Native STEM Portraits Annotated Bibliography

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This annotated bibliography includes references and summaries of literature, primarily literature on empirical research studies, that are focused on the experiences of Native people in STEM (science, technology, engineering, and mathematics) higher education. The literature pieces were produced between 2005 and 2021 and are listed below alphabetically. This set of literature is not exhaustive, meaning it does not include *all* literature that is written about Native people in STEM higher education. However, this document was curated to serve as a resource, as part of the *Native STEM Portraits* Project (NSF-2000619), for scholars who are interested in Native undergraduate and graduate populations.

Note: For each of the summaries below, the terminology of the authors is adopted. Therefore, terminology will differ across summary entries. For example, while some entries use "American Indian," others may use "Native," "Indigenous," or "indigenous."

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- Allaire, F. S. (2014). *'A 'ohe pau ka 'ike ka halau ho a'okahi: All knowledge is not taught in the same school: A multiple-case study on the navigation of personal, cultural, and professional identities of Native Hawaiian members of Hawai'i's science, technology, engineering, and mathematics community* [Unpublished doctoral dissertation]. University of Hawai'i at Manoa. https://www.proquest.com/docview/1611438409?sourcetype=Dissertations%20&%20Theses

Summary: This dissertation explores a multiple-case study that includes 10 Native Hawaiian participants in STEM with a focus on their experiences within the STEM community and how they navigate their personal and professional identities. The author identified four major themes: (1) identity salience, (2) personal/cultural connections to science, (3) a Hawaiian doing things versus doing Hawaiian things, and (4) being a first-generation Native Hawaiian scientist. Since the completion of this unpublished dissertation, the author has published and further disseminated his dissertation findings in two journal articles (see Allaire, 2018 and 2019 below).

Recommendations: This author provides implications of his research and research recommendations to the field. His two implications include embracing the plurality of identity and shifting to a different identity paradigm that offers greater inclusion and acceptance. Based on his research, the author believes that a paradigmatic shift will enable secondary and post-secondary institutions to offer better support to Native

Hawaiian STEM students academically, emotionally, psychologically, and culturally. The author offers several research recommendations to the field, primarily focused on the types of research topics that could be further explored. For example, one research topic offered is focusing on ecologically driven identity salience and the effects of cultural proximity to provide insight on the development and maintenance of Hawaiian identity.

- Allaire, F. S. (2018). Themes from a narrative analysis of Native Hawaiian experiences in science, technology, engineering, and mathematics. *Journal of Ethnographic & Qualitative Research, 12*(3), 173–192.

Summary: This ethnographic qualitative study builds upon the author's work in his dissertation (see Allaire, 2014) and explores the experiences of 10 Native Hawaiians in Hawai'i's STEM community, including undergraduate students, graduate students, and professionals. The author identifies three major themes: (1) identity construction and maintenance; (2) personal and cultural connections to STEM; and (3) experiences as a first-generation Native Hawaiian scientist. For the first theme, "identity construction and maintenance," the author reports how participants constructed and maintained (a) their Native Hawaiian identities, noting that this was core to who they are and how it impacted their desires to pursue STEM, and (b) their professional identities, describing how participants built and embraced their scientist identities. In explaining the second theme, "personal and cultural connections to STEM," the author discusses how participants used their Native Hawaiian values to guide them through their STEM experiences. This theme highlights how participants' experiences converged and diverged from traditional western science methods and beliefs. The third theme, "experiences as a first-generation Native Hawaiian scientist," describes the challenges that participants encountered as the first of their families to attend college. This includes overcoming the barriers of being stereotyped, tokenized, and isolated. These findings offer readers a more in-depth understanding of the experiences Native Hawaiians have as they navigate pursuing STEM studies and careers.

Recommendations: This author encourages future researchers to examine the effects on Hawaiian identity as it relates to being raised in Hawaii versus being raised on the Continental U.S. The author also recommends that researchers examine how participation in extra-curricular STEM-based programs impact Native Hawaiian students and how they form their scientist identities at the primary and secondary levels.

- Allaire, F. S. (2019). Navigating uncharted waters: First-generation Native Hawaiian college students in STEM. *Journal of College Student Retention: Research, Theory & Practice, 21*(3), 305–325. https://doi.org/10.1177/1521025117707955

Summary: Further building upon his previous works (see Allaire, 2014 and 2018), this qualitative study examines the experiences of 10 Native Hawaiians in STEM with a particular focus on their first-generation student experiences. It highlights the challenges these participants encountered, such as lacking support, feelings of isolation,

experiences of being tokenized, and being stereotyped. In addition to discussing the barriers that participants encountered, the author also describes the supports the participants had that helped them to persist in STEM. These supports include internal motivation to counter stereotypes and succeed, and identifying sources of support, such as family support, academic support, and engagement in student organizations.

Recommendations: In this article, the author offers recommendations aggregated from participant interviews. For example, participants shared "that the science community must recognize what underrepresented minorities can bring to the discussions and research agendas" (p. 321). Rather than simply hiring Native Hawaiians for the sake of appearing diverse, institutions should have genuine interest in Hawaiian epistemology or methodology to foster trust between Hawaiian communities and STEM communities. The author also highlights the importance of STEM cohorts to the participants in the study and how these participants believed that the state of Hawaii and the university should be committed to make Native Hawaiian and nonculturally based programs more financially sustainable. Finally, the author recommends that the university should consider appointing a dedicated faculty member to provide support and guidance specific to Native Hawaiian students to offer them culturally appropriate role models.

Antonellis, J. C. (2013). *"Energy is… life": Meaning making through dialogue in a tribal college physics course* (Publication No. 3597820). [Doctoral dissertation, The University of Arizona]. ProQuest Dissertations & Theses.

Summary: This dissertation investigates Native student meaning-making through dialogue in a singular intrinsic case study of a culturally relevant physics course at Tohono O'odham Community College, a tribally controlled college. The study focuses on two male Native students taking the course (N=2), examining how their personal, cultural, and philosophical experiences (denoted as their "funds of knowledge") were incorporated into their physical concepts, such as energy, motion, and Newton's laws, specifically through classroom dialogue. The syllabus for the culturally relevant course was developed over two years with guidance from Native professors, students, and other keepers of Native wisdom. Data was collected through audio recordings of classes and reflective journal entries from the teacher of the course, who was also the researcher and author. The methodology for this study drew from qualitative and Indigenous research frameworks, with the author recognizing that the study does not fully embody the Indigenous research paradigm given that the author herself is not Native. Findings reveal that the students readily related the course content to their cultural perspectives. The incorporation of their personal experiences into the class allowed them to consider their cultures from a scientific perspective, with both students viewing science as a part of their cultural heritage by the end of the course. Additionally, the students enjoyed considering physics topics from a philosophical perspective and found that they engaged with physics in a way that they would not have been able to otherwise. Dialogues revealed students' ability to merge scientific knowledge with their cultural and spiritual worldviews. Furthermore, the dialogical classroom environment allowed for the creation of a "third space" where Indigenous and Western knowledge

systems coexisted, fostering engagement and persistence in STEM learning. This research highlights the significance of culturally responsive pedagogies in supporting Native students' academic success and retention in STEM disciplines.

Recommendations: The author recommends that STEM courses take the form of third-space learning environments that integrate Indigenous and Western epistemologies through dialogue and culturally relatable course content to promote equity in STEM education. Suggestions include the incorporation of dialogue and storytelling sessions into STEM courses, support for culturally relevant curricula on the institutional level, active collaboration with tribal communities and Native students, and further research into how cultural identity influences STEM learning. These approaches can enhance the retention and success of Native students in higher education by affirming that cultural heritage can not only coexist with but is actually enmeshed with academic excellence.

