

BY ROLI VARMA

Attracting Native Americans to Computing

IN THE LAST TWO DECADES, the racial/ethnic composition of those earning computer science (CS) bachelor's degrees has changed in the U.S. Between 1985 and 2005, the proportion of CS bachelor's degrees awarded to White students declined from 80% to 55%. The proportion awarded to Asians increased from 5% to 12%, to Afro-Americans from 6% to 11%, to Hispanics from 3% to 6%, and to American Indians/Alaska Natives (hereafter Native Americans) from 0.4% to 0.5%.⁷ Despite this slight increase, the number of Native Americans pursuing a bachelor's degree in CS has been low compared to their population as well as to other minorities.

Unique historical, economic, and cultural factors set Native Americans apart from the rest of students. The way in which they have experienced modern education, economic conditions under which they live, and distinct cultural traditions they maintain while meeting the expectations of the main stream educational system all play a role in how well Native American students will perform in CS studies. The arrival of Europeans to the U.S. in 1492 marked the assignment of inferior status to Native Americans

in comparison with the White race. Historically, Native American education has been addressed as a quandary, as an issue that must be "fixed" by a third party, for example, by the dominant White culture.⁵ The U.S. government formed off-reservation boarding schools to assimilate Native Americans to the dominant culture.³ Because Native Americans were not considered citizens of the United States, they were forced to remain in these boarding schools. When the U.S. government granted citizenship to Native Americans born within the territorial limits of the United States in 1924, they were allowed to attend regular public schools.¹² Nevertheless, many public schools were geographically inaccessible to Native Americans, and they continued to use the Bureau of Indian Affairs (BIA) school system.

Economically, Native American students tend to be consigned to high poverty and rural elementary and high schools, and thus remain at a disadvantage both at home and in schools, with regard to access higher education.¹¹ Out of 2.5 million Native Americans, almost 500,000 live on more than 300 reservations and trust lands. Only six out of approximately 550 tribes have more than 100,000 persons each, and four tribes have populations of at least 50,000 each; most tribes have populations less than 10,000.⁹ Even when Native Americans are not isolated by the remoteness of reservations and size of communities, they face hard economic conditions. For instance, many Native Americans live in poverty compared to the total population. In 1999, the poverty rate of Native Americans was almost 26% compared with the poverty rate of 12% for the U.S. total population. The median family income and per capita income of Native Americans was \$33,144 and \$12,893 compared with \$50,046 and \$21,587 for the total population, respectively.⁹ Poverty and isolation translate into many other constraints such as health problems, learning disabilities, and alcoholism. Such economic inequalities give rise to

less access to and thus success in higher education especially in science and engineering fields including CS.

Culturally, Native Americans maintain tribal traditions, values, and languages. They have humanistic and holistic approaches of learning and knowledge that emphasize the importance of grasping the big picture before studying particular subjects. They consider independence, individualism, and competitiveness somewhat taboo and deem generosity, sharing, harmony and group-oriented learning environments to be more important. Science and engineering curriculum and instructions are based on the philosophy of secularism, reductionism, and compartmentalization.³ The cultural discontinuity experienced by Native Americans in institutions of higher education is seen as creating obstacles for them to do well in science and engineering fields, including CS.^{4,5,10}

Despite above circumstances, many Native Americans do well in CS education. This paper considers some factors that drive Native Americans to major in CS and succeed (or not) in completing the degree. It is based on in-depth interviews conducted with 50 Native American male and female undergraduate students who were majoring in CS at six Hispanic-Serving Institutions (HSIs; the Hispanic enrollment must be at least 25% of the total student enrollment) or Tribal Colleges and Universities (TCU; the Native American students' enrollment must be 50% of the total student enrollment) in 2004-2005. There are about 30 TCUs in the United States, most of which are located on Indian reservations, and about 200 HSIs, which are spread throughout the country. For consistency in data collection, the author conducted all interviews, which were recorded, subsequently transcribed, and inserted in Nvivo software for analysis. Two independent coders coded the data for reliability and validity. Though there were slightly more students interviewed from HSIs, the total count of male and female students for this study is the same.

What Needs to Overcome?

Students interviewed gave three aspects which need to be dealt with to improve enrollment and retention of Native Americans in CS: economic fac-

Table 1: Challenges Faced by Native Americans in Computer Science Education

Challenges	Hispanic-Serving Institutions			Tribal Colleges/Universities			Total
	Female (n=13) %	Male (n=13) %	Total (n=26) %	Female n=12 %	Male n=12 %	Total (n=24) %	(n=50) %
Economic Factors	46	38	42	50	58	54	48
Social Factors	31	46	38	25	25	25	32
Cultural Factors	23	15	19	25	16	21	20

tors such as lack of computer resources at home or on reservations, shortage of qualified teachers, and dearth of job opportunities on or close by reservations; social factors such as limited motivation of higher education over all and of CS in particular, not having family encouragement, absence of role models, and existence of bias and prejudice; and cultural factors such as tribal responsibilities, customs, and oral traditions (Table 1).

