJECT: RECIPE

This project team has already been working on another project with interventional activities through the entire pathways shown in Figure 1 except the middle school level because of funding agency priorities and resource limitations[1]. However, the need for intervention at the middle school level was clearly recognized by the project team and the result is this project funded by NASA.

Pre-college excellence is the main goal. The project was conceived with the firm belief that the activities to attain that goal can be designed and implemented only through a collaborative effort from the university, tribal college faculty and the school teachers.

This project has the potential of reaching out to a total K-12 population of 2900, 52% of which is in the Reservation Schools and 48% in the surrounding schools with about 30% in grades 1-7 in each case.

The following objectives under four categories were identified to achieve the goals of the project:

Academic Preparation

1. To strengthen the STEM skills of the pre-college students by providing a lively environment in which they can explore mathematics and science
2. To emphasize the interrelationships of science, mathematics, technology, and engineering in the day-to-day activities, industry, and today's scientific advancements at each activity
3. To strengthen problem-solving and critical-thinking abilities in each lesson
4. To strengthen skills required for communicating scientific topics and experiments in each lesson
5. To introduce the students to college/university, and industry environment
6. To provide information on what it takes to pursue a STEM college education and NASA careers
7. To provide continual intervention activities rather than sporadic one-day and annual short-span events on STEM disciplines.

Curriculum Improvement

8. To develop/enhance Gateway Courses in Algebra, Geometry, Chemistry, and Biology
9. To improve K-12 curriculum in STEM areas responsive to the needs of NA students for college preparation in STEM disciplines

Career Application

10. To introduce STEM career prospects in NASA through NASA-developed educational materials electronically or in person
11. To encourage and counsel students that Native Americans have always participated in STEM activities in their own way and it is possible for them to pursue STEM careers without compromising their culture

Collaboration

12. To involve members of the American Indian Society for Engineering and Science national and the student chapters of educational institutions in the State and other successful Native American professionals in STEM areas including NASA in professional advisory and mentoring roles
13. To build a mentoring peer group of parents and teachers interested in STEM, and STEM professionals on the Reservation

14. To develop a culturally sensitive team of NASA professionals, University and Tribal College faculty, and Reservation High School teachers to continue the collaborative effort proposed beyond the project period

Project Design

In the first year, TM school and Ojibwa Indian School were targeted. Dunseith and St. John Schools were additionally invited to join in the second year. Rolla and Rollette schools came on board in the third year.

The project focused on **five components** that are essential to realize an increase in the Reservation student participation in STEM disciplines and to encourage them to pursue college education and NASA careers in those areas.

1. Informational activities,
2. Instructional activities,
3. Interaction with industry
4. Interaction with Native American STEM professionals, and
5. A collaborative framework among the University and Tribal College faculty, and the Reservation High schools

Specifically the following activities were implemented.

Academic Preparation and Curriculum Improvement

1. After-school Enrichment Sessions
2. Weekend Academy
3. Summer Camp
4. Develop and Improve Gateway Courses at TMCC
5. Workshops for teachers and embedding NASA materials in Curricula
6. Culturally relevant course materials and teaching

Appropriate NASA educational products, listed on the web page www.spacelink.nasa.gov and from NASA's Central Operation of Resources for Educators (CORE), were used in activities 1 through 4. In the weekend academy and summer camp sessions, videos or slides illustrating the principles and/or applications of selected topics were used.

Career Application

1. Meetings with Native American and other STEM and NASA professionals
2. Informational sessions about university and college campuses, NASA STEM career prospects, and STEM degree requirements

NASA career opportunities were emphasized by bringing NASA material to the students via internet and by inviting the representative of the NASA Educator Resource Center of the State.

Developing the Collaborative

1. Planning Meetings
2. Weekend Academy and Weekly Enrichment Activities Workshop
3. K-12 Curricular workshops
4. Develop an advisory team of Native American professionals and others interested

The activities in this category provide opportunities for developing an enduring group of culturally sensitive educators and professionals interested in improving the educational opportunities for Native American students in STEM disciplines. This objective is in addition to the educational purposes for which the activities are designed. The team will consist of members representing academic, career, and cultural interests. NASA representatives were invited to participate in all of the activities listed above.

Activities

Though the project had activities directed both toward middle and high school students, details of only selected middle school activities are discussed.