- Bernstein, H., Martín, C., Eyster, L., Anderson, T., Owen, S., & Martin-Caughey, A. (2015). Evaluation of the Alaska Native Science & Engineering Program (ANSEP). *Urban Institute.* https://www.urban.org/research/publication/evaluation-alaska-native-science-and-engineering-program-ansep

Summary: This report evaluates the Alaska Native Science & Engineering Program (ANSEP) based at the University of Alaska between September 2013 and December 2014. ANSEP was designed to prepare and support Alaska Native students from secondary through post-secondary education to pursue, persist, and succeed in engineering and science (E&S) careers. The program provided Alaska Native students with a multitude of supports and opportunities, which empowered and excited youth to pursue engineering and science studies and career pathways. This in-depth report provides insights into the successes and challenges ANSEP experienced during this time frame and provides key findings as to how it benefited the program's target population and beyond.

Recommendations: This report details in what ways the ANSEP model may be replicated and in what ways it cannot, which may be useful for other programs interested in supporting this population at other institutions.

- Brandt, C. B. (2007). Scientific discourse in the academy: A case study of an American Indian undergraduate. *Science Education, 92*. 825–847.

Summary: This ethnographic case study follows Deborah, an American Indian undergraduate student in the biological sciences, and describes how she experienced and "performed in the context of Eurocentric science" (p. 832) at her university. The author describes how Deborah navigated the conflicts of Eurocentric scientific views and her traditional worldviews, such as barriers to her participation in some class

activities. In addition to describing the barriers, the author also explains how Deborah reconciled conflicts between her traditional worldviews and those of Eurocentric science through cultural survival.

Recommendations: The author concludes this piece with implications for teaching, advocating for a shift in how educators view discourse and encouraging them to become more inclusive in practices to support students' participation in the classroom.

- Bueno Watts, N. (2011). *Broadening the participation of Native Americans in Earth sciences* (Publication No. 3466860). [Doctoral dissertation, Arizona State University]. ProQuest Dissertations & Theses.

Summary: This dissertation examines the systemic barriers affecting Native American and Alaskan students' participation in and completion of Earth science degree programs, aiming to address the underrepresentation of Native scientists in this field. Using qualitative research methods and guided by the postcolonial theoretical framework, the researcher, a non-Native and non-white female, identifying as an Earth scientist and science educator, conducted and analyzed 20 (N=20) semi-structured interviews. Interviews consisted of 15 Native Earth scientists and 5 non-Native program directors whose job is to promote Native participation in Earth sciences. Five of the 15 Native scientists were also program directors. Of the Native Earth scientists, 12 identified as female and 3 identified as male. Eleven of the 15 participants were first-generation college students, 9 were "non-traditional college students" (pursuing a degree more than 20 years after their high-school graduation),12 completed a bachelor's in science and 7 earned a master's in science, with a variety of participants currently pursuing various degrees. The study utilized constant comparison analysis to identify themes related to persistence, retention, and success. In interviews with the 15 Native participants, several barriers were uncovered, including financial limitations (reported by 80% of the participants), lack of institutional support for cultural and familial obligations (53%), unsupportive faculty for women and non-traditional students (80% of women and 50% of non-traditional students), significant mental and physical health barriers (53%), and irrelevant or offensive Western-dominated course content (80%). Participants also highlighted the disconnect between Earth science curricula and the practical needs of Native communities, coupled with the dominance of Western scientific paradigms that often exclude Indigenous worldviews. Key supports for success identified by Native and non-Native participants were financial assistance, meaningful mentoring relationships, and opportunities for hands-on research tied to community needs.

Recommendations: The author's recommendations for the promotion of Native participation in Earth science are drawn from what Native Earth scientists identified as significant to them in the success of their degree completion coupled with

recommendations from the 10 program directors. Mentoring emerged as a particularly critical factor, as it provided both academic guidance and cultural understanding. Additionally, the creation of specialized university programs and professional organizations with the specific goal of supporting Native student scientists is recommended, as well as the integration of culturally relevant course content into all Earth science curricula. Participants also emphasized the importance of community-inspired research that integrates Indigenous knowledge with Earth science to not only address pressing problems in Native communities but also inspire students to pursue STEM degrees by demonstrating the relevance of Earth science to their cultural values and community needs. To address financial barriers, the study calls for increased scholarships and funding opportunities. The author recommends further research on effective pathways to recruit and retain Native students in STEM, with an emphasis on strategies that blend traditional and modern scientific perspectives.

- Bueno Watts, N., Smythe, W., Ward, E. G., Dalbotten, D., Green, V., Tano, M., & Berthelote, A. (2014). Geoscience Alliance: Building capacity to use science for sovereignty in Native American communities. In D. Dalbotten, G. Roehrig, and P. Hamilton (Eds.), *Future Earth—Advancing civic understanding of the Anthropocene, Geophysical Monograph 203* (pp. 67–75). John Wiley & Sons, Inc.

Summary: This book chapter responds to a series of recommendations by the Geoscience Alliance (GA) that aims to broaden participation in the geosciences, specifically for Native Americans. It describes the landscape of Native Americans in geosciences, goals of the GA, and how members of the GA are responding to issues faced by Native American communities as they pertain to “anthropogenic global changes” (p. 68). This chapter details different research and program efforts that were being implemented to address the challenges Native students faced in pursuing and completing Earth science degrees. Efforts included describing the impacts of the dissertation research conducted by Bueno Watts, the Salish Kootenai College Hydrology Degree Program, and the NSF-funded Cultural Validity in Geoscience Assessment project. Bueno Watts’ study focused on identifying the barriers to Native American students’ participation in the geosciences. The authors discuss the history and goals of the first hydrology degree program offered at North American tribal colleges and universities. They describe the promise of the program and its ability to attract and increase the number of Native Americans in the geosciences. Finally, the authors detail the efforts being conducted to include Blackfeet and Navajo communities as part of “place-based, culturally informed science assessment” (p. 73). This effort includes surveying experts from these Native American communities, as well as tribal college faculty and students to “identify important and culturally relevant geoscience concepts” (p. 73) to teach culturally relevant geoscience topics to Blackfeet students.

Recommendations: Drawing from Bueno Watts’ dissertation research, the authors note that by introducing geoscience programs at tribal colleges and universities, Native Americans are offered new and increased opportunities to participate in the geosciences. Through the Cultural Validity in Geoscience Assessment project, the

authors suggest different effective practices such as utilizing a mixed methods approach when engaging in assessment and evaluation practices within Native communities.

Carroll, B., Mitchell, H., Tambe, P., & St. John, M. (2010). *Supporting Native American students along STEM education pathways: Findings from an exploratory study of South Dakota's educational landscape.* Inverness Research. https://inverness-research.org/2016/10/07/ab2010-01_rpt-epscore-edu-landscape/

Summary: This exploratory landscape study examines the experiences of Native Americans in South Dakota and their pathways into STEM. It highlights four case studies or vignettes of participants, and reports on findings collected from students, faculty, and program leaders across the state of South Dakota from secondary school to post-secondary education. The authors report on several major themes: (1) similarities across the Native American students interviewed (e.g., non-traditional pathways through education); (2) types of science and math experiences students valued most (e.g., small-scale learning experiences were valued over impersonal, large-scale learning experiences); (3) opportunities and supports that made a difference to Native American students (e.g., people who valued education); (4) additional supports that would be most helpful to Native American students (e.g., more attention on retention); (5) important issues and contextual factors that can affect Native American students' path to and through post-secondary education (e.g., the desire for work opportunities in local communities); and (6) the current landscape of programs and resources in South Dakota supporting Native American students (e.g., connections between Tribal Colleges and Regents institutions).