Economic Factors: Almost half of the students interviewed (48%) believed that Native American communities lack educational and computer resources, which creates distinct obstacles for them that White and even other minority students do not encounter. More students from TCUs (54%) than from HSIs (42%) pointed out economic factors that contribute to their unequal participation in CS education, although there was no difference between male and female students (Table 1).

As one student said, "Somehow computers have been much more common with White, upper- and middle-class households, and not so much with non-White groups and lower class." "Because of lack of familiarity, [Native Americans] are not sure what computers are all about," noted another. Talking about general educational resources at TCUs, one student showed his frustration, "We simply do not have computer science teachers [on the reservation]. We have one computer science teacher who is literally teaching everything. There are two student teachers from [X] who are doing their internships here." Students blamed poor economic conditions, which forces many Native Americans to seek employment after high school rather than higher education. One student generalized, "The main goal in my community is to get a high school diploma or GED [General Education Diploma], and then go into the work-

force. It is not until we are in our 30s or 40s and have our families that we decide to come back and get some type of higher education." Students further asserted that there is a "perception that there is no work for someone with a CS degree on the reservation."

Social Factors: About one-third of the students interviewed (32%) pointed out that for Native American students, higher education is one among many other indicators to be successful in life. Their family members would like them to be more attentive to family values than education. Then, being the only Native American in CS classes tends to be an alienating experience. More students from HSIs (38%) than TCUs (25%) pointed out such social issues. Within HSIs more male (46%) than female (31%) students believed Native Americans experience social issues while there was no difference between male and female students from TCUs (Table 1).

Students identified several social factors that work against motivating Native American students to pursue and persist in CS programs at the undergraduate level. Many students talked about early socialization and lack of encouragement from parents and community that result in Native Americans' unwillingness to pursue higher education, and for those who do, their reluctance to major in a science or an engineering field. As one student put it bluntly, "I just don't think [Native Americans] have the determination, the discipline, or even the encouragement to do well in sciences." Another said, "A lot of Native American students don't have that kind of support from home growing up. [Families] don't put a value of doing well in school." Students further pointed out lack of proficiency in mathematics and sciences, which pushes Native Americans toward social work, Native languages, and nursing. As this student acknowledged that there is a perception that

“they have to be extremely intelligent, they have to be smart in order to be able to work with computers.” These students believed that for many Native Americans having a degree in CS means moving out of or never being able to return to the reservation, which they prefer not to do. Most importantly, students mentioned the direct hostility and/or indirect intimidation expressed toward them by their white peers and faculty which made them view CS as an unfriendly place for Native Americans. As one student mentioned: “They look down on you...like what are you doing here?” Another said, “Sometimes there is over sympathy...and sometimes too much appreciation just for the fact that you are a Native American in computer science. There is never a middle ground.” The responses along the lines of prejudice/bias were seen more frequently among students from HSIs than from TCUs. Among students from TCUs, females felt that they were being pushed out by their male peers.

Cultural Factors: Some students interviewed (20%) mentioned that Native Americans face cultural conflicts between the traditional Native and the dominant Western worldviews to pursue education in CS. Once enrolled, students face several problems when they try to maintain their cultural customs and traditions while studying CS. Slightly more female than male students from TCUs mentioned cultural conflicts then did those from HSIs (Table 1).

As one student acknowledged, “Native Americans place higher value on nature and not being in a rush to do technological things or to incorporate technology into their lives.” Another student mentioned, “Some of it would be the upbringing and the ideology of nature controlling forces as the divine force and a lot of Native Americans might see computers as a conflict of nature so they would want you to stay away from them as a profession.” Also, CS is based on written tradition, most of the work is done alone, and coding is very detailed and individually oriented. This makes recruitment in CS rather challenging. As one student acknowledged, “We are kind of people who don’t like to write... Native Americans believe in oral tradition.” Another said, “Computer science learning is such that we have to put ourselves above others. ...We are

taught to put ourselves above no one.” Then there are several cultural issues for those studying CS. Students believed that the pace of CS courses is often faster than their absorption of CS material and the large volume of course work is combined with the teachers’ expectation of mastering it at high speed. This is not compatible with tribal duties, which was the number one cultural factor mentioned by students as creating the most conflict in their lives in regard to their CS studies. Students from HSIs have to make sacrifices by choosing between tribal ceremonies and school responsibilities. In contrast, students from TCUs face little such challenges due to the close location between their homes and the colleges they are attending. As one student explained, “We have to attend ceremonies. If we don’t, we are not viewed as a part of the community. ...It takes too long to drive back and forth.”

