

Work in Progress: Increasing Recruitment of Native American Students in Computing Programs

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Abstract - While Native Americans make up 6.9% of the population of Arizona, they comprise only 1.9% of the student body at Arizona State University. Additionally, only about 1.9% of the students in Computing and Engineering programs at Arizona State University are Native American. From 1994 to 2005, Native American students constituted between 2% and 3% of Computer Science and Engineering enrollment. Clearly, Native American students are under-represented in computing and engineering in Arizona. This paper describes a curriculum that we are developing to help increase the recruitment of Native American students in the computing programs at Arizona State University.

Index Terms – Native American, Computer science, Undergraduate, Enrollment

INTRODUCTION

Native Americans form just 0.5% of the engineers in the U.S. labor force. However, there are encouraging signs as well. According to the U.S. Department of Education, college-age population of Native American students will increase by 15% from 2000 to 2015 while the corresponding numbers for White students will increase by 7% until 2010 and will then decrease. Within the last 15 years, freshmen engineering enrollment for Native Americans has increased from 0.7 to 1.0 percent [1]. We conclude that we can help both the underrepresented Native American community and engineering college enrolment by targeting Native American students for computing education.

The under-representation of Native American students can be attributed to various factors. Research points to lack of interaction with role models, weak preparation in math and science and culture clash with the majority culture. Conversations with Native American educators and administrators at Arizona State University revealed that poverty on the reservation, lack of mentorship, and the absence of continuous academic engagement limit educational careers [11]. Our program will deal with most of these factors as we attempt to recruit more Native American students in our computing programs. Our program consists of two phases: The first phase provides math and science support and has an all-round educational component while the second phase

consists of a bridge program specifically geared towards computer science recruitment.

SUPPORT MATERIALS

For our research, we have used several resources to create a curriculum that starts with the 8th grade and culminates with a summer bridge program towards the end of high school. These resources are listed below:

- **ACM K-12 curriculum [10]:** Our approach will have us follow the recommendations of the ACM K-12 curriculum in developing the students' Computer Science skills. We will combine the ACM curriculum with other educational tools described below to accommodate our unique demographic.
- **Bloom's taxonomy [9]:** This will help us measure the development of cognitive and emotional skills. As we recommend math, science and computer science training for Native American students, we will measure their improvement using various dimensions provided by Bloom's taxonomy.
- **Curry's Theoretical Model of Learning Style Components and Effects [3]:** This model mandates sustained motivation, increased task engagement and development of information processing skills in students. Adhering to this model enables the curriculum to provide a solid and protracted academic footing for students.

PROGRAM PHASE I

According to Powers [2], the challenge in educating Native American students is "determining cultural gap while maintaining high standards and promoting a positive climate for school learning." The first phase of our program aims to address cultural adjustment challenges as well as others like decline in grades in middle school in math and sciences [4], lack of outreach and mentorship, and inadequate training in math and science concepts. Our program will also take into account feedback collected during multiple focus groups conducted by the authors featuring Native American students at Arizona State University.

The first of our two program phases starts in the 8th grade with monthly camps that train Native American students in math, science and computer science

The monthly camps will cover Level I in the ACM K-12 curriculum and will feature students in grades 7, 8, and 9. The camps will alternate between being conducted at the ASU

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campus and on the reservations. The students will be made to use computer hardware and software, technology-based products, work on algorithmic puzzles, and discuss what role computers play in society and in their lives in particular. Students will also receive assistance in math and science concepts covered in school from senior students. These senior students will be at an advanced stage of the first phase. This will be an informal start to a mentorship program.

This phase will also feature summer programs for students that have completed 9th and 10th grades. These programs are a more expansive version of the monthly camps in that students will be trained in introductory computer science programming and hardware. The students will also be taught math and science concepts from the following year so as to prepare them better for early high school years during the preceding summer. Throughout the first phase, we will track progress along the skill dimensions described by Bloom's taxonomy and the continuity of our program fulfills the requirements of Curry's model.

PROGRAM PHASE II

The second phase of our program features a summer bridge program targeted at Native American students who have completed 11th and 12th grades.

The summer bridge program is designed to be conducted at either the ASU campus or in a reservation setting. The bridge program will feature a comprehensive computer science development project from the inception stage to product completion stage. The program will feature programming LEGO Mindstorm robots using either a graphical or text-based programming language.

The decision to conduct the program using LEGO Mindstorms was based on existing research as well as our focus group surveys. Microsoft Corporation stated last year [5] that teaching programming using games could help stymie the decline in computer science enrollment in the United States. Programming and building LEGO robots operates in a somewhat similar premise. Similar findings have been reported by research conducted at Wichita State University [6], Utrecht University [7] and the United States Air Force Academy [8].

Powers [2] and Aragon [3] also state that Native American students learn more effectively when provided with a visual project that requires them to internalize the assignment rather than merely follow a sequence of steps. Our focus group discussions further clarified the need for a project based on fun, visual impact and human ingenuity rather than plain theory.

The summer program will have students define a robot that will have a specific appearance and perform specific tasks. Students will have to formalize the design as specifications and then go about constructing the robot. They could confine themselves to the sensors that form part of the

LEGO kit or could try additional sophisticated attachments for advanced robots. After the robot is constructed, the students will program the robot to perform visible tasks. Students will test their robots for visual performance.

In the duration, students in their freshman year in college will mentor students attending the bridge program. Our program achieves the following broad objectives:

- It provides assistance in math and science to ensure that students do not drop out on account of weak grades
- The program builds an appreciation for technology early on which provides a segue for computing education
- Computing technology is taught in a manner that is fun, visual and relies on human ingenuity
- Both phases together provide continuity as well as progressively boost overall dimensions of learning prescribed by Bloom's taxonomy

This program is on-going and we are trying to put it in place with a planned pilot in the summer. The pilot will be an abridged version of the summer bridge program.

Space constraints preclude a fuller discussion of focus groups conducted with Native American student organizations and data collected from other bridge programs that cater to minorities and sometimes specifically to Native Americans.

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