Recommendations: The authors provide several recommendations to the state of South Dakota on how to better support Native American students on STEM pathways. Some recommendations include continuing and increasing the funding of existing programs that already support Native Americans to pursue STEM. The state should identify other opportunities in which multiple tribes and multiple school systems and their respective cultures can not only overlap successfully, but also be understood, valued, nurtured, and co-exist together. There should be a statewide database that records and tracks attendance, enrollment, retention, and attrition rates across all school systems to better monitor school persistence across all levels of schooling. Instead of funding new programs, the state should consider providing more funding to existing programs that are already working to build and maintain the infrastructure of the state. Although state specific, stakeholders may be interested in applying these recommendations in other contexts.

- Cech, E. A., Metz, A., Smith, J. L., & deVries, K. (2017). Epistemological dominance and social inequality: Experiences of Native American science, engineering, and health students. *Science, Technology, and Human Values, 42*(5), 743–744. https://doi.org/10.1177/0162243916687037

Summary: In this study, the authors examine the impacts of epistemological bases for experiences and unequal treatment of Native American students in Science, Engineering, and Health (SE&H). The authors describe how Native American students (N=44) at two research universities navigate the SE&H epistemologies and their own indigenous epistemologies. They highlight the following themes: (1) recognition of epistemological dominance (e.g., noting the conflicts and hostility between indigenous ways of knowing and epistemology in SE&H education); and (2) the process of disadvantage via epistemological dominance (e.g., problematic pedagogical practices, such as required classroom assignments that directly conflict with indigenous belief systems, like touching human remains or dissecting certain animals). The authors provide implications of their findings and highlight how the ongoing conversation of broadening participation in the United States does not align with the culture of epistemological dominance that exists in SE&H fields.

Recommendations: The authors offer recommendations to SE&H educators as they relate to incorporating other epistemologies into the classroom. These recommendations encourage educators to be more inclusive of other Native epistemologies and other marginalized epistemologies to challenge the notion that current dominant SE&H epistemology is the only way of concept learning.

- Chow-Garcia, N. (2016). *Educational pathways for Native American graduates: Stories through the STEM bachelor's, master's, and doctoral degrees*. (Publication No. 10157808). [Doctoral dissertation, University of Rochester]. ProQuest Dissertations & Theses. http://hdl.handle.net/1802/31301

Summary: This dissertation explores the persistence, retention, and success of Native American graduates (N=9) in STEM fields across bachelor's, master's, and doctoral degrees. Using a critical Indigenous research paradigm grounded in the Diné concept of Hózhó (harmony and balance) and the Indigenous Storywork Methodology, the study captures the experiences of Native graduates as they navigated higher education pathways and uplifts their stories to inspire future generations. Of the 9 graduates (2 bachelor's degrees, 4 master's degrees, 3 doctoral degrees), 3 were female and 6 were male. Six participants belonged to the Haudenosaunee tribe and 3 belonged to other tribes. Participant ages ranged from 21 to 65. Participant STEM disciplines included Engineering, Physics, Ecology, Computer Science, Chemistry, and Zoology. Interviews were structured as conversations and storytelling sessions as opposed to traditional Western question-and-answer interviews. Findings highlighted significant themes among participant stories. Graduates' families, even with limited financial resources (reported by 6 of 9 participants), instilled a love and curiosity for STEM into their

children. However, 5 out of 9 participants reported a lack of support outside of the home, namely high-school teachers and counselors who discouraged them from pursuing STEM because of their Native heritage. For the participants, challenges during their degree pursuit consisted of limited schooling options due to a reliance on financial aid, struggling with severe physical and mental health challenges (the graduates themselves or their family members), and a lack of high-school preparation for difficult college coursework. Additionally, 6 out of 9 participants reported experiencing feelings of self-doubt. Participants reported a variety of supportive factors that helped sustain them on their academic journey. All participants identified family, strong internal motivation, and involvement in Native support programs at their institutions, specifically the variety of summer, research, and professional networking opportunities that came out of those programs as key supporting factors. Additionally, all graduates spoke of the importance of mentors and connecting their cultural identity to their ongoing and future work in STEM.

Recommendations: The author emphasizes the need for higher education institutions to adopt culturally responsive practices, such as incorporating Indigenous knowledge frameworks and creating inclusive campus environments that honor Native identities. The author calls for changes in current policy and practice, namely, increased collaboration between STEM departments and tribal communities, additional mentorship opportunities for Native students, and an expansion of financial aid and grant resources targeted for Native students. The study also suggests that future research should further explore Indigenous methodologies and how they can inform STEM education to better support Native student success.

- Cintina, I., & Kana'iaupuni, S. M. (2019). Finishing strong: GPA and timely college graduation outcomes among Native Hawaiian STEM majors. *The Review of Higher Education, 42*(4), 1459–1487. https://doi.org/10.1353/rhe.2019.0072

Summary: This study examines the relationship between GPA and timely graduation for Native Hawaiian students who graduate with their STEM bachelor's degrees from the University of Hawaii. When comparing data for Native Hawaiian graduates with White and Asian students, the results suggest differentials between their GPAs and timely graduation. Overall, Native Hawaiian students appear to have lower GPAs, which further impacts their career prospects upon graduation. When examining timely graduation rates, Native Hawaiians appear to take longer to graduate than their non-Native Hawaiian peers, which impacts retention rates, as the costs to continue their education deter them from persisting and completing their programs.

Recommendations: Results of this study encourage the implementation of policies and programs that support Native Hawaiian students in strengthening their GPAs and completing their degrees within a 4-year timeframe. Future researchers should examine P-20 Partnerships for Education data to explore how Native Hawaiians transition from their studies into the labor market. Other research should be conducted to examine

other factors that influence Native Hawaiian students GPAs and timely graduation rates, such as student service utilization. Researchers should also consider examining what happens to Native Hawaiian students who do not complete their programs.

- Colston, N. M., Turner, S. L., Chagil, G. M., Jacobs, S. C., & Johnson, S. (2019). *Exploring the career thinking of Native American engineering students* [paper presentation]. American Society for Engineering Education Conference 2019. Tampa, FL.

Summary: This conference paper reports on an exploratory study that examines the barriers, supports, and personal strengths of Native American engineering undergraduate and graduate students as they relate to their interest in and pursuit of an engineering career. The authors issued an online survey taken by 23 participants who reported that the most challenging barriers they encountered were financial (e.g., having to work concurrently with attending school to make ends meet) and academic (e.g., insufficiently prepared to study engineering). Participants reported that perceptions of not belonging and lack of career information about engineering were also barriers. The authors highlight that the most notable external support for participants was family encouragement to pursue engineering and entering engineering programs that had positive social climates. Participants endorsed multiple personal strengths, such as being confident in their communication and collaboration skills and commitment to their academic and career preparation in engineering. According to the authors, these findings inform an understanding of how Native American engineering students assess their own characteristics and skills as they consider pursuing and persisting in engineering.

