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An Instructional Wind Tunnel as a Learning Platform for Science, Technology, Engineering, and Mathematics at a National Indian Community College

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Abstract: Involving more students in Science, Technology, Engineering, and Mathematics (STEM) programs is one of the biggest challenges in instruction that will have a significant impact on tomorrow's American society. This calls for novel teaching tools and methods that will interest and excite the students, motivating them to pursue STEM careers while providing highly technical and rigorous teaching programs. This article describes an unprecedented collaborative program between the Southwestern Indian Polytechnic Institute (SIPI), a National Indian community college based in New Mexico, and the Rensselaer Polytechnic Institute (RPI), a university based in New York. The collaboration consisted in the development of a STEM learning platform based on an instructional wind tunnel at SIPI. The development of this platform was led by a PhD candidate from RPI who, in exchange, gained invaluable teaching experience. This paper describes what was done in one trimester and the next steps that will be implemented in order to make the platform fully operational. Moreover, this paper describes the results that have been obtained thanks to the collaborative effort of the community college and the research-intensive university, with a particular stress on the improvements that have been produced in the students' STEM education and interest.

Keywords: Native American Instruction, STEM, community college.

Introduction

Occupational employment projections from the Bureau of Labour and Statistics estimate that by 2018 the United States will have up to 1.2 million jobs in engineering, science, technology and mathematics (STEM)-related fields (U.S. Bureau of Labor and Statistics, 2009). The U.S. Department of Commerce, Economics and Statistics Administration (Langdon, 2011) reports that STEM occupations are growing by 17% while other occupations are only growing by 9.8%. Unfortunately, according to the Bureau of Labor and Statistics (2010), only 16% of bachelor's degrees in 2020 will be STEM-related. This means that there will not be enough U.S. STEM professionals to sustain the demand. The number of Native American students that pursue STEM degrees is even lower, around 13.6% (Babco, 2003).

Several studies have proven that high schools (Harris Online Survey, 2011) and community colleges (National Science Foundation, 2012; Hoffman et al., 2010) are fundamental in involving and preparing students in STEM careers. Therefore, introducing STEM-related activities in high schools and community colleges can greatly benefit students' preparation and interest. An example is the game design introduced by Repenning (2010) that stimulates students' computational thinking. Moreover, an interesting work proposed by Bhajaria & Gannod (2006) describes a method for increasing the recruitment of Native American students in computing programs in the Arizona State University.

This paper describes a unique collaboration between the Southwestern Indian Polytechnic Institute (SIPI), a National Indian community college based in New Mexico, and the Rensselaer Polytechnic Institute (RPI), a university based in New York. The collaboration aims at developing a STEM learning platform in SIPI, based on the design, manufacturing and testing of an educational wind tunnel while improving RPI PhD students' preparation for academic/teaching careers. Native American students are involved in every single phase of the project, and face all the major tasks that an engineer is supposed to carry out while designing a product. Moreover, they become familiar with experimental methods that will be invaluable throughout their academic careers. The purpose of this collaboration is to become a roadmap for alliances between community colleges and universities and showcase how both organizations would greatly benefit from such a partnership.

The Southwestern Indian Polytechnic Institute is a federally operated college funded through the U.S. Bureau of Indian Affairs (BIA). The college was established to provide technical and higher education at the associate degree and certificate levels for members of federally recognized tribes. The enrolment derives from over 100 different Indian Tribes. From 1993 SIPI board of regents directed the college to begin offering transfer degrees with an emphasis on science and technology. Currently SIPI offers six associate degree programs in the sciences.

The educational wind tunnel has been chosen as the backbone project of the collaboration because its design, construction and testing expose students to many engineering concepts in several fields like mechanical, aerospace, civil, electronic and electrical engineering, and computer science.