After-School Enrichment Sessions for Middle School Students

Each year, the RECIPE project selected 32 Native American middle school students, and eight mathematics, science teachers or TMCC student STEM mentors from participating schools. Two TMCC instructors and two to four NDSU faculty members worked with the high school teachers and college student to develop, organize, and conduct activities for these sessions. The middle school students were divided into 8 groups of 4 students. Each teacher/mentor was assigned one group. The after-school enrichment sessions are designed as 2-hour sessions in which the selected high school teachers engage the selected students in mathematics and science activities once a week from 3:30 to 5:30 p.m. for eighteen weeks during an academic year. Lively and interesting topics were chosen and lesson plans developed for these sessions.

Topics for the after-school program were selected with input from the North Dakota NASA Space Grant Program Coordinator, TMCC instructors, NDSU project manager, and participating high school teachers. Topics were selected with the following considerations:

1. Mathematics and science contents that are suitable, although may be challenging, for middle school students and are relevant to NASA missions;
2. Use of NASA educational materials as basis for lesson plan preparation; and
3. Hands-on activities which are interest to middle school students and doable with available equipment and materials.

Prior to the beginning of each academic year, the NASA program coordinator was consulted for NASA lesson materials and topics that are "hot" among middle school children. Based on the NASA materials, availability of other resources and previous project experience, a tentative list of topics was selected by the TMCC and NDSU project managers. This list was then presented to the participating middle school teachers for discussion and comments. The TMCC and NDSU project managers were responsible for explaining the potential math, science and engineering content of each topic, and possible student activities. Middle school teachers commented on each topic for its potential interest level to the students, suitability of math and science levels, and their capability to carry out the activities. As a result of these collaborative efforts, topics for the year were determined for further development. As an example, following is the initial topic list and the final topics selected for this academic year.

Four topics were to be used during the year. Six topics were initially considered out of which four would be selected:

1. Growing plants without soil;
2. Food for astronauts;
3. Powering the spacecrafts and renewable energy;
4. Micro-gravity;
5. Space Mathematics; and
6. Water quality and purification.

The middle school teachers showed interest in all the topics except the Space Mathematics. Even after the TMCC project manager, a math instructor, explained interesting math problems he had in mind, the teachers were still reluctant to have a stand-alone math session. The concern was that math itself might not attract students. However, the group recognized that the math could be included as components in other topics, especially the micro-gravity and the energy ones. It was also suggested to combine the plant growth and food for astronauts into one topic. As a result the following four topics were selected.

1. Growing plants without soil and food for astronauts;
2. Powering spacecrafts, renewable energy and hot air balloons;
3. Micro-gravity; and
4. Water quality and purification.

After selecting topics, middle school teachers were divided into groups to develop detailed materials for program implementation, and NDSU professors were identified and recruited to provide technical assistances to the middle school teachers. Each group worked on one topic. The teachers were required to collect and organize reference materials, train themselves on the concepts related to the topic, prepare hands-on activities, and develop lesson plans. During this process, NDSU professors and TMCC instructors served as resource persons helping each group through email and occasional face to face meetings. NDSU professors developed supplemental materials to address technical concerns raised by the teachers. They also provided guidance to the teachers through a 2-day workshop to demonstrate and try out the hands-on activities in the lesson plans.

Workshop for After-school Enrichment Sessions

Middle school teachers can exert great influence on their students, not just through what they teach but also their enthusiasm to a topic, their understanding of the materials, and how the learning activities are carried out. Because the extra curricular topics selected for the after-school enrichment program are mostly new, or at least partially new, to the teachers, well-prepared lesson plans and proper training of the teachers on the concepts and activities are key factors to the success of the project. It was also realized that most middle school teachers are heavily loaded with their teaching responsibilities. Therefore, effective use of their time on preparation of the after-school enrichment sessions was also an important factor to be considered. To address most of these issues, a workshop was organized each year to train the teachers on all the topics, and to test the hands-on activities, and finalize the lesson plans. Participating NDSU and TMCC instructors provided assistance to the teachers in the workshop.

