NATIVE AMERICANS ENGINEERING ASPIRATIONS

Literature Review: Research in Native American STEM Career Preparation

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Goals

NSF EAGER Project

Interests and aspirations for engineering faculty positions

Literature Review

What is known about the career preparation of Native Americans in the STEM fields?

NATIVE AMERICANS
ENGINEERING ASPIRATIONS

Are you Native American?
Are you 18 or older?
Are you an engineering faculty or student?

Invitation to Participate in a Research Study

An Exploratory Study Pinpointing the Factors That Influence Native Americans Interests and Aspirations for Engineering Faculty Positions

If you answered **YES** to these questions, we invite you to take place in the research study. Participants will take part in an online survey, and in a focus group (students) or an individual interview (faculty).

The purpose of the research study is to develop a deeper understanding of the factors influencing Native American or Alaskan Native involvement in the engineering professorate. We hope to provide evidence for best practices for encouraging Native Americans to pursue the engineering professorate and to consider the academy as their professional home.

You can find us at:
AISES NATIONAL CONFERENCE 2018
EXHIBIT HALL
1213
Interviews on Friday & Saturday

Participants will receive a $15 gift card for participation.

Thank you

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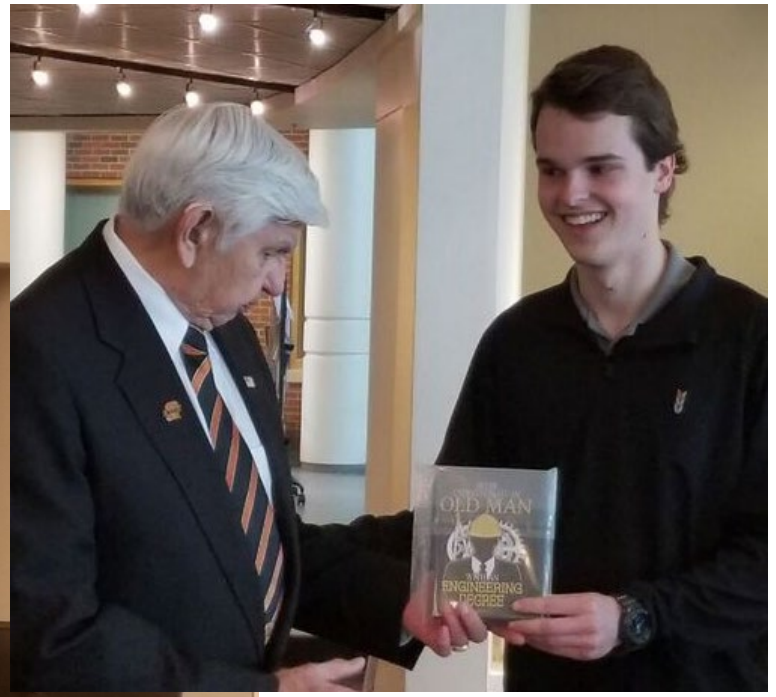
Opening Thoughts

Who am I in relation to this?

- Engineering rules!
- Culture happens
- Identity is fluid



Research Context

- Emphasis on stimulating diverse participation in STEM education, including active career guidance on the part of educators

- According to recent reports (Yoder, 2016), Native Americans (NA) are underrepresented in the field of engineering and at a rate disproportionate to their representation in the population:

  NA Engineering Students (0.6%; N=1853)

  NA Engineering Faculty (0.2%; N=68)

Search Logic

Academic databases

- ERIC, PsychInfo, Academic Search Premiere, ASEE

From 1990-2018

- Native American/American Indian + STEM/science/engineering +/- Career

Includes only peer-reviewed journal articles

- No books, conference presentations, dissertations, reports, grey literature, websites

- No studies where NAs are generally grouped with other URMs
- Include the context of STEM/engineering education

Systematic Review

Three Thematic Categories:

- Pre-College STEM Experiences (8)
- Entry & Persistence in STEM degrees(8)
- Native Science (9)

Each article:

- Claims, conclusions, findings
- Definition of terms
- Calls for Follow-up Studies
- Gaps in literature
- Disagreement about constructs

Pre-College STEM Experiences

Themes

Fun, Hands-on Learning (e.g. Submarines, Wind Turbines, Physiology)

Culturally Responsive Curriculum (Native plants & Glass bead making)