The advantages for both institutions are numerous. RPI provides a PhD candidate expert in the field of aerodynamics who gets invaluable experience in teaching, acquiring a very important skillset, crucial for academic careers as stressed by Austin et al. (2009). In exchange, SIPI greatly benefits from RPI's knowhow and develops a STEM learning platform that will have positive effects not only on the National Indian college community but also on the nearby tribal institutions. The learning platform will also be used by SIPI as a showcase of successful collaboration and will contribute to develop further relationships with other organizations.

The ultimate goal of this research was to determine the impact that a collaboration between a National Indian community college and a university would have on both the institutions, with a special interest on the improvement on STEM programs both in terms of enrolment and students' interest. An ancillary goal of this research was to determine the effects of the collaboration on PhD students' academic career preparation.

The paper is organized as follows: Section 2 describes the educational objectives of the collaboration; Section 3 describes the learning platform structure, its connections to different engineering programs and the timeline of the project; Section 4 describes in detail the activities that have been completed in Phase 1 and 2, while Section 5 contains a discussion about the results presented in Section 4. Section 5 contains the conclusions and the final remarks.

Section 2: Educational Objectives

The educational objectives of this collaboration can be summarized in the following:

- Develop a STEM learning platform in a tribal community college. As proven in several studies (National Science Foundation, 2012; Hoffman et al., 2010), community colleges are very important institutions for STEM careers development. Specifically, SIPI is the ideal benchmark because of the very low percentage of STEM enrolments among tribal colleges (Babco, 2003).

- Expose Native American students to multiple engineering fields. Students might be interested in different engineering fields, and it is important to expose them to a very broad range in order to effectively trigger their passions.

- Involve Native American students with hands-on projects. Formal lectures have proven to discourage students from pursuing STEM careers, especially in the case of Native American students (Tharp, 1989; Tharp & Yamauchi, 1994). The idea is to involve students as much as possible in the design, manufacturing and testing. Hands-on projects are an effective way to transfer knowledge. Moreover, students learn very important skills they will need in academia.

- Stimulate Native American students' critical thinking. A minimum number of formal lectures gives to students the necessary knowledge to design an effective wind tunnel, but the actual design of the tunnel is completely left to the students. Most of them will be facing critical design choices for the first time. The key element of design is critical thinking, a process that involves the evaluation of different factors and their importance for generating a final solution.

- Train PhD students for academic careers. Most of the time, the only teaching experience for PhD students is obtained through a teaching assistantship (TA). With few exceptions (Austin et al., 2009) most of the Doctoral programs do not prepare PhD students for STEM-related teaching careers. With this collaboration, the PhD student learns every important aspect of teaching: extensive formal lecture time, course management and preparation (quizzes, midterm and final are written by the PhD student, course material is organized by the PhD student as well), mentoring and grading.

- Train PhD students for funding management. One of the key skills that PhD students must have when pursuing an academic career is the ability to appropriately allocate funding to perform research activities. With this collaboration, the PhD student has to manage the funding reserved for the wind tunnel construction, purchasing the necessary material according to students' designs. Funding obstacles and purchasing within the Federal system require advanced planning and the ability to handle time constrains.

From a research methodology point of view, a set of formal lectures was organized in order to familiarize the students with the concepts necessary to design and build educational wind tunnels. The formal lectures took place in the first part of the program. Students' preparation and learning ability were tested through the use of homework given by the instructor to the students. After learning the basics, students faced directly the challenge of designing and building the instructional wind tunnel. The positive influence of hands-on activities on student learning capabilities was tested using Design Assignments, Work Behaviour Assessments, and a Final Report. The effect of the collaboration on students' interest towards STEM programs was tested in the end of the trimester using a survey that was reviewed by a committee including the president and vice-president of SIPI, the chief information officer of the Bureau of Indian Education (BIE), the chairperson of the SIPI Advanced Technical Education (ATE) and a member of the New Mexico Math and Science Council (MASC).