Three to four hours activities were planned for each topic during the two-day workshop. Each topic development team took turns to present its lesson materials to the rest of participating teachers. The hands-on activities were led by NDSU professors. Professors used this opportunity to address questions during the presentation, provide more in-depth explanation of the concepts though various activities, demonstrate proper procedures to carry out the activities, and guide the high school teachers on data collection and analysis. Since professors were there as partners in a team, the workshop environment was more relaxed with all participants actively involved. Working with professors in their labs also provided middle school teachers opportunities to be exposed to research activities in the university and to learn more about how scientists and engineers are trained in different programs.

The main purpose of the workshop was to get all participating middle school teachers trained on all the topics, so that each teacher would be able to work independently with his/her student group. It also was hoped that they would incorporate some of the concepts, activities, or methods learned through this project into their regular classes. The role of the professors during the workshop was not to teach the teachers to be experts in different areas, but to provide a learning environment for them to absorb the knowledge that is useful for them as middle school teachers and enable them to use the new methods and technology in their classrooms. Therefore, the professors were asked to provide alternatives activities in each topic, so when the teachers working with their students, they could have choices on the activities based on student levels and school facility. For example, for the topic of water quality and purification, the lesson materials included principles and concepts of several simple water quality parameter, such as temperature, pH, color, turbidity, conductivity, and dissolved oxygen and how water can be purified through flocculation, sedimentation, filtration and carbon adsorption. The hands-on activities included measurements of the water quality parameters using the Calculator Based Laboratory monitors (CBL) with different probes, and using alum, sand and activated carbon for water purification. The material for each parameter or treatment method was prepared as stand-alone unit. Teachers had choices to work with their students on their selection of the parameters and water samples. The measurements can be qualitative, comparing the parameters for different water samples, or quantitative, measurement of pH change with acid or base addition, or conductivity or color with different amount of salt of dye added to a water sample. Simple water treatment units can be constructed to observe how the clarity and color of the water changes as it is treated by different methods. The operation of the water treatment units also can be combined with the water quality parameter measurements to determine what parameters are changed through different treatment and to have a better understanding how a system may be put together to achieve water purification goals.

Develop and Improve Gateway Courses at TMCC

Gateway courses at TMCC were identified as courses in algebra, geometry, biology, and chemistry. Existing courses were reviewed for content and delivery. After-school enrichment activities were designed to prepare the students for successfully completing gateway courses. One NDSU faculty, one TMCC faculty and 2 teachers were involved in this activity.

Meetings with Native American Professionals

An advisory team consisting of Native American professionals was formed. The members were drawn from national and local AISES, local industry, and NDSU alumni. We have Native American engineering and science graduates from NDSU who have established themselves as successful practicing professionals. The advisory team members were valuable resource for the students as role models, guest speakers, and mentors. Local College and University AISES chapter activities were good occasions for the high school students to mingle with college students and talk about science and technical topics. The representative of NASA Educator Resource Center of the State was invited to participate in the meetings.

Informational Activities

Internship opportunities are available with 3M, IBM, and Indian Health Services for NA college students. Representatives from these organizations have volunteered time for guest presentations to the students and for instructional equipment in the past. These professionals were invited to talk to the students about STEM careers in their companies and organizations. Faculty and/or staff from the NDSU and TMCC Admissions office provided information on STEM programs admission and degree requirements to the students on selected occasions.

<u>STEM Emphasis</u>

Throughout the program problem-solving strategies was emphasized. Use of algebra, trigonometry, and calculus were illustrated in solving descriptively stated problems. The fact that science and mathematics are inherent in everything that we see around us was illustrated through examples of day-to-day commonly observed phenomena. Suitable field trips for observing and collecting data were developed along those lines. Laboratory exercises and hands-on activities were developed to verify scientific and mathematical concepts. Culturally relevant examples were used wherever applicable. Computers were used whenever applicable. Computer assisted presentations of topics and results of experiments were required of all students. Modern tools such as internet, e-mail, web pages, digital camera, electronic sensors, etc. were used as appropriate. NASA resource materials were integrated in all activities appropriately.

RECRUITMENT AND SELECTION

We prepared a project announcement and brochure containing the project description. Copies were distributed to parents of all students of participating schools. Copies were also mailed to mathematics and science teachers and guidance counselors at the high schools. The selected eight teachers/mentors recommend students to project director.