Recommendations: Based on the findings reported, the authors suggest that there is a strong need for extra-curricular skills development or opportunities that raise awareness about scholarships, internships, and career pathways for Native engineering students. Due to its small sample size, the authors caution with generalizing their findings. As such, they encourage future researchers to conduct similar studies but at a larger scale and to further validate the use of Social Cognitive Career Theory amongst Native American engineering students. They also provide a call to action, noting that more research should examine the influence of “cultural experience [on] socio-cognitive constructs of career thinking” (p. 11).

- Cruz Rios, F., Naganathan, H., Tello, L., Adams, S., Cook-Davis, A., El Asmar, M., Grau, D., & Parrish, K. (2021). Catalysts and barriers faced by Native American engineering undergraduate students in Arizona. *Journal of Civil Engineering Education, 147*(2), https://ascelibrary.org/doi/10.1061/%28ASCE%29EI.2643-9115.0000033

Summary: This paper identifies and explains the barriers and catalysts that influence persistence for Native American students in undergraduate engineering degrees. The

authors report quantitative and qualitative findings. The quantitative findings focus on Native American higher education trends in the state of Arizona over a 10-year span (2007–2016). The quantitative data shows that the overall Native American representation in engineering is declining. The qualitative findings focus on barriers and catalysts, organized into four categories (academic performance, family support, institutional support, and tribal community support) that arose from focus group and individual interviews with 29 Native American undergraduate engineering students. Students reported two different experiences with regard to academic performance, highlighting the differences between academic preparation for those who attend school on and off the reservation. Students shared how family support served as a motivator for them to persist, often receiving words of encouragement during times of stress. Of note, the authors identified a commonly discussed issue that arose in interviews - the general expectation that the participants will return to the reservation upon completing their studies to help take care of their families. Students described institutional support as involvement in Native American support groups (e.g., AISES), peer support, access to tutoring services, and formal and informal mentors and role models. Tribal community support was framed as students' desire to give back to their tribal communities, serving as a motivator to persist and succeed in their studies. However, participants shared the challenges of wanting to give back and the lack of opportunities on reservations to give back to their communities. Overall, the authors identified that family support and institutional support were catalysts for success for Native American students in higher education. On the other hand, the desire to provide support to their tribal communities served as a unique barrier for Native American students in engineering.

Recommendations: The authors offer multiple recommendations as to how institutions can better support Native American students' persistence in engineering. Among others, these include the importance of collaborating and communicating with local tribal communities to provide them with information about engineering careers. Additionally, institutions should consider how engineering can connect to giving back opportunities for Native American students to help attract and retain this population within engineering.

- Dameron, S. L. (2014). *American Indian students' experiences of S.T.E.M. in a Native-serving institution* [Unpublished doctoral dissertation]. Oklahoma State University.

Summary: This dissertation aims to understand the factors influencing persistence, retention, and graduation among American Indian students pursuing STEM degrees at four-year institutions. This qualitative, multiple-case study explores the educational experiences of 8 academically (6 females, 2 males) successful American Indian STEM students at a Native-serving institution through in-depth interviews, writing responses, focus groups, and member check interviews. The students were pursuing a range of STEM disciplines including Math (1), Biology (3), Physiology/Exercise Science (1),

Psychology (3), Biochemistry (1), and Chemistry (1). The study, guided by Brayboy's theoretical framework Tribal Critical Race Theory (TribalCrit), utilized open coding, ethnopoetics, and discourse analysis for data interpretation. Key findings highlighted the significance of family and faculty support, mentorship, and a welcoming institutional environment for American Indian students as primary contributors to student persistence. Additionally, all participants stressed the importance of individualized academic plans, created with either an academic advisor or a mentor. Barriers included financial challenges, limited academic preparedness, lack of culturally relevant curriculum, and the persistence of stereotypes. Notably, all 8 participants reported facing negative stereotypes related to their American Indian heritage from either their peers or the institution (faculty/staff). Additionally, all participants reported feelings of being underprepared for college coursework. Finally, the author stresses the importance of Native representation in faculty, noting that there was not a single American Indian faculty member in any of the STEM departments during the time of the study. The dissertation highlights that recognizing and respecting students' cultural identities while addressing structural barriers can improve retention and graduation rates for American Indian students in STEM fields.

Recommendations: The author provides a variety of recommendations to institutions to promote the retention and success of American Indian STEM students. The author recommends the recruitment and retention of American Indian scholars to faculty in STEM departments and as academic advisors, as well as professional development opportunities for all faculty to improve their understanding of the culture of American Indian students and common academic issues they may face. The author emphasizes the importance of culturally relevant coursework, recommending the creation of STEM classrooms and curriculums that are open to all different ways of knowing and being. Individualized student support, such as mentorship and advising tailored to cultural needs, was also emphasized. Additionally, the author calls for institutions to build relationships with local tribes to enhance American Indian student engagement and further bridge understanding and community.

Enno, A. M. (2018). *Cultural factors in identity development of Native American and Latinx undergraduates in STEM fields* [Unpublished doctoral dissertation]. Utah State University.

Summary: This multi-paper dissertation examines contextual factors that influence identity development of high-achieving Native American and Latinx undergraduates in STEM fields from a strength-based perspective. The longitudinal study surveyed Native American and Latinx undergraduate STEM majors (Paper 1: N=113, 67 female, 47 male; Paper 2: N=114, 68 female, 47 male) engaged in undergraduate research. The most common majors among participants were Biology (19) and Mathematics (16). The first paper in the dissertation focuses on mentor-mentee similarity and its impact on students. A survey was sent out to participants six times over the course of two years, inquiring about ideal similarity and perceived real similarity between participants and their mentors. The author developed continuous scales to measure surface-level (e.g.,

race, gender) and deep-level (e.g., values, beliefs) similarities between students and their mentors. The surveys revealed that while both surface-level and deep-level similarities were valued by participants, deep-level was rated as more significant for a positive mentoring experience. Students that reported stronger ethnic identification were more likely to prefer that their mentors shared both deep and surface-level similarities with them, suggesting the interrelatedness of the two levels of similarities. The results suggest that culturally competent mentoring, which takes into account student values and cultural background, can positively influence underrepresented students in STEM fields. The second paper addresses intersectional identity development, exploring how students integrate their ethnic and professional identities. A survey went out to participants six times over 3 years, with questions related to three identities: their professional identity as a scientist, their ethnic identity, and an integration of the two—their identity as a Native American or Latinx scientist. Findings reveal a correlation between a strong ethnic identity and a strong professional one, indicating that the two identities can reinforce each other. However, while students developed strong ethnic and scientific identities separately, integrating both into a cohesive intersectional identity proved more challenging.

Recommendations: The author offers several recommendations for improving persistence and positive identity development among Native American and Latinx STEM students. The study emphasizes the importance of culturally competent mentorship and the role of deep-level similarity in fostering positive mentoring relationships, especially when surface-level similarities may be lacking. The author recommends that institutions provide cultural training to mentors to address the unique challenges faced by minority students, such as Native American and Latinx students. Additionally, the development of support programs for minority students is recommended, with the specific goal of helping students reconcile their cultural identities with their scientific identities. Future research is recommended to further explore the role of intersectional identity in STEM persistence and success.