Section 3: Learning Platform Structure and Timeline

The learning platform is composed of three main phases. Figure 1 shows how every phase is made of two blocks and which set of skills or knowledge every block delivers to the students. Figure 1 also shows the students' evaluation criterion for each block.

Phase 1 consists of two blocks of formal lectures given by the instructor. In this phase students become familiar with concepts that are typically studied in physics, aerospace engineering and civil engineering. In the first block, the instructor introduces the main concepts of fluid mechanics. He starts with a brief explanation of the importance of fluid mechanics in real world applications and touches the basic definitions needed to proceed into the topic.

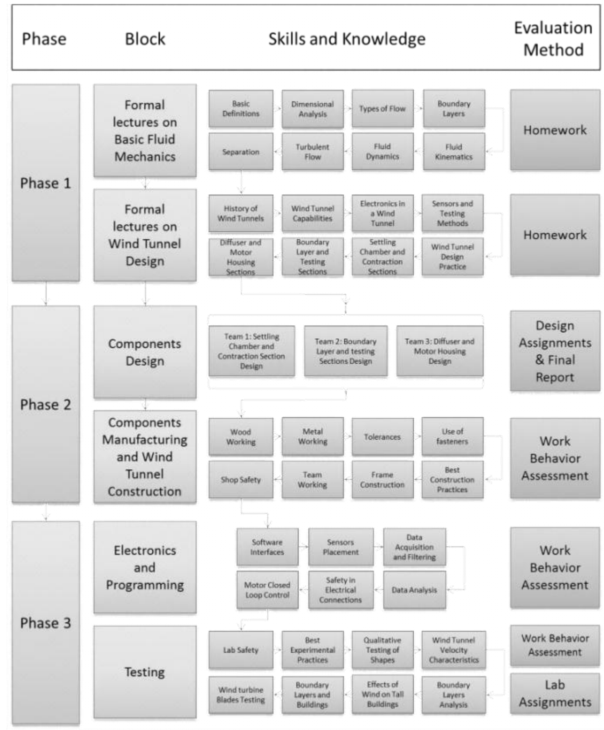

Figure 1: STEM learning platform structure

The concept of dimensional analysis is introduced to make the students understand the importance of scaling and the theory of experiments on scaled models. The different types of flows are analysed and the concept of boundary layer is introduced. The instructor proceeds introducing the most important principles and laws of fluid mechanics and he addresses the meaning of turbulent flow and the characteristics of this particular regime. The concept of separation is also introduced and the effects of separation are discussed. Practical examples are used by the instructor to stress the importance of streamlined bodies for improving the aerodynamic performance. In this first block of formal lectures the students are expected to learn the basic knowledge on which all the rest of the class is built. It is important to support all the theory with abundant practical examples to give a real-world meaning to the theoretical concepts introduced in the lecture. Open questions and interactions with the students further improve the learning experience.

In the second block, the instructor switches to more applied concepts related to wind tunnels. The majority of the concepts introduced in this block are tied to the theory introduced in the first block. A brief history of wind tunnel design evolution is provided, in order to show how the technology evolution is tied to the increasing performance demand. The testing capabilities of different types of modern wind tunnels are analysed. The instructor then introduces the students to the electronics, sensors and testing techniques generally used in wind tunnels. In the last part of this block the instructor goes through all the components of wind tunnels and explains to the students their importance and their function.

These two blocks of formal lectures give to the students all the basic knowledge necessary to successfully design a wind tunnel. The critical thinking that they will use in the design phase will be based on the knowledge that they developed in Phase 1. Their understanding is tested through homework.

Phase 2 consists of two blocks: the design of a wind tunnel and its construction. In this phase students become familiar with concepts that are generally taught in mechanical engineering courses.

In the first block, students design every component of the tunnel, applying the concepts learned in Phase 1. The instructor gives to the students a set of Design Assignments with the double purpose of evaluating their design abilities and of guiding their design effort (also specifying a set of restrictions and requirements to engage their critical thinking and refine their design skills).