Applicants must have satisfactory grades in mathematics and science courses and provide recommendation letters from teachers in both subjects. An essay on their interest in mathematics and science or any topic of their choice in those areas was required. A personal interview with the director or one of the eight mentors was arranged for final selection. The project director reviewed all applications with their supporting materials and selected 32 participants and a few students for the waiting list.

The eight STEM teachers/mentors were selected based on the recommendations from their principals and based on the subjects they teach. Each signed a letter of intent that clearly stated their desire to be involved in this project and their willingness to apply learned skills in their classrooms.

LESSONS LEARNED

The project team was developed with strong support from TMCC, solid commitment from NDSU faculty members, and enthusiastic participation of middle schools in and around Turtle Mountain reservation. However, implementation of the program has been a challenge in many aspects. Following are some lessons learned as the project progressed.

1. ***It is important to involving school teachers in the lesson plan development with proper input from professors***

   In the first year, though the topics were selected from the pool of NASA lesson plans, little input was sought from the school teachers. Networking among the teachers did not occur spontaneously as was expected. The teachers were trained in a workshop on each topic by NDSU professors providing strong input on the technical content. The participating teachers faced difficulties in implementing the lesson plans because they did not have adequate science background for teaching the selected topics at the middle school level. Also little help was available to the teachers after the workshop. It became evident that the teachers need to be heavily involved in the development of lesson plans from the very beginning and not just in the implementation.

   To overcome the problems of the first year, in preparation of the second year, each school teacher was asked to develop a lesson plan based on NASA materials and to share the lesson materials with other participating teachers. As a result, seven lesson plans were developed and implemented. This approach certainly increased the teachers' comfort level of teaching and enabled to develop a good network mechanism among the teachers. However, the opportunity for input from NDSU professors was minimal and consequently the STEM content in lesson plans were relatively low. One topic was covered each week or at the most in two weeks, barely enough time to cover the topic to any meaningful depth.

A different approach again was used for the third year. This time, the program management team selected six topics with input from the North Dakota State NASA coordinator. Four out of these six were selected for implementation after consultations with middle school teachers. Four lesson plan development teams were formed. Each team consisted of two middle school teachers and an NDSU professor. NDSU professors were responsible for providing lesson plan materials and teachers assembled the lesson plans with hands-on activities. Each lesson may last for 2 to 4 weeks depending on the nature of the topic. A two-week train-the-trainer workshop was then organized. Each team had half day to present its lesson plan and demonstrate activities, during which NDSU professors had the opportunity to explain the principles and to strengthen the STEM content. This approach was received well by the teachers and worked well for implementation.

2. ***Respect the expertise and comfort zone of school teachers***
   Training teachers can be more challenging than teaching students. Most middle school teachers who participated in this program have many years of teaching experience, and have established their specialty area and teaching styles. Although they are willing to learn new concepts and new materials, they may not be receptive to be lectured by university professors, especially when the materials are out of their daily topics with strong STEM contents. First, they are not interested in becoming experts in all the topic areas. Secondly, they need to prepare and deliver the new STEM content material at the appropriate level to the middle school students. When engineering professors did not recognize these important factors, training became boring to the teachers and they usually encountered difficulties in implementing the lesson plans. When the school teachers were engaged in each step of the process and were encouraged to explore the topics themselves with proper guidance from the professors, more positive attitudes and cooperation resulted. Therefore, it is important to enable teachers to absorb new materials and allow them to incorporate them in their lesson plans instead of simply giving them lesson plans developed for them and ask them to teach.

3. ***A net work with tribal college as a focal point is critical for improving STEM education in Indian Reservations***
   Participating in middle and high school STEM education by university professors may be considered as an effort to achieve vertical integration of STEM education aimed at attracting more students earlier into the STEM disciplines. To implement such a program in Indian Reservations has to overcome several difficulties, including sparsely distributed student populations, lack of exposure to new technologies, limited school facility and resources, cultural difference, and knowledge gaps. A well- organized network of school teachers, tribal college instructors, and university professors is evidently critical for carrying out such integration to reach project goals.