- Foor, C. E., & Shehab, R. L. (2009) *"I feel like Forest Gump:" Mixed-race Native American students find community in a college of engineering* [paper presentation]. 2009 ASEE Annual Conference & Exposition, Austin, Texas. https://doi.org/10.18260/1-2--4674

Summary: This quasi-longitudinal study examines the experiences of mixed-race Native American undergraduate students in engineering disciplines. Of the 35 students who were interviewed for the study, only 29 narratives are included in this paper. The authors provide an in-depth description of the 29 participants' demographics, including Certificate of Degree of Indian or Alaska Native Blood status, blood quantum range and physical attributes, and experience with Native American culture and socialization. When reporting on the challenges participants faced regarding their racial and cultural identities, the authors share how participants experience contestations to their identities since they do not look "Native enough." Questioning of their Native identities left

participants feeling tensions, internally and externally with their racial minority and majority peers as they interacted within the classroom and Native organizations such as AISES. In contrast, the authors then share how participants' interactions within AISES differed, noting how they felt more comfortable within a STEM-focused Native organization more so than a non-STEM Native organization.

Recommendations: The authors recommend educators and administrators to consider cultural competency, cultural capital, and regional differences when developing advising or mentoring programs. They also encourage evaluating the intentions of programs designed for specific populations, being cognizant of the conflict between program's intent and actual impact. This is particularly important for mixed students, such as the mixed Native American students in this study, who, on paper, do not appear as part of the minority.

- Foster, C. H. (2016). *Hybrid spaces for traditional culture and engineering: A narrative exploration of Native American women as agents of change* [Unpublished doctoral dissertation]. Arizona State University.

Summary: This dissertation explored the experiences of three Native American women working in engineering and technology, with the goal of highlighting their voices and challenging assumptions about minority women's experiences in STEM fields. The study utilized narrative inquiry methodology, drawing on the tenet of identity as constructed, multiple, and intersectional, and guided by the theories of Third Space and Hybridity. The author conducted in-depth semi-structured interviews with 3 Native women (2 Navajo, 1 Akimel O'odham-Mexican): one working at a large tech company, one working at a tribally owned technological business, and one who founded her own technology company. Participant ages ranged from 34 to 54. Two of the participants were technical service providers and one was an engineer. Data were collected through interviews, field notes, observations, and document analysis. Findings of the study identified key themes influencing persistence and success in the lives and careers of the three participants. These themes included cultural navigation, the importance of community connections, overcoming hardships, and the role of leadership in promoting positive change for Native communities. Specifically, the findings focused on transitional moments in the participants' lives that fostered perseverance or connection to community. All three participants reported a feeling of "walking between two worlds" in the pursuit of their STEM careers, which led to seeking out opportunities to join their two worlds, professional and cultural, together. This, in turn, led to the creation of a "hybrid" or "third" space that existed at the intersection of the participants' identities and enabled positive change in both worlds for participants. In these created spaces, the participants used their professional skills to support and uplift their Native communities while also challenging the dominant narratives in engineering and technology spaces. These findings suggest that third spaces promote a holistic identity for participants to seemingly integrate their cultural and professional identities. The study highlighted the

importance of creating supportive networks that respect and incorporate Native cultural values within STEM education and workplaces.

Recommendations: The author suggests institutions can better support Native students or employees in STEM fields by recognizing and respecting cultural identities, developing mentorship programs, and fostering partnerships with tribal communities. Further, support for Native STEM students to return to their communities post-graduation is recommended, as well as opportunities for them to use their degrees to effect positive change in their communities. The author also recommends studies and support initiatives that focus on Native women in STEM specifically, who are often broadly included in "minorities" in STEM, but in practice are not actually represented. Recommendations for future research include further narrative inquiries to explore diverse Native experiences across various STEM fields and tribal backgrounds, as well as examining institutional strategies for inclusivity in STEM education and professions.

Henry, D. J. (2019) *Tribal colleges: Influences on Native American students completing STEM degrees* (Publication No. 27742777). Concordia University (Oregon). ProQuest Dissertations & Theses.

Summary: This dissertation examines the experiences of Native American students (N=13) pursuing STEM degrees at Tribal Colleges and Universities (TCUs). The study aimed to uncover the strategies that TCUs use to promote Native student success in STEM and the influence that TCUs have on increasing the number of Native STEM graduates. Data for this study consisted of one-on-one interviews with the 13 students, a focus group discussion with three Native and non-Native TCU STEM professors, and nonparticipant observation of a bridge program for the recruitment and preparation of middle- and high-school students to pursue degrees in STEM. The student participant group consisted of 6 females and 7 males, who were actively pursuing degrees in the following STEM disciplines: Biology (3), Medical Lab Technician (3), Chemistry (2), Environmental Science (2), Computer Science (2), and Engineering (1). This was a qualitative study, with transcripts coded and analyzed thematically. Key themes identified included cultural support, financial assistance, a family-like atmosphere, accessibility, and academic resources. The study found that students valued the supportive environment at TCUs, which fostered a sense of belonging and cultural recognition. Major findings indicated that financial support and low costs were significant factors in retention. Additionally, all professors in the focus group reported that TCU policies that allow for the integration of Western ideas with traditional knowledge have been crucial for the recruitment and retention of Native STEM students. Findings indicate that attendance is crucial to success in the pursuit of a STEM degree, and that students struggle with attendance due to a lack of adequate transportation and childcare support at TCUs. Additionally, it was noted that students who successfully obtain STEM degrees at TCUs often struggle with post-graduation certifications and tests, thus, preventing these students from entering the fields that they studied in and contributing to low rates of Native peoples working in STEM fields.

Recommendations: The study suggests expanding culturally relevant curriculum elements, including to non-tribal universities. Additionally, recommendations were made to increase the number of Native faculty in STEM departments and develop training programs for non-Native faculty to address cultural competence and teach a culturally relevant curriculum. The author also emphasizes the importance of bridge programs sponsored by TCUs or other academic institutions for secondary students and mentorship from Native STEM professionals to inspire and retain Native students in STEM fields. To address post-graduation struggles, the author recommends that TCUs increase focus on post graduate preparation within undergraduate courses. Further research is recommended to explore long-term career success and the impact of TCUs on Native professionals' advancement in STEM industries.

- Kaakua, J. K. (2014). *Self-efficacy beliefs and intentions to persist of native Hawaiian and non-Hawaiian science, technology, engineering, and mathematics majors* (Publication No. 10799169). University of Southern California. ProQuest Dissertations & Theses.

Summary: This dissertation investigates the factors influencing self-efficacy and intent to persist in STEM fields among Native Hawaiian and non-Hawaiian undergraduate students at the University of Hawaii at Manoa. This non-experimental, single-institution quantitative study, grounded in Social Cognitive Career Theory and Astin's (1999) Inputs-Environment-Outcomes model, surveyed STEM undergraduate students (N=638) to identify self-input and environmental factors associated with self-efficacy and persistence. The study consisted of 54.9% women and 43.9% men, with the following STEM disciplines represented: Natural Sciences (47.5%), Engineering (33.2%), Tropical Agriculture (13.2%) and Earth and Ocean Sciences (4.7%). The participant pool was 17.1% Native Hawaiian. For data analysis, variance tests (ANOVA), factor analysis, and regression analysis were used. Findings identified a set of variables that successfully predicted self-efficacy and intent to persist, including sense of belonging to major, GPA, family support, and participation in academic support/honors programs. Self-efficacy predicted a commitment to completion of the STEM major, and Native Hawaiians reported higher levels of intent to commit. Additionally, Native Hawaiians exhibited higher levels of peer interaction and participation in support programs, but lower levels of support from faculty in terms of emotional development, advice about professional goals, and opportunities for research. Using these findings, the author constructed the Ho'okahua (foundation building) conceptual framework, created to promote understanding and support for Native Hawaiian students in STEM. The framework centers around self-efficacy, sense of belonging, and involvement as core elements supporting persistence in STEM for Native Hawaiian students and offers a culturally grounded model for improving educational outcomes and guiding further research and policy development in STEM education.