Students are divided into three teams and each team is responsible for the design of two of the six main sections of the wind tunnel. Students learn not only the importance of teamwork but also the importance of communication between teams. Every section of the wind tunnel has to be compatible with the other ones. This means that every team necessarily has to work with the other teams to find common interfaces and solutions. Moreover, one of the requirements given by the instructor includes regulations regarding the materials used by every team. Customizations are discouraged in favour of standardization. This not only reduces the cost and complexity of the project but also teaches the students the importance of standardization in design, challenging them with the need to find common solutions to satisfy different design requirements. In addition to submitting all the material required in the Design Assignments, the teams have to collect all their design material and organize it into a Design Final Report, where more in-depth explanation of the design choices are given. The instructor is involved in this task by showing to the students how to write technical/scientific reports in terms of structure, content and language. The Design Final Report is a very important evaluation and teaching tool. It is important for the instructor to understand the design choices of the students but it is also an invaluable teaching tool that introduces the students to professional design practices. The students through the formalization of the report can understand how design is the product of a set of decisions that are made based on requirements and needs.

After an evaluation of the Design Final Report and a discussion about the design choices, each team obtains the permission to build his sections (if all the specifications contained in the design assignment have been met). In this construction phase (second block of Phase 2), the students learn very important skills like wood and metal working, proper use of fasteners and frame construction techniques. They also understand key concepts like mechanical tolerances and shop safety. In this block students are evaluated using a Work Behaviour Assessment (WBA) that will take into account their ability to work in a team, their initiative, their organization capabilities and their work habits.

Phase 3 consists of two blocks, the design and construction of a data acquisition system and wind tunnel testing. In the first block students place a set of sensors in the wind tunnel and connect them to a central data acquisition system. This unit is connected to a computer in order to treat and analyse the collected data. Moreover, the students have to connect the motor to a motor controller, and to a computer, in order to perform a closed loop control on the air speed inside the wind tunnel. In this block students learn key concepts that are fundamental in electronic and electrical engineering. Furthermore, the students have to write a code in Labview® to automate the data collection process and to perform a closed loop control on the wind speed inside the wind tunnel, becoming familiar with key concepts that are generally taught in computer science. Students are evaluated using a second WBA that assesses their ability to work in a team, their initiative, the quality of their work, their organization capabilities and their work habits.

In the second block, students have to perform experiments in the wind tunnel that they have built. Students start with qualitative aerodynamics analysis of shapes of their choice, where the aerodynamics performance is analysed using a set of tufts of yarn attached to the surfaces. This part is very important to stimulate students' interest in aerodynamics. They are allowed to test models of cars, boats or airplanes of their choice. The complexity of experiments is gradually increased, introducing quantitative analysis through the use of sensors integrated in the wind tunnel. Some examples of experiments that can be performed in the instructional wind tunnel are:

- determining the wind speed vs. motor speed characteristic (fundamental for refining the closed loop control on the wind tunnel air speed).

- determining the boundary layer shape of different configurations through the use of a Pitot tube and of different boundary layer modules (each module designed to replicate a specific environment e.g. urban environment, rural environment, ocean, etc.) following Schlingting & Gersten (2000) and Lopes et al. (2008).
- determining the effects of wind on tall building scaled models through the use of a set of accelerometers mounted on the scaled building.
- determining the effects of different boundary layers on the fluid-structure interactions occurring between tall building scaled models and wind.

In this block, the students are evaluated using a set of Lab Assignments. Every Lab Assignment requires the students to perform a set of mandatory activities but also leaves the students a certain degree of freedom regarding the models that is tested in the tunnel. This keeps the involvement and interest of the students high while stimulating their creativity and their understanding of aerodynamics concepts. In this particular block, students learn key concepts related to experimental methods used in civil and aerospace engineering.