The tribal college, TMCC, provided vital academic and cultural links in such a net work. TMCC is located in the center of the Turtle Mountain Chippewa Indian Reservation with a pre-engineering program and properly equipped labs. These labs were made available to training of school teachers and student activities. TMCC instructors were involved in both project management and implementation. Participation of TMCC instructors made day-to-day project management and technical support easy. The location and setting of TMCC make young students feel more comfortable in terms of cultural familiarity. Exposure of middle and high school students to tribal college facility and programs attracts them to enroll in STEM programs of the college in the future. Although solid enrollment number is not available at this point, survey of participating students showed that majority of them intended to go to tribal college and/or four year universities. Currently, TMCC and NDSU are actively planning for expanding the activities into tribal college curricula and extra curricular activities.

4. ***Commitment from university faculty, tribal college instructors and school teachers is the key for making the program sustainable***

   A group of NDSU engineering, math and science professors have been engaged in such STEM projects for more than seven years, starting with an ONR project, followed by this NASA project and several projects supported by NSF, ND Rural Initiatives, and NDEPSCoR. The success of this program can be attributed to commitment of these professors to the common goal of improving STEM education in the Reservations. These NDSU professors have spent countless hours in Reservations working with students and tribal teachers. They are also engaged in various activities to learn Indian culture. As a result, trust and strong bonds have been established among the professors, instructors, and teachers, as well as the institutions.

   With strong relationship built, attracting enthusiastic middle and high school teachers to the program becomes almost natural. Although middle school teachers are usually heavily loaded and the pay from the NASA project is only $20/hr, several teachers have stayed with the after-school-enrichment program throughout the three years. Their efforts have created positive impact on the students. More and more students are applying for this program each year even though the program gives no stipend to students.

EVALUATIONS

Because of the extra curricular and informal nature of the activities in this program, it is difficult to quantitatively evaluate the achievement of each of component of the project. However, positive impact could be evaluated based on the following feedback and observations.

- Number of middle school teachers participating in the program increased each year.
- The workshop had good impact on the school teachers. Many of them have used methods and/or technologies learned through the program in their classroom.

Several of them expressed such workshops at universities should be held more often.

- Although no stipend is paid to students, more students applied to the after school enrichment program each year. High retention rates were achieved through the years.
- Number of students attending the summer camp increased through the years and reached the limit.
- Exceeding the originally planned number, many students approached their science teachers to be in the program this year.

CONCLUSIONS

The authors firmly believe that the 3-year project was successful in generating interest among middle school students in Turtle Mountain Reservation, North Dakota for pursuing STEM careers. The participating teachers benefited greatly from the collaborative to enhance their content and delivery capabilities in STEM teaching with appropriate and interesting examples of NASA applications. Students and teachers became aware of NASA career opportunities. The project activities provided the students opportunities for developing skills for pursuing higher education in STEM disciplines. The authors also believe that the activities for outreach projects such as this need to be designed and delivered collaboratively by university and tribal college faculty and teachers in order to be successful. The opportunities for contact with NA STEM professionals help improve the self-esteem and confidence of the students to pursue STEM pathways.

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BIOGRAPHICAL INFORMATION

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Carol Davis is the (Acting) President of the Turtle Mountain Community College. She has been instrumental in initiating a number of collaborative educational projects to increase participation of Native American students in STEM disciplines.

Table 1. Freshmen intending science and engineering major: selected years, 1986-2002 (Percent Distribution)
(Adapted from Science & Engineering Indicators, 2004)