Recommendations: Recommendations from this dissertation come in the form of implementation of the Ho'okahua Framework. The framework, grounded in a sense of belonging, community engagement, and self-efficacy, calls for academic institutions,

and STEM departments within institutions, to strive to foster a sense of belonging in their students. To achieve this, the author recommends the establishment of first-year learning communities to build support and aid in the high school to college transitions, implementation of Native-Hawaiian-specific STEM excellence programs, and a system of decentralized meaningful academic advice with one-on-one mentorship opportunity. Future research directions highlighted the need for longitudinal studies and expanded qualitative analysis to explore cultural factors in greater depth.

Kant, J. M., His Horse Is Thunder, W., Burckhard, S. R., & Meyers, R. T. (2015). Why don't more American Indians become engineers in South Dakota? *International Journal of Engineering, Social Justice, and Peace*, *4*(1), 17–34. https://doi.org/10.24908/ijesjp.v4i1.5992

Summary: This critical-design ethnographic study, based in South Dakota, interviewed American Indian (N=107) and non-American Indian (N=30) non-engineering undergraduate students to further understand why American Indian students were not pursuing engineering majors or careers in South Dakota. The authors also sought to explore the ways in which American Indians could be attracted to engineering fields. Interviews were conducted with both groups, with non-American Indian students serving as a comparison group to the American Indian students' responses. Of note, American Indian student interns were trained in the team's methodology and given the role of interviewer, speaking with the American Indian non-engineering students for the study. The authors identified several major factors that impact American Indian students' decisions in whether they choose to pursue a major in engineering. Some of these factors included lack of exposure to engineering during primary and secondary school; and a lack of understanding of what kind of activities constitute engineering and what is involved in becoming an engineer. The authors also indicated that the effects of poverty (e.g., financial considerations in pursuing postsecondary education were a common theme among student responses) were a main finding and reason why American Indian students were not pursuing or encouraged to pursue engineering.

Recommendations: The authors offer a set of recommendations dedicated to addressing how American Indian students can be attracted to engineering fields. These include identifying and showing American Indian students the tribal and cultural relevancy of engineering and how it can be used to give back to their communities. Participants also shared the importance of introducing engineering at a young age during primary and secondary school. The continued exposure of engineering during grade school may encourage American Indian students to consider pursuing it in postsecondary education. Other needs that were outlined by the authors that American Indian students require are: increased presence of role models and mentors in engineering; encouragement from their support system (e.g., friends, family, teachers, tribal Elders and/or tribal government) to value STEM education, particularly engineering; and increased support to understanding math, as it was identified as a barrier in showing interest in engineering.

- Kerr, J. Q., Hess, D. J., Smith, C. M., & Hadfield, M. G. (2018). Recognizing and reducing barriers to science and math education and STEM careers for Native Hawaiians and Pacific Islanders. *CBE—Life Sciences Education*, *17*(4). https://doi.org/10.1187/cbe.18-06-0091

Summary: This paper describes the barriers and supports Native Hawaiian and Pacific Islander (NHPI) students experience and the need for them to pursue science and math education and STEM careers. The authors organized a 2-day workshop, inviting instructors from life science programs based in the US-affiliated islands in the Pacific to attend. Fourteen of these workshop participants identified as members of the Indigenous peoples of their islands. These workshop participants were given two tasks: (1) to identify the barriers causing Pacific Islanders from pursuing STEM education and careers; and (2) to find solutions or supports that can be provided to remove or reduce these barriers. Some of these barriers include: cultural barriers to STEM education and careers (e.g., barriers posed by chief systems, family, religion, and stereotype threat); geographical barriers to STEM education (e.g., there are limited number of primary and secondary schools on the islands, making it difficult for students to travel from their home island to the island(s) where their school(s) are located); K-12 math and science preparation is lacking (e.g., lack of relevant curricula, adequate facilities, and resources); and financial barriers to STEM education from K-12 education to college (e.g., lack of funding for student support and mentoring for NHPI students that encourage them to pursue STEM careers). Workshop participants also identified solutions and supports to remove barriers experienced by NHPI students. See recommendations below.

Recommendations: Solutions and supports were organized into five categories: (1) overcoming cultural barriers (e.g., engaging families with “talk story” opportunities with Native mentors or role models who persisted in STEM programs); (2) coping with geographic barriers (e.g., island high schools must be subsidized to support students living away from home); (3) improving K-12 education (e.g., expanding K-12 teacher training from only English and math to science and technology); (4) removing financial barriers to achieving college-level training and experience in STEM fields (e.g., implement a minority program across U.S.-affiliated Pacific Islands that would provide NHPI students with funding pending their federal funds’ arrival); and (5) creating an NHPI student-scientist organization to provide networking, scholarship, and grant opportunities for members. Readers interested in the in-depth review of the recommendations developed by workshop participants can find these recommendations on pages 7–9.

- Kodaseet, G. G., & Varma, R. (2012). In pursuit of a computing degree: Cultural implications for American Indians. *Journal of American Indian Education, 51*(1). 67–88. https://doi.org/10.1353/jaie.2012.a798472

Summary: This article examines how cultural relevancy influences the experiences of 50 American Indian students in undergraduate computer science (CS) programs at

Hispanic-serving Institutions (HSIs) and Tribal Colleges and Universities (TCUs). For this paper, the authors examined participant responses to six questions that focused primarily on what factors influenced American Indian students' decision to pursue and persist in CS. The authors identified two major themes in their findings – (1) the necessity for the incorporation of American Indian culture in the curriculum for students' success in CS; and (2) a lack of exposure and familiarity with computers and technology served as a major obstacle to student interest in CS. The latter contributed to the low number of American Indian students choosing to pursue CS in college. Of note, American Indian students from HSIs reported more conflicts between their participation in cultural activities and school responsibilities than students attending TCUs. This study's findings support the importance of cultural relevancy for American Indian students in higher education, particularly in CS.

Recommendations: The authors offer several recommendations for educational institutions and for future research. For example, they recommend implementing a cultural self-assessment program to see how their goals of valuing diversity are impacting their American Indian students. The authors also recommend that more studies should be conducted at TCUs examining experiences of American Indians pursuing IT or technology-driven fields through associate degrees or certificate programs. Additionally, they encourage greater collaboration between HSIs and TCUs to create more opportunities for American Indians through shared resources, such as providing distance learning opportunities from HSIs to TCUs in more rural/isolated locations. Meanwhile, TCUs can show HSIs how cultural relevancy can have a positive impact on student engagement for American Indian students.

McMahon, T. R., Griese, E. R., & Kenyon, D. B. (2019). Cultivating Native American scientists: An application of an Indigenous model to an undergraduate research experience. *Cultural Studies of Science Education*, *14*, 77–110. https://doi.org/10.1007/s11422-017-9850-0

Summary: This study examines the utility of the Circle of Courage as a model for cognitive apprenticeships to foster a positive scientific learning environment within an undergraduate research experience for Native students. Students were paired with mentors or mentoring teams who shared research interests and worked collaboratively on a scientific research project for the duration of the research experience. Although 46 students participated in the program between 2012–2014, the present study sample only includes 20 students, all of whom self-identify as Native American. The authors report on themes of belonging, mastery, independence, and generosity (organized by the Circle of Courage constructs) that were built into the program and the components' impact on students' experiences. The authors also discuss the importance of mentors and their role in integrating the Circle of Courage into their interactions with students and the changes they made to the program over its implementation. Overall, the authors found that the application of the Circle of Courage had a positive impact in their undergraduate research experience program. They also highlight how these findings

support the use of undergraduate research experiences as essential learning opportunities and academic preparation for higher education.