The Role of Economics, Social, and Cultural Factors

Much emphasis has been put on the centrality of social milieu and indigenous culture in the enrollment, retention, and attrition of Native Americans in science and engineering education, including CS.^{4,6,10} This study, however, shows that economic factors such as lack of computer and educational resources, shortage of qualified teachers, and dearth of job opportunities on or close by reservations as an important cause leading to low enrollment and retention of Native Americans in the CS field. Even when students interviewed discussed limited personal motivation, an overwhelming majority of them pointed out the need for employment after high school, the lack of which keeps them away from higher education. Similarly, students’ preference for social work and nursing was also the consequence of a lack of qualified teachers training Native American students in science and engineering fields in elementary, middle, and high schools. Teachers with technical skills and interests serve to inspire students to learn about CS and to recognize the value of a CS degree. A lack of this inspiration results in the students not perceiving a current or future utility of CS for them, and they are unlikely to be motivated to enter into and continue in the CS field.

Comprehensive data on the depth of the digital divide—the gap between people with access to information technology and people without such access—for all Native Americans are seldom available; due to their small numbers, they tend to be included in “other” categories.^{7,8} Scant data on the digital divide are available for Native Americans living on reservations. One study found that out of 551 tribes, only 146 tribes reported that the tribe owned a computer, 121 tribes reported that the tribe had a computer lab, and 91 tribes reported that the tribe had Internet access.¹ Another study found that out of the 185 schools supported by the BIA on reservations, only 76 are connected to the Department of Interior’s Internet service with fractional T1 lines. Classroom cable drops, which can be used to connect computers once facilities and equipment become available, are present in 104 schools. At some reservations, such as the San Carlos Reservation in Arizona and the Navajo Reservation that stretches across parts of New Mexico, Arizona, and Utah, more than 80% of the population lack home telephone service.² If there are not adequate information technology resources available for students in their early years, the interest in CS will not be fomented.


This, however, does not mean that social and cultural factors do not play a role in the enrollment, retention and attrition of Native Americans in CS. There are indeed social and cultural issues arising from Native Americans’ worldview and the field of CS. Students interviewed often made a reference to the “Western World,” which they viewed as different from their “Native World,” but in which Native Americans have been required to assimilate to be successful in CS. For many Native Americans, the importance of family, home, community, tribal duties, and philosophy outweigh educational choices. Even when Native Americans are not exposed to their native culture because they grew outside reservations, there is a sense of holding on to native customs, language, and traditions. Such social and cultural differences show challenges Native American students are likely to face in becoming successful computer scientists.

Yet, when students interviewed considered changing their major from CS to

something else, it was seldom due to social and cultural conflicts. Instead, the reasons for Native American students to think of changing from a CS major came down to more practical concerns resulting from their economic status, such as having gone to disadvantaged elementary, middle, and high schools. Students believed that their schools did not prepare them for CS education at the undergraduate level. They further discussed how they are unable to keep up with the CS field due to working and looking after their families.

Native American students are likely to be successful in CS if the model of education is socially and culturally appropriate and economically attractive to Native Americans. While it is true that the cultural discontinuity experienced by Native Americans creates obstacles for them to pursue CS education which is built on the philosophy of secularism and reductionism, it is also true that unless Native Americans see the potential of a CS degree to improve their economic status and then are prepared mathematically, they are unlikely to pursue the degree. Therefore, a model that combines social and cultural sensitivity with economic issues is more likely to be successful than concentrating within the framework of one area.

Conclusion

To conclude, cultural, social, and economic factors juxtapose and complement each other, and one without the other would not be adequate to explain the challenges Native Americans face in CS education. Also, it needs to be acknowledged that too much emphasis on social and cultural values is risky as it lays blame on Native Americans for their own low representation in CS on the one hand and separates the new global, technologically oriented world away from Native Americans on the other hand. Most importantly, the incorporation of CS is necessary, if not essential, for the success of Native Americans as a community. Otherwise, Native Americans will face the danger of being left behind with the rise of an information society. Nevertheless, this endorsement must be done hand-in-hand with the incorporation of Native values, so that it does not translate into a risk for Native American culture, but instead slowly and smoothly grows to become part of it. 

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