Race/ethnicity, and field	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
All intending S&E major	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Physical sciences	6.4	6.1	6.1	6.3	6.5	6.6	6.9	7.3	6.4	7.2	6.1	6.0	5.6	5.3	5.2	5.3	5.9
Biological/agricultural sciences	17.3	17.4	16.9	17.0	17.9	19.9	22.1	23.9	24.9	26.3	24.7	24.3	23.3	22.8	20.5	20.9	22.2
Mathematics/statistics	3.2	3.0	2.7	2.7	2.7	2.6	2.6	2.3	2.6	2.4	2.1	2.0	2.2	2.0	2.2	2.1	2.4
Computer sciences	10.0	8.3	7.9	7.7	7.7	7.4	6.6	6.6	7.9	9.6	11.0	12.4	14.7	15.4	16.2	14.4	9.6
Social/behavioral sciences	29.3	32.4	36.4	33.9	33.2	29.6	30.3	29.5	30.1	28.7	26.9	26.2	28.0	27.3	28.7	29.4	30.4
Engineering	33.8	32.9	30.0	32.2	31.8	34.0	31.4	30.4	27.9	25.8	29.2	29.2	26.1	27.3	27.1	27.5	29.5
White	29.2	27.8	27.8	29.6	29.3	30.5	30.7	31.7	30.8	30.9	32.3	32.8	30.5	31.7	30.6	31.9	31.3
Physical sciences	2.0	1.9	1.9	2.0	2.1	2.3	2.4	2.6	2.1	2.5	2.1	2.4	2.0	2.0	2.0	2.1	2.1
Biological/agricultural sciences	5.0	4.7	4.7	5.1	5.4	6.0	6.8	7.6	8.8	9.0	8.9	8.6	7.7	7.9	6.6	7.0	7.0
Mathematics/statistics	0.9	0.9	0.8	0.9	0.9	0.8	0.8	0.9	0.8	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.8
Computer sciences	2.6	2.1	1.9	1.9	1.8	1.8	1.8	1.8	2.1	2.5	3.0	3.5	3.8	4.1	4.3	4.0	2.8
Social/behavioral sciences	8.7	9.3	10.2	10.1	9.8	9.3	9.4	9.4	9.1	8.7	8.7	8.6	8.4	8.6	8.7	9.1	9.4
Engineering	10.0	8.9	8.3	9.6	9.3	10.3	9.5	9.4	7.9	7.5	8.9	9.0	7.9	8.5	8.3	9.0	9.2
Black	29.1	31.0	31.2	32.0	31.5	35.5	37.1	37.9	34.8	35.8	36.9	38.0	35.0	37.2	36.8	35.2	35.4
Physical sciences	1.0	1.0	0.7	1.2	0.8	1.2	1.3	1.6	1.6	1.6	1.4	1.2	1.1	1.2	1.2	1.0	1.2
Biological/agricultural sciences	3.7	4.1	4.0	4.6	4.6	5.3	6.5	7.4	7.4	8.7	8.6	8.8	7.1	7.9	7.5	7.8	8.4
Mathematics/statistics	0.6	0.6	0.6	0.4	0.5	0.6	0.7	0.6	0.8	0.7	0.6	0.6	0.5	0.6	0.5	0.4	0.5
Computer sciences	6.6	5.2	4.8	5.9	5.7	5.6	5.1	5.4	4.7	6.3	6.5	7.1	8.5	8.4	8.1	7.4	4.7
Social/behavioral sciences	8.8	9.6	13.0	10.6	11.0	10.4	10.8	10.0	10.8	9.9	10.1	10.3	11.8	11.4	11.1	12.5	12.0
Engineering	8.4	10.5	8.1	9.3	8.9	12.4	12.7	12.9	9.5	8.6	9.7	10.0	6.0	7.7	8.4	6.1	8.6
Mexican American/Chicano and Puerto Rican American	35.2	35.1	31.2	33.5	33.9	30.6	32.2	33.2	37.0	36.0	35.5	36.9	32.8	36.2	33.3	33.6	34.7
Physical sciences	1.4	1.5	1.5	1.7	1.8	1.4	1.5	1.6	1.6	1.3	1.3	1.4	1.4	1.0	1.4	1.2	1.6
Biological/agricultural sciences	7.0	6.7	5.3	5.6	5.5	6.2	6.8	6.9	8.5	7.9	8.1	9.3	7.8	8.6	7.1	7.4	8.2
Mathematics/statistics	0.8	0.5	0.5	0.6	0.8	0.3	0.7	0.4	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.7
Computer sciences	2.4	2.6	2.2	2.2	2.1	2.8	2.5	2.1	2.4	2.9	3.6	3.4	3.9	3.8	3.8	3.8	2.4
Social/behavioral sciences	11.4	12.4	12.8	12.9	12.9	9.9	11.1	12.5	13.5	12.2	11.8	11.4	10.4	10.9	12.3	11.6	13.2
Engineering	12.2	11.4	8.9	10.5	10.8	10.0	9.6	9.7	10.4	11.2	10.1	10.8	8.7	11.3	8.1	8.9	8.6
American Indian/Alaskan Native	30.6	31.5	31.9	33.9	31.8	31.2	31.7	31.9	30.2	30.6	33.6	34.9	32.8	35.4	33.8	35.3	32.0
Physical sciences	2.0	2.2	1.7	2.0	3.0	2.0	1.8	1.5	2.0	2.0	2.6	2.5	2.1	2.7	2.6	1.8	1.7
Biological/agricultural sciences	5.5	6.3	5.5	4.8	7.3	6.5	7.4	8.0	8.0	9.3	8.9	8.8	8.2	9.3	6.9	8.4	7.9
Mathematics/statistics	0.8	1.0	0.6	0.6	0.4	0.3	0.4	0.7	0.7	0.4	0.5	0.5	0.4	0.7	0.4	0.6	0.6
Computer sciences	2.3	2.7	2.4	2.2	2.3	3.0	2.1	2.3	2.2	3.0	3.7	5.0	4.6	4.4	4.0	4.4	2.8
Social/behavioral sciences	9.6	9.3	13.2	13.5	10.7	9.7	10.6	11.0	10.4	9.5	9.9	10.7	11.1	10.4	11.9	12.7	11.5
Engineering	10.4	10.0	8.5	10.8	8.1	9.7	9.4	8.4	6.9	6.4	8.0	7.4	6.4	7.9	8.0	7.4	7.5