Recommendations: The authors offer insights into how the Circle of Courage framework can be utilized by other programs.

- Nguyen, T. T. T., Francis, O. P., Miller, S. F., Kuehu, D. S., McLean, K., Irvine, J. L., & Izawa, N. R. (2018). *Native Hawaiians in engineering: A path to the professoriate* [Conference paper]. 2018 American Society for Engineering Education Annual Conference & Exposition, Salt Lake City, UT.

Summary: This paper presents early findings of a three-phase, mixed-methods study that examined the gaps in academic progression for Native Hawaiian students in undergraduate engineering. The first phase of this study focused on surveying undergraduate students in the College of Engineering at the University of Hawai'i at Manoa (N=168; self-identified Native Hawaiian students, N=17); the second phase interviewed Native Hawaiian graduate students (N=6), using questions developed by examining the survey responses from undergraduate students; and the third phase developed support workshops for undergraduate upperclassmen and graduate students to encourage them to persist in their engineering studies and also provide teaching opportunities to graduate students. Although there are various survey findings, one noteworthy difference was the contrast between Native Hawaiian and non-Native Hawaiian students' response to the reason why they chose to pursue engineering. According to the authors, Native Hawaiian students reported that they chose to pursue engineering because they wanted to benefit society and make a difference more so than the other options provided (e.g., good money/high paying). At the time this paper was published, the authors were still coding their interview data collected from the second phase. However, they noted three candidate themes that have emerged from initial coding. These themes included: (1) the value of family and giving back to their family; (2) students' families' low understanding of engineering and graduate education; and (3) the value of faculty mentoring. The authors described the third phase as a set of 6 workshops offered to address student concerns (total N=20 students, of the 20 only 14 self-identified as Native Hawaiian) identified in the interviews and what they found in the literature. One example workshop topic included self-identity as a Hawaiian and balancing one's cultural identity with their engineering identity. The authors also described how they developed opportunities for Native Hawaiian graduate students to serve as teaching assistants for engineering courses.

Recommendations: Given the small sample size of this study, the authors caution against generalizing their findings to other populations. The authors do recommend, however, discussing with Indigenous students the various ways scientific and technical knowledge are considered, and that non-Western methods are no less scientific than

Western methods. The authors urge the need for conversations to take place about hiring practices and academic mobility of Native Hawaiian graduate students upon completing their degree programs.

Page-Reeves, J., Cortez, G. L., Ortiz, Y., Moffett, M., DeerInWater, K., & Medin, D. (2019). Situating giving back for native Americans pursuing careers in STEM: "You don't just take, you give something back". *Intersections: Critical Issues in Education*, *3*(1). https://digitalrepository.unm.edu/intersections/vol3/iss1/4

Summary: This article examines how a desire to "give back" impacts Native American students' (N=30) and professionals' (N=40) decisions to pursue and persist in STEM fields. The authors developed a framework that focuses on five different ways participants reported they engaged in giving back activities. These five types are: (1) duty, expectation, and reciprocity (e.g., feeling obligated to take what they learn in their studies and bring this knowledge back to their communities); (2) defining success in STEM in relation to giving back (e.g., having a sense of purpose and needing to be successful so that one can help their family and community members); (3) translating and bridging functions of giving back in STEM (e.g., translating scientific terms and perspectives into their Native language for members of their community to understand); (4) being a role model and blazing a trail in STEM (e.g., showing other Native youth that they can also be successful in STEM; and (5) giving back as a challenge in STEM (e.g., being unable to identify a way that their specific discipline, such as being an aerospace engineer, can be used within their Native community). The authors conclude their paper by reporting how previous research has addressed the challenges of giving back for Native students, such as encouraging institutions to incorporate Native students' cultural values more into their educational and leadership experiences.

Recommendations: Based on their findings, the authors agree with previous research that institutions should incorporate Native students' values into their first-year curriculum courses in STEM to emphasize the communal value of their STEM careers and real-world application. Universities and industry would benefit from working with organizations, such as AISES, to develop content that would help students find connections between giving back and their STEM career pursuits. Institutions should consider creating a network with Native STEM alumni to connect students with Native professionals in STEM to share their experiences and perspectives with younger generations of Native students pursuing STEM.

- Rich, N. L. (2011). *Restoring relationships: Indigenous ways of knowing meet science and environmental studies in undergraduate education* [Unpublished doctoral dissertation/master's thesis]. Antioch University, New England.

Summary: This dissertation is a comparative qualitative study that explores how Indigenous ways of knowing can be integrated into science and environmental studies in undergraduate education. The study, using a phenomenological and critical inquiry-based research paradigm, conducted open-ended interviews with seven faculty members and two Indigenous elders from a variety of academic institutions, including a tribal college, and public and private universities across 5 states in the United States and Canada. The faculty and elders together represented the following STEM disciplines: Biology, Environmental Studies, Sustainable Development, Integrative Science, and Natural Resources. The study aimed to understand the benefits, challenges, and effective pathways for integrating Indigenous knowledge in academia. Key findings included the importance of integrating Western and Indigenous ways of knowing while maintaining the integrity of both knowledge systems, guided by the Mi'kmaq principle of Two-Eyed Seeing. Participants highlighted several perceived benefits of integrating Indigenous knowledge into curricula, including gained confidence for Indigenous students, correction of harmful misconceptions about Indigenous communities, and an enriched and holistic education for all students. Additionally, participants reported that the inclusion of Indigenous knowledge provided students with a new understanding of relationality, which, in turn, promoted a shift towards advocacy and activism. Barriers identified included colonial legacies embedded in academia, a lack of faculty training on Indigenous methodologies, and limited institutional support. Participants emphasized the need for institutional change, including faculty development in culturally relevant pedagogy and stronger partnerships with Indigenous communities. The dissertation contributes to the growing field of Indigenous environmental studies and advocates for a pedagogical model that centers relational knowledge and cultural respect while addressing social justice concerns.

Recommendations: The author provides a variety of recommendations at the institutional level to promote the seamless integration of Indigenous ways of knowing into STEM education. The author recommends a re-examination of the current assumptions and superiority of Western ways of knowing in science, as well as increased recruitment and retention of Indigenous faculty, specifically through means of recognition of academic achievement in Indigenous knowledge. Additionally, the author suggests that departments foster a classroom environment that enables dialogue of all different ways of knowing and learning through experience. The study also calls for future research on Indigenous student experiences in STEM fields and the development of culturally responsive STEM curricula that emphasize relational learning and environmental stewardship.

- Smith, J. L., Cech, E., Metz, A., Huntoon, M., & Moyer, C. (2014). Giving back or giving up: Native American student experiences in science and engineering. *Cultural Diversity and Ethnic Minority Psychology*, *20*(3), 413–429.

Summary: This paper details three different studies, all of which examine communal goal incongruence as a possible factor to Native American student underrepresentation in STEM fields. The authors first surveyed 80 Native American STEM freshmen who reported that they highly endorsed communal goals rather than individualistic work goals. They then surveyed Native American (N=49) and White American (N=47) students in STEM and non-STEM majors. With this survey, it was confirmed that Native Americans equally endorsed communal work values regardless of their major. Of note, Native American women in STEM endorsed communal work goals at a significantly greater extent compared to all non-STEM majors. In their third study, which was further split into two sub-studies, the authors surveyed Native American STEM majors from their second study (N=32, 21 women and 11 men) after they completed their first semester. This survey asked participants about their academic belonging uncertainty, intrinsic motivation, perceived performance, and intentions to persist. With this survey, the authors found a correlation between a strong endorsement of communal work goals with lower self-reported motivation, weaker persistence intentions, and poorer performance in STEM. Overall, the data showed that the more Native American STEM students endorsed communal work goals at the beginning of their academic career, the less of a sense of academic belonging they felt as they progressed into their studies. From this third survey, the authors then conducted interviews to further examine this correlation between communal work goals and feelings of belonging uncertainty. They interviewed 33 students, 32 of whom took both surveys and 1 who only took the first. These interviews further support the quantitative findings from the third survey, such that there is a connection between communal work values and a weaker sense of belonging.

Recommendations: The authors offer multiple recommendations for future research and implications to the field. One recommendation is to conduct future research focused on understanding how communal work goals are learned and internalized by Native American students and how these goals interact with “Western” approaches to STEM. They also encourage academic programs to foster an environment where communal work goals can be afforded to recruit and retain Native American students and other underrepresented groups.

- Varma, R. (2005). *Out of the mix: Native Americans in information technology* [Paper presentation]. 2005 ASEE Annual Conference & Exposition, Portland, OR.

Summary: This paper describes the different obstacles that Native American students face in pursuing degrees in information technology. Its findings are based on data collected from 50 interviews with Native American undergraduate students in computer

science (CS) and computer engineering (CE) programs across six different institutions, including tribal and non-tribal universities. The author identifies five major obstacles that participants shared as to why Native American students did not pursue degrees in information technology. The first major obstacle participants identified was lack of exposure and access to computers or computer-related courses prior to attending college. The second was a lack of personal motivation to pursue CS/CE programs due to conflicting ideology between traditional Native culture and CS/CE academic culture. For example, students reported that Native American culture has an emphasis on nature while CS/CE has an emphasis on technology. The third obstacle that participants identified was related to the overall lack of Native American representation in higher education, which further feeds into even smaller numbers of Native Americans in CS/CE. The fourth obstacle indicated that, generally, Native Americans do not pursue CS/CE because they may have interests in another career and/or are unaware of the career opportunities and applicability that CS/CE education offers. The fifth obstacle suggested that some Native American students may not have familial support or encouragement to pursue CS/CE programs.

Recommendations: The author does not provide recommendations.

Williams, D. H., & Shipley, G. P. (2018). Cultural taboos as a factor in the participation rate of Native Americans in STEM. *International Journal of STEM Education*, *5*(17), 1–8. https://doi.org/10.1186/s40594-018-0114-7

Summary: The authors of this paper report findings interwoven through a literature review, survey data (N=96), and interviews (2 STEM and 2 non-STEM Native American faculty members) to understand how Native American cultural taboos impact the participation rates of Native Americans in STEM. In their literature review, the authors primarily focus on the plant and animal taboos emphasized within the Navajo and Cherokee cultures. They also analyze similarities between these two cultures, such as their shared taboos around interacting with dead human bodies. The authors then report their survey findings, highlighting the ways in which students identified how cultural taboos affected their STEM education experience. For example, 38% of survey participants reported that they would choose not to pursue a science major if they knew or suspected that pursuing a science major would require them to violate a serious tribal taboo. In contrast, one striking finding was that 67% of survey participants agreed that if science classes were respectful of tribal taboos, then they would be more likely to take that class. Interviews with faculty members confirmed what the authors found in their literature review and surveys. These interviews provided anecdotes that embodied or emphasized the experiences of the students who took the survey. For example, one faculty member recounted how they knew one Native American student who was enthusiastic about pursuing a science major at their non-tribal university. However, as this student continued into their studies, they began asking for alternatives to certain

assignments that violated their Tribe's taboos. Unfortunately, their professors would not accommodate them, thus forcing this student to switch majors. The authors conclude with explaining the importance of acknowledging Native American students' concerns around conflicts with their cultural values, such as taboos, with studying STEM, and how to support Native American student retention.

Recommendations: The authors provide several recommendations as to how institutions can improve Native American student retention in STEM programs. Some recommendations revolve around how institutions can accommodate Native American students' cultural beliefs and respect their cultural taboos. One such example is allowing students to perform appropriate ceremonies prior to laboratory exercises that conflict with cultural taboos. Another recommendation is encouraging STEM departments to engage in conversation with local Tribes to create a more welcoming environment, allowing opportunities to collaborate with Native educators and other leaders to create a more respectful learning and working environment.

- Wolfgramm, M. V. (2021). *The influence of community cultural wealth and Tauhi Va on the navigation of Pacific Islanders in science, technology, engineering and mathematics (STEM)* (Publication No. 28415448). [Doctoral dissertation, Claremont Graduate University]. ProQuest Dissertations & Theses.

Summary: This dissertation examines how cultural wealth and the Tongan concept of tauhi vā, the reciprocal care of relationships, influenced Pacific Islander (PI) students in navigating STEM higher education. This qualitative phenomenological study, guided by an asset-based framework, explores the experiences of 31 PI students pursuing STEM degrees and recent STEM graduates through surveys, educational journey maps, and semi-structured artifact elicitation interviews. Interviews drew upon the talanoa method, a Pacific research framework rooted in the reciprocal sharing of knowledge and mutual vulnerability between the researcher and participant. The participants represented a diverse range of Pacific nationalities (Hawaiian, Chamorro, Palauan, Samoan, Tahitian, Tongan, Chuukese, and Yapese) and were pursuing a variety of STEM disciplines, including but not limited to: Biology, Chemistry, Computer Systems, Environmental Science, Engineering, and Physiology. Qualitative analysis of findings identified three major themes: navigation and wayfinding, vā; creating space and tauhi vā; and relationship maintenance through reciprocity. PI students reported facing systemic barriers, such as inadequate advising, stereotyping, and an isolationist STEM culture, requiring them to adapt and forge unique educational paths, much like Pacific wayfinders who are guided only by the stars. In this navigation, participants formed social and academic support networks with other PI students, countering the isolating culture of STEM fields. This vā (space) allowed for healing, connection, and collaboration. Cultural practices of maintaining vā and relationships that formed in the vā through reciprocal support and responsibility were identified as critical for perseverance. This included mentoring younger peers and sharing knowledge within PI-

created institutional communities. The study demonstrates how community cultural wealth and tauhi vā empower PI students to persist in STEM despite systemic challenges.

Recommendations: The author emphasizes the importance of institutions acknowledging and integrating PI cultural values into their support structures. This starts at the K-12 level, with counselors and advisors encouraging PI students to pursue STEM in college, and the development of STEM bridge programs created specifically for Pacific Islanders. At the institutional level, this involves the integration of culturally relevant topics and perspectives for PI students into STEM curricula and cultural competency training for STEM faculty. Additionally, the author recommends developing culturally relevant mentorship programs, recognizing the importance of collective success, and creating counterspaces where PI students can find community and validation. In research, the author emphasizes the need to acknowledge Pacific Islanders as Indigenous peoples, starting with disaggregating Pacific Islanders from Asians or Asian Americans in census and research data. Further research is also recommended into the unique barriers and strengths of PI students in STEM to inform policy changes that better support retention and persistence among Indigenous students in higher education STEM programs.

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