

Recommended Practices for (Native American) STEM Partnerships

Jeffrey Hovermill
Ashish Amresh
Northern Arizona University

Paige Prescott
University of New Mexico

Abstract: Session presenters/authors have worked to support STEM education in Native American serving schools for many years. During the last few years, substantial progress has been made towards building capacity for culturally sustaining STEM activity in classrooms, schools, and partnering school districts. This paper highlights the ways that improved communication and collaboration among project partners (teachers, teacher educators, school administrators, community members, STEM professionals) have supported this progress. Recommendations for (Native American) STEM partnerships based on these experiences will be shared in this session.

Introduction

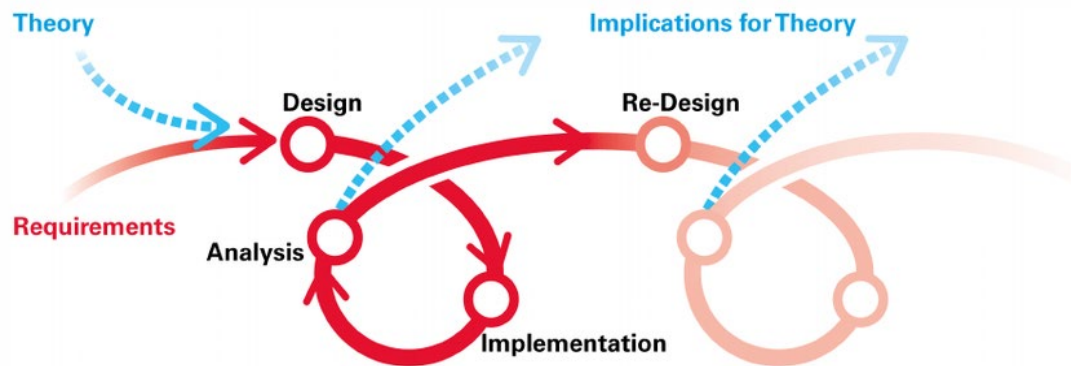
The authors of this paper are STEM educators who live and work in communities that border Native American reservations and regularly work with teachers, schools, and school districts that serve Native American students. The recent NSF-funded initiatives that we are involved in have demonstrated great promise towards building capacity for culturally sustaining STEM education practices in the Native American serving schools and school districts that we work with. This paper outlines some key design features that have contributed to this impact and situates them within Partnership and Indigenous Education research and recommendations.

‘Indigenous people are the *most* underrepresented ethnic group in STEM fields’ and ‘more equitable representation of Indigenous peoples in STEM is not just a moral imperative; it is also necessary to ensure diverse, high-quality STEM perspectives and approaches’ (Castagno et al., 2022).

Key Project Design Features

Research on school-university partnerships has long highlighted the importance of collaboratively working together towards a common vision and building effective communication structures (Martin et al., 2004). This is easier said than done, however, when considering the long history of deceit and damage that colonialism has done to Native American communities (Werito and Vallejo, 2022). Peel et al. (2002) emphasize that partnerships are much more effective and viable if there is a climate of respect, trust, and a true collaborative spirit and that time must be allowed to build these relationships.

Two National Science Foundation grants (acknowledgements at end of paper) have provided impetus and opportunity to work towards deepening partnerships towards culturally sustaining STEM. Culturally sustaining education refers to teaching and learning that is grounded in a cultural worldview, from whose lens are taught the skills, knowledge, content, and values that students need in our modern, global society (Kana’iaupuni, M. and Kawai’ae’a, K., 2008). The design of culturally sustaining education programs demand that the programs be developed locally with the communities or First Nations playing an active role in developing culturally based curricula and in delivering instruction (Assembly of First Nations Education, 2016). Both NSF projects incorporate a collaborative design process that allows opportunity for many stakeholders to collaboratively develop and refine the curricula over time, as shown in Figure 1, below.



Design-based research as an ongoing process of innovation. Figure adapted from Fraefel (2014, p. 9)

Partnership Steps

Our two NSF grants had overlapping but distinct STEM education goals. One was focused on integrating mathematics and science within community, culture, and other disciplines. Details of this project were shared at SITE last year. (Hovermill et al., 2023). The other project focused on integrating culture and language within Computer Science education. Details of this project are to be shared at SITE this year. (Prescott et al., 2024). Both projects, however, utilized the same collaborative design model (Fraefel, 2014) and necessitated long periods to obtain support and participation from school and community representatives. Many meetings with teachers, school principals, superintendents, district administration, and school boards occurred over the course of several years to discuss and decide upon project goals, procedures, and timelines. Presentations were then given to Native American oversight agencies (Department of Dine' Education, Navajo Nation Human Research Review Board) before permission was ultimately given to proceed with project implementation and research.

It is important to note the important role that Northern Arizona University's (NAU's) commitment to their support of partnering with Native communities has played. 'In recognition of the unique sovereign status of Native Nations and the sacred land on which the university was built, NAU will continue its intentional support for Indigenous students, faculty, and staff; develop university-wide culturally responsive educational opportunities and programming; and build mutually beneficial partnerships with Indigenous communities that will position NAU as the nation's leading university serving Indigenous Peoples (NAU, 2022). At the core of these partnerships are the core principles that NAU's 7Gen Center has outlined, below:

Respect - Indigenous-based principle that guides our harmonious interactions ethically, relationally, and environmentally.

Responsibility - It is our sacred responsibility to honor and care for Indigenous students, staff, faculty, and allies.

Relationship - We acknowledge and honor our relationships through trust, wisdom, and strength necessary to establish and cultivate relationality with one another and the universe.