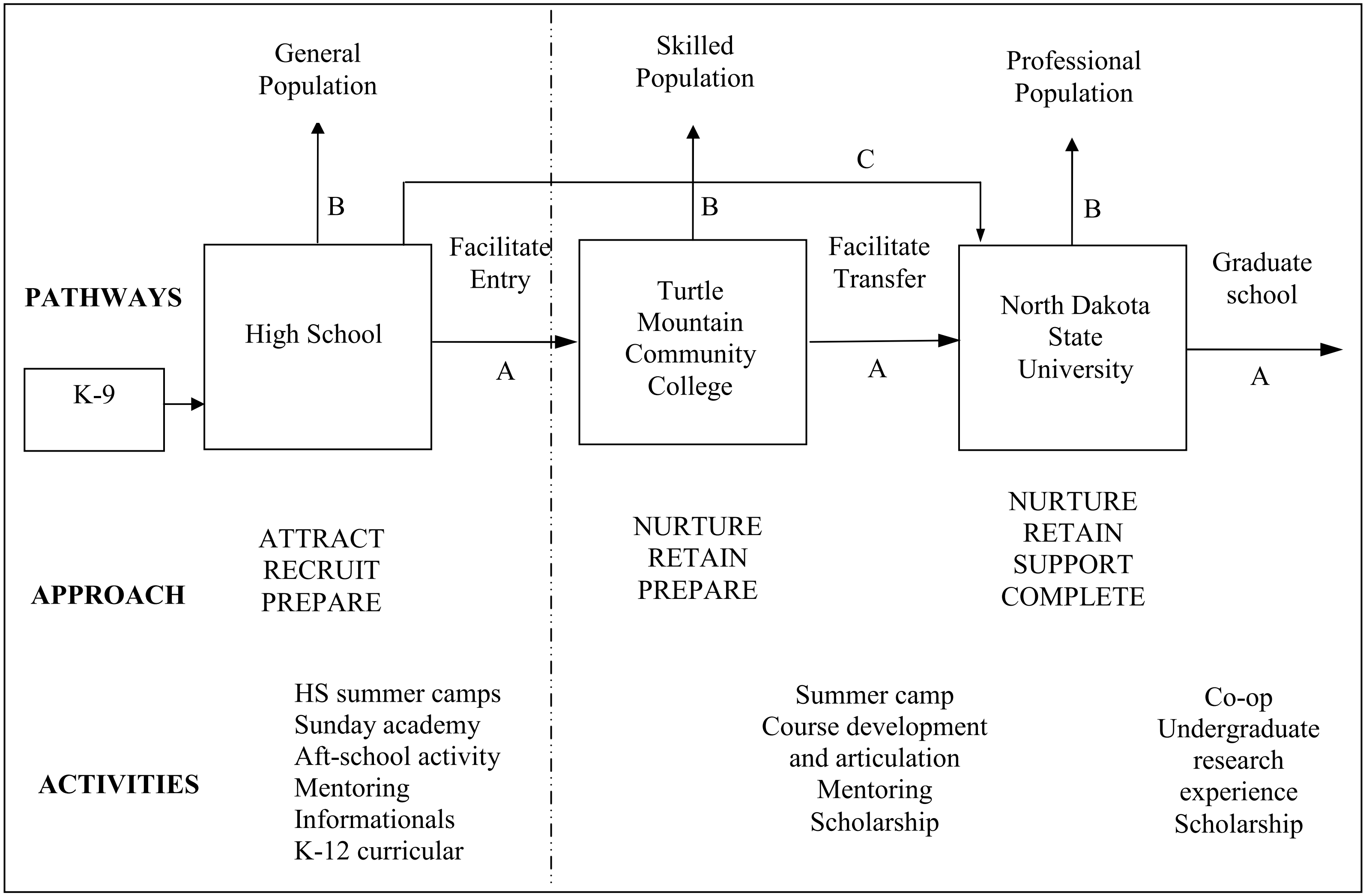

Figure 1. Native American Student Pathways to STEM Careers