Phase 1 and Phase 2 take place in one trimester. Phase 3 takes place in the following trimester. After the first two trimesters, the learning platform is completely operational and Phase 1 and Phase 3 will be combined to form an Introduction to Aerodynamics class, or integrated into an existing class which will be offered every trimester. The learning platform will not be a single project but a tool that will be used extensively every trimester. Table 1 gives a timeline representing the evolution of the learning platform during the first two trimesters.

Table 1: Learning Platform Timeline

Month 1		Month 2		Month 3	
Front Lecture on Fluid Mechanics	Front Lecture on Wind Tunnel Design	Components Design	Components Design	Components Manufacturing and Wind Tunnel Construction	Components Manufacturing and Wind Tunnel Construction
Phase 1		*Phase 2*			
Month 4		**Month 5**		**Month 6**	
Brief Review of Theory	Electronics and Programming	Electronics and Programming	Testing	Testing	Testing
Phase 3					

Section 4: Report on the implementation of Phase 1 and Phase 2

This section reports the results of the first trimester. Phase 1 started in the middle of January 2013 and has been implemented in SIPI (together with Phase 2) as a Design Project class (ENGR285). The class has been defined as a 3 credit hour class, with two lectures per week. Seven students were actively enrolled in the class, two females and five males. The students' age was between 18 and 25 years old. All the students were enrolled full time and were either in their last or penultimate year before graduation. All the students were enrolled in the ATE program.

During Phase 1, students demonstrated a higher interest in the applied part of lectures (second block of Phase 1) related to the wind tunnel construction. Students' preparation has been evaluated through homework. Only 57% of the students completed the homework in time. Grades in hundredth fractions and in letters are reported in Table 2. NC means Not Completed.

Table 2: Homework grades on Phase 1. NC means that the homework has not been completed/returned

Student	Grade	Grade (Letter)
1	NC	NC
2	NC	NC
3	NC	NC
4	40/100	F
5	82/100	B
6	93/100	A
7	99/100	A

Phase 2 started in February 2013. After a discussion between instructor and students, the teams agreed to build an open-return, subsonic wind tunnel for civil engineering application. This implies a boundary layer replicating the atmospheric boundary layer existing on the Earth's surface. The atmospheric boundary layer is a particular velocity profile that the wind has on the Earth's surface. This velocity gradient is generated due to the drag existing between the airflow and the Earth surface (Schlichting & Gersten, 2000).

The students were divided into three groups. Team 1 designed the settling chamber and the contraction section. Two students were assigned to this team. Team 2 designed the boundary layer and testing sections and three students were assigned to it due to the higher amount of work required. Team 3 designed the diffuser and the motor housing section and two students were assigned to this group. Team 2 designed the boundary layer section following the work of

Lopes et al. (2008) due to the space restrictions that the teams had.

A schematic representing students' design is reported in Figure 2, where the general structure of the wind tunnel is shown:

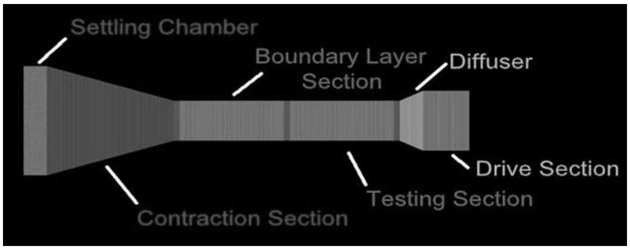

Figure 2: Preliminary Sketch of the Wind Tunnel drawn by the students

The three teams collaborated in order to have common interfaces, to be able to connect their parts to each other. Every team received a Design Assignment with the requirements and restrictions related to the parts that they were supposed to design and with a list of deliverables.

The deliverables included:

- Cover/Introduction paper explaining the key design choices, the main function of the each designed part and the purpose of the assigned section in the wind tunnel
- List of components (off-the-shelf and customized)
- Two-dimensional drawings of the components and sub-components
- Three-dimensional drawings of the components and sub-components.