Reciprocity - Demonstrating appreciation and gratitude for the exchange of information and knowledge to build and maintain harmonious communities.

Representation - Indigenization holds accountable the systems and structures at NAU that prevent multidimensional Indigenous representations and participation. We advocate for NAU to center, honor, and prioritize contemporary voices, identities, experiences, and increase the presence of Indigenous faculty, staff, students, and communities.

Redistribution - We value the standard of more equitable redistribution of institutional resources to meet the needs of Indigenous students, staff, faculty and communities.

We share this information so that people interested in working in this sphere understand the time and detail necessary to form alliances, buy-in, and support. Teacher attrition has historically been a problem with professional learning initiatives in our region. We are now seeing the benefit of spending this much time and energy during project ramp-up and implementation, as demonstrated by the increasing numbers of teachers who have sustained

their participation over time (Table 1, below). With both NSF projects now in their final year, we are seeing substantially more follow through with completing and implementing all professional learning activities. As we move forward, we are confident that the pieces are in place to continue building momentum in this area.

Project Title	Year One Participating Teachers (Started / Completed)	Year Two Participating Teachers (Started / Completed)	Year Three Participating Teachers (Started / Completed)
Project Co-STEM	(18/8)	(18/16)	(20/20)
Project Let's Talk Code	(16/4)	(16/6)	(18/15)

Another key design feature has involved integrating school district personnel into all aspects of project design and implementation. This has allowed schools and districts to find time and place for planning to occur at schedules that work for them. Some online (Zoom meetings) support has been helpful but being in schools and classrooms in person is more valuable. Obtaining supplies for participants and negotiating and breaking down program expectation timelines into achievable steps have also been helpful ways to sustain teacher participation.

Project Co-STEM lessons have focused on place-based, data-rich, instruction. Place-based education (Sutherland and Swayze, 2012) promotes learning experiences that are rooted in the cultural, historical, environmental, and/or economic contexts of students and provides opportunities to understand the ways that culture and place are intrinsic to the experiences of Native students. Place-based, data-rich instruction supports students to use data and data tools in their STEM learning through a place-based approach. Examples of Co-STEM lessons have included scientific investigations of water quality and agriculture, accompanied by narratives and discussion of cultural practices associated with these concepts.

Project Let's Talk Code lessons have focused on the integration of Native culture and language, and computer science and coding principles, within instruction associated with core academic areas such as math, art, and language arts. Both projects have seen increases in teacher confidence in teaching STEM concepts and in integrating culturally relevant instruction and increased interest and achievement in STEM.

After many years striving to best support culturally sustaining STEM partnerships, we are happy to see many teachers and students excited about STEM! Just this year, there have been Native American STEM, STEAM, Coding, and Robotics events outside of school in addition to the creation of many community- and culturally-based STEM classroom lessons.

References

- Assembly of First Nations Education (2016). *First Nation's Control of First Nation's Education*.
- Castagno, A., Ingram, J., Camplain, R. and Blackhorse, D. (2022). "We constantly have to navigate": Indigenous students' and professionals' strategies for navigating ethical conflicts in STEM. *Cultural Studies in Science Education*, Volume 17: 683-700.
- Fraefel, Urban. (2014). *Professionalization of pre-service teachers through university-school partnerships*. WERA Focal Meeting: Edinburgh. (<https://shorturl.at/pJXY7>)
- Hovermill, Amresh, Evans. (2023). Participatory Design-Based Research with Native American serving Middle Schools. SITE 2023 Conference Proceedings.
- Kana'iaupuni, M. and Kawaiyaeya, K. (2008). Toward a Hawaiian Indigenous Education Teaching Framework. <https://files.eric.ed.gov/fulltext/ED523184.pdf>

Martin, D., Reeves, W., Wilson, E., O'Dell, L., and Egan, T. (2004). *Taking on the Teacher Supply and Retention Challenge: A Performance Focused Model for School-University Partnerships*. ERIC: <https://files.eric.ed.gov/fulltext/ED492336.pdf>

Northern Arizona University. (2022). *Elevating Excellence: A Bold and Boundless Future for All*. https://nau.edu/wp-content/uploads/sites/197/0613_742018_OOP-Elevating-Excellence-Brochure-FY22_9x9_ADA-FINAL.pdf

Peel, H.A., Peel, B.B. and Baker, M.E. (2002). School/university partnerships: a viable model. *International Journal of Educational Management*, Vol. 16(7), pp. 319-325.

Prescott, Hovermill, Amresh, Yan, Begay (2024). *Let's Talk Code: A flexible professional development and implementation in computer science to expand access to CS in underserved communities*. SITE 2024 Conference Proceedings.

Sutherland, D., Swayze, N. The importance of place in indigenous science education. *Cultural Studies of Science Education* 7, 83–92 (2012). <https://doi.org/10.1007/s11422-011-9371-1>.

Werito, V. and Vallejo, P. (2022). The State of Navajo Education. In *Transforming Dine' Education*. Tucson: University of Arizona Press.

Acknowledgements

Project CoSTEM is funded by NSF ITEST program Award # 1949241 titled “Developing a culturally responsive pedagogical framework for STEM self-efficacy and career interest in the middle grades.” The work is also reviewed and approved by the Navajo Nation Human Research Review Board (protocol # NNR- 22.461).

Project Let's Talk Code is supported by the National Science Foundation's Computer Science for All program award # 2031505. The work is also reviewed and approved by the Navajo Nation Human Research Review Board (protocol # NNR- 22.460).