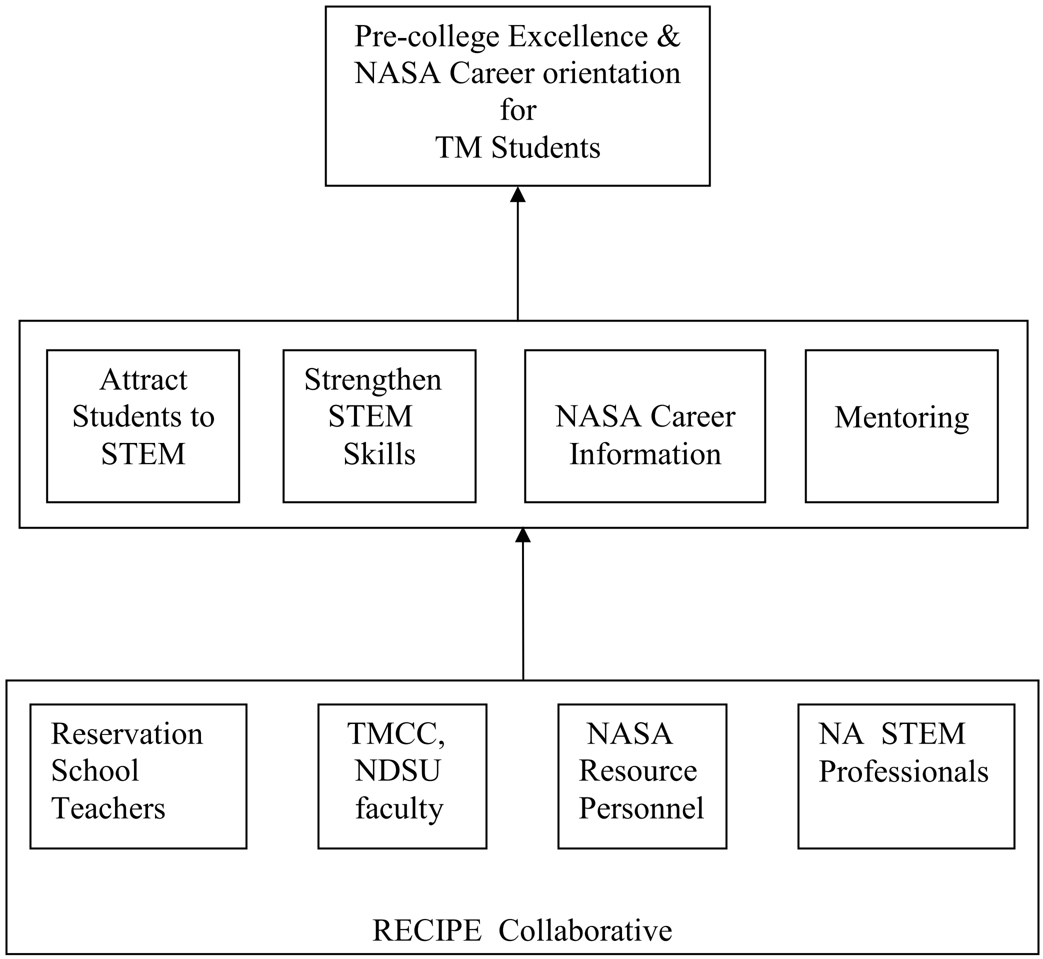

Figure 2. RECIPE Project Goals and Participants