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Board 343: Native American Student Research Experiences in IoT-Enabled Environmental Monitoring Technologies: An Analysis of North Dakota Tribal Student Experiences in Beijing, China and Mobile, Alabama

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Native Americans are significantly unrepresented in postsecondary engineering programs. This deficiency is linked to many interrelated social, cultural, and economic factors that influence student readiness, awareness, and retention in engineering disciplines [1]. Educational efforts addressing the complex impediments that traditionally hinder Native American student success in engineering is important to change this academic narrative. Experiential learning programs that focus on developing academic engagement through shared learning experiences helps ease learning barriers to success as this approach enables Native American students to build a community of peers within the discipline and develop a unique engineering identity [2].

Program Recruitment

This National Science Foundation (NSF)-funded International Research Experiences for Students (IRES) summer program (2019-2022) centered on providing Native American college students, from the Northern Great Plains region, with an opportunity to obtain specialized training, personalized mentoring, and peer support in engineering research. Native American students were recruited annually from five Tribal Colleges (Nueta Hidatsa Sahnish College, Sitting Bull College, Cankdeska Cikana Community College, Turtle Mountain Community College, and United Tribes Technical College) and two research universities (North Dakota State University and University of North Dakota) in North Dakota to participate in a five-week, IRES summer program

In 2019, Native American student participants traveled to Beijing, China to learn Internet of Things (IoT)-enabled technology at the Beijing University of Technology (BJUT). In 2020 and 2021, training for student participants was placed on hold due to the Covid-19 pandemic. In 2022, public limitations related to Covid-19 had eased in the United States due to vaccine availability; however, fluctuating global travel restrictions created the need to domestically relocate the IRES training program to Mobile, Alabama.

Covid-Influence Program Reorganization

In 2022, a cohort of 12 students – five new Native American students from North Dakota, five traditionally underrepresented engineering students from southern Alabama, and two previous Native American students from the 2019 Cohort (serving as senior mentors) – were trained on wireless sensor network design, energy harvest design, edge-AI design, and new technologies, such as memristors, for IoT-enabled environmental monitoring systems at the University of South Alabama (USA) in Mobile, Alabama (**Figure 1**).

Engineering-based learning content in the program remained consistent with instructional material taught to the 2019 cohort, apart from technical updates; however, changes in sociocultural learning experiences were adjusted for the new program location. Learning activities and dialogues were expanded to incorporate aspects of the south Alabama culture – comprising of a multilayered history involving White Southern, Black Southern, and Poarch Band of Creek Indian populations – with Chinese and the Northern Great Plains Native Americans cultures.

Figure 1. Student participants of the 2022 Cohort at the University of South Alabama in Mobile, Alabama.

Instructional Strategy

Instructional goals of the program were targeted at providing students: 1) instructional training and research experience on environmental monitoring technologies, 2) professional development in communication, peer-engagement, and cultural mindfulness, and 3) mentoring through partnerships and peer groups. Connected social and cultural experiences were designed to connect students with new educational possibilities, enhance student perspectives, build a peer-support community, and provide students with a chance to explore options for their academic and career pathways in an intellectually supportive and culturally enriched environment. Opportunities and experiences for students were designed to encourage interest and excitement about the engineering field and to help students see themselves as engineering students.

Methods

Program training effectiveness and student experiences were evaluated through student skill assessments, student engagement observations, formative and summative participant surveys, training observations, feedback from group discussions, and individual interviews.

Results to Date

Results indicate that student participants grasped key quantitative and technical skills through the combination of instructional guidance, peer-mentoring, and hands-on experiences. Nearly all students experienced positive and unexpected encounters in cultural learning and perceived the overall experience as positively impacting their academic training, career development, and cultural understanding.

When comparing student experiences between the locations of Beijing, China and Mobile, Alabama, the consensus among Native American student participants from North Dakota indicated that they preferred, or would have preferred, having their initial 'culture shock' experience in Mobile, Alabama during the first year of a distance-study program. New student participants felt that having an initial 'culture shock' in Beijing, China would have been too overwhelming for them at these early stages of their academic careers. Most of the same students believed that the skills obtained from the domestic distant-study program have better prepared them for an international experience in the future, and showed a particular interest of participating if a follow-up event would be scheduled with members the same student cohort. Students who had experienced training in both locations agreed that having an initial distant-study experience in Mobile, Alabama would have eased some of the initial anxiety of their international study-abroad experience. The primary feedback was in relation to adjusting to living on-campus, which is not common at most Tribal Colleges.

Specific results from participant surveys and interviews are in the process of being submitted for publication. One-year, post-program, follow-up interviews are currently being planned for the summer of 2023 for additional comparison of program impacts.

Discussion

Changing an academic training program from being in a 'study-abroad' to a 'study-domestic' setting because of a global pandemic has unique challenges; however, gaining unexpected insight into how diverse student populations navigate, adapt, and experience different training environments and cultures is invaluable. This NSF-funded IRES program revealed essential concepts that make Native American students feel welcomed, valued, and heard. Listening and adapting to student needs through a flexible, genuine, and culturally-aware curriculum empowers students and is essential for lifelong learning and successful integration of underrepresented students into engineering-based disciplines.

References

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