All the students completed the Design Assignments and the grades are reported in Table 3.

The material produced by each team was collected and organized into a Design Final Report describing the components and motivating the design choices in depth. Table 4 reports the Design Final Report grades.

Table 3: Design Assignments' grades on the first block of Phase 2

Student	Grade	Grade (Letter)
1	70/100	C
2	95/100	A
3	95/100	A
4	100/100	A
5	100/100	A
6	100/100	A
7	100/100	A

Table 4: Design Final Report's grades on the first block of Phase 2

Student	Grade	Grade (Letter)
1	0/100	F
2	75/100	C
3	75/100	C
4	80/100	B
5	80/100	B
6	95/100	A
7	95/100	A

Figure 3, Figure 4 and Figure 5 show the final three-dimensional rendering of the parts respectively designed by the Team 1, Team 2 and Team 3 while Figure 6 shows the assembly in the end of the design process.

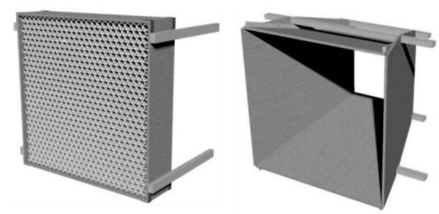

Figure 3: Settling Chamber (left) and Contraction Section (right) designed by Team 1

Figure 4: Boundary Layer and Testing Section, designed by Team 2

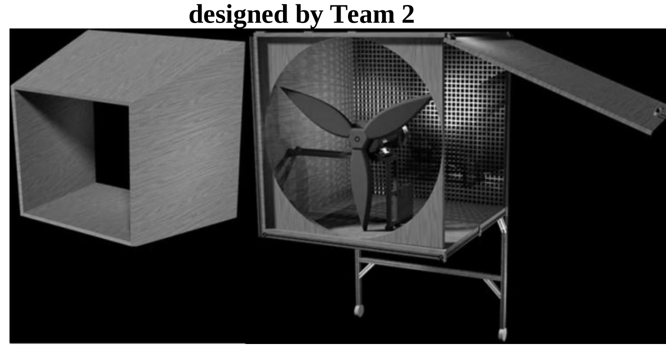

Figure 5: Diffuser (Left) and Motor Housing (Right), designed by Team 3

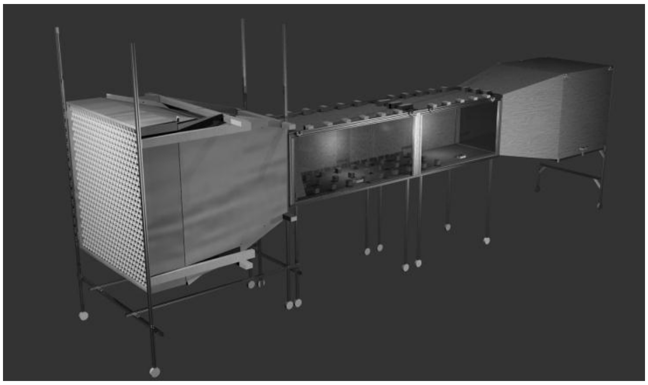

Figure 6: Full Wind Tunnel Rendering, assembled by collaborating Team 1, Team 2 and Team 3 members

The first block of Phase 2 was completed by the end of March 2013. The second block of Phase 2 started in the beginning of April 2013 and lasted until the end of the month. In this phase the students used their designs to manufacture the components needed for assembling the wind tunnel. Every student demonstrated a very high motivation and by the end of the month, every section of the tunnel was assembled. Figure 7 shows two of the assembled components (boundary layer and testing section):

Figure 7: Assembled Boundary Layer and Testing Sections

In this part students have been evaluated with the WBA according to their teamwork abilities, to their organization and work habits and to their initiative. Grades for the WBA are reported in Table 5:

Table 5: Work Behaviour Assessment Grades on the second block of Phase 2

Student	Grade	Grade (Letter)
1	95/100	A
2	95/100	A
3	100/100	A
4	100/100	A
5	100/100	A
6	100/100	A
7	100/100	A

At the end of Phase 1 and Phase 2, a survey (Table 6 in Appendix) was distributed among the students to understand the impact of the learning platform on their learning process and on their interest towards STEM careers. The survey has been reviewed by a committee including the president and vice-president of SIPI, the chief information officer of the Bureau of Indian Education (BIE), the chairperson of the SIPI Advanced Technical Education (ATE) and a member of the New Mexico Math and Science Council (MASC). The survey consisted of 13 questions and its reliability, measured through a test-retest method, has given a correlation coefficient r = 0.988.

Section 5: Results Analysis

Table 2 shows that the majority of the students achieved poor results in the evaluation of their theoretical understanding of the concepts introduced in Phase 1. About 40% of the students did not even return the homework. This result is in line with the known fact that formal lectures are not an effective way to transfer knowledge, especially in minority institutions, like underlined by Tharp (1989) and Tharp & Yamauchi (1994). An additional element that probably contributed to poor results was the mathematical preparation of the students: the instructor determined through the analysis of some homework and through the analysis of questions arising in class, that the majority of students had significant gaps in their mathematical preparation, which was supposed to be at the Calculus 1 level.

The results shown in Table 2 do not reflect in the design activity. In fact, Table 3 shows that all the students but one received the highest grade in this phase. This can be explained by the fact that a practical implementation of the theoretical concepts explained in Phase 1 helped the students to understand them better and allowed them to properly design the wind tunnel components. The instructor reported that many students clearly shown a better understanding of the theoretical principles while working in the design phase.

Table 4 shows the results of students' grades for the Final Design Report. These grades are significantly different from the grades shown in Table 3. Theoretically, the report was only a formal document to contain all the design material produced for the design assignments. The difference in grades is caused by the inability of some students to write technical reports. The instructor provided guidelines but could not give a full lecture related to writing technical reports due to time constrains. These results prove that many students necessitate of classes to improve their technical writing skills.

Table 5 shows how all the students actively and positively participated in the second block of Phase 2 consisting of the manufacturing and assembling of the wind tunnel. The instructor reports that the students worked beyond the required hours to finish the assembly of the tunnel in time, showing a deep involvement in the project.

From the survey results in Table 6, it can be seen that the totality of the students strongly agrees that the course helped them to better understand what the core topics of several engineering fields are. Moreover, they strongly agree that the course increased their interest towards engineering disciplines. The majority of the students agrees or strongly agrees that the course improved their design skills and made them understand what a design process is. Furthermore, they think that the course helped to connect concepts they learned in other classes and apply them to practical engineering problems. Students recognized the importance of a limited formal lecture time, necessary to understand the key theory principles.

The fact that the totality of the students would recommend this class to friends and that would take the class in the next trimester to perform experiments in the wind tunnel suggests that the student have been successfully engaged in the class.
Recent SIPI Enrolment Data (2013) is shown in Figure 8.

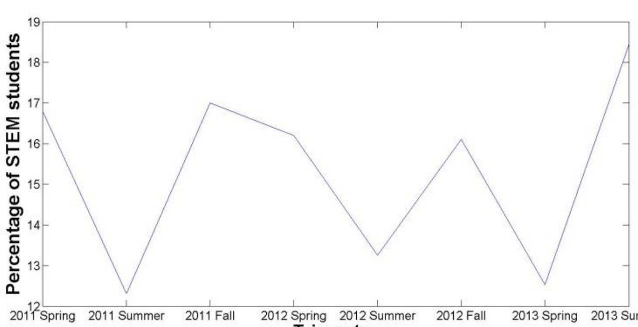

Figure 8: Enrollment data from SIPI showing the percentage of students that enrolled in STEM programs

The graph shows a significant increase of students' enrolment in STEM programs in the 2013 summer trimester. The collaboration started in the spring 2013 trimester, which appears to have had one of the lowest enrolments in STEM. The significant increment in STEM programs enrolment can be seen as the first effect of the positive influence of the learning platform.