Also,

Research Experiences for NA Teachers

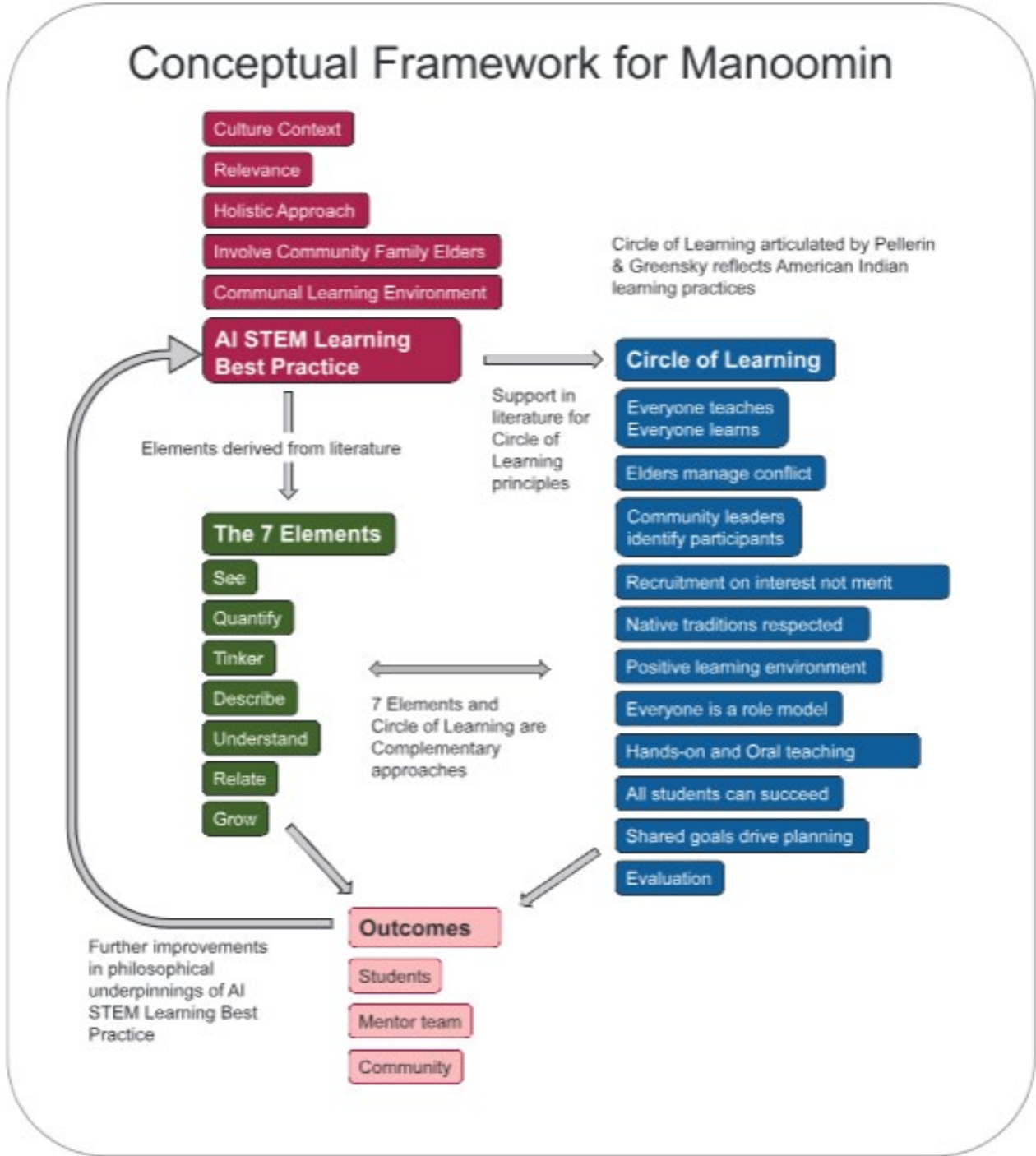
NA Student perceptions about scientists

NSF-OEDG Manoomin Science Camp Project: A Model for Engaging American Indian Students in STEM Dalbotten et al. (2014)

When STEM learning is connected to culture and place

- Manoomin “wild rice” science camp focused on a resource with important economic, cultural, and spiritual meaning
- *Circle of Learning* as framework for community-based participatory research (5-12 students, undergrads, teachers, and scientists) based on trust and relationship development
- *Seven Elements of STEM Learning*, pedagogy emphasizing whole student

Conceptual Framework for Manoomin



Supporting the Career Aspirations of American Indian Youth Alliman-Brissett & Turner (2005)

When career learning is early and explicit

- Developed a career education curriculum called Two Feathers to target American Indian youth
- By the end of their lessons, participants had considered a broad spectrum of career interests and opportunities, had increased their self-confidence and expectations related to a number of different careers, and had demonstrated heightened awareness of diverse career prospects and perceptions of cultural and social support
- Providing early education and exploration within their cultural context is very helpful in increasing self-efficacy and interest in more advanced fields (e.g., engineering)

Entry and Persistence in STEM Degrees

Themes

- Individual vs. Institutional Contexts
- Tribal College and University partnerships
  - ANSEP
- Persistence in Higher Education/Faculty/Professoriate
  - Mentorship
  - Health Science emphasis

Giving Back or Giving Up: Native American Student Experiences in Science and Engineering Smith,et al. (2014)

Exploring the role of Communal Identity

- Endorsement of communal goals by NA STEM majors at the start of their college careers was negatively associated with their intentions to persist due to the notion that STEM does not fulfill their desire for careers that can “give back” to tribal community
- An important piece of entry and persistence to STEM field was the ability to integrate and find meaningful connections between tribal beliefs/practices and the values/goals of STEM and American colleges

Broadening Conceptualization of Native Identity as Foundational for Success among NA in STEM

Page-Reeves, Marin, DeerinWater, and Medin (2017)

Native Identity as multidimensional and dialectic

Embracing STEM identity and