Section 6: Conclusions

A STEM learning platform based on the design, development and testing of an instructional wind tunnel for civil engineering applications has been created through the collaboration between the Southwestern Indian Polytechnic Institute (SIPI) and the Rensselaer Polytechnic Institute (RPI). The goal of this collaboration is to increment Native American students' interest in STEM careers. A National Indian community college has been chosen because of the very low Native American students' enrolment in STEM programs.

The learning platform becomes operational through the implementation of three phases. The first and second phases have been successfully implemented in SIPI during the spring trimester.

The impact of the learning platform on students' interest in STEM was evaluated through the use of a survey given to the student at the end of the trimester. The impact of the learning platform on students' preparedness was measured using homework, design assignments, a design final report and work behaviour assessments on students' working habits.

The differences between the poor homework grades, and the strong performance on design assignments and final reports are significant. This can be explained by the fact that students better grasped the concepts of aerodynamics when facing practical design issues. This confirms the importance of having a practical, hands-on approach in STEM-related courses at early instruction stages. Based on the homework grades alone, it is clear that a theoretical class of introduction to aerodynamics would have discouraged more than 50% of the students. This result is in line with the findings of Tharp (1994, 1989).

The significantly good grades in the design part demonstrate that the students developed their critical thinking abilities and managed to collaborate inside and outside the team to create a successful design. The positive grades assessing the student work behavior also demonstrate that the practical, hands-on approach has been really effective in engaging the students.

The final survey given to the students proves that the learning platform has been effective in increasing students' interest towards STEM careers and that it helped the students to better understand engineering concepts that would have been otherwise more difficult to grasp. Moreover, the survey proved that the course was effective in improving students design skills and critical thinking, helping them to connect theoretical concepts learned in other classes and use them to solve practical engineering problems.

The enrolment data for the trimester that followed the introduction of the learning platform shows a significant increment in STEM programs enrolments. This increment can be seen as a first positive effect of this unique collaboration between a National Indian community college and a university and represents a significant change compared to the trends underlined by Babco (2003).

Phase 3 will start on the fall trimester 2013 in SIPI and will make the learning platform fully operational.

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Appendix:

Table 6: Learning Platform Student Impact Survey

Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I felt that the course helped me to better understand how several engineering disciplines work (Mechanical, Civil, Electronic, etc.)	**100%**	0%	0%	0%	0%
This course increased my interest towards engineering disciplines	**100%**	0%	0%	0%	0%
This course made me understand what a design process is	**80%**	**20%**	0%	0%	0%
This course taught me that a product design is a result of several decision based on requirements, costs and specifications	**80%**	**20%**	0%	0%	0%
I think that the design and construction of the wind tunnel helped me to better understand aerodynamics	**60%**	**40%**	0%	0%	0%
In this course I learnt a lot of useful skills that I can use in college	**80%**	0%	**20%**	0%	0%
I felt that having an instructor expert in aerodynamics helped a lot	**100%**	0%	0%	0%	0%
This course allowed me to put together several concepts that I learnt in other classes	**100%**	0%	0%	0%	0%
I would recommend this class to friends interested in pursuing an engineering career	**100%**	0%	0%	0%	0%
I think that the course gave me better design skills	**100%**	0%	0%	0%	0%
I think that building the tunnel was a very helpful activity to understand the typical problems of product design	**100%**	0%	0%	0%	0%
I think that the lecture time in the beginning of the course was important for designing properly the wind tunnel	**80%**	**20%**	0%	0%	0%
I want to continue this project in the next trimester and do experiments in the wind tunnel	**100%**	0%	0%	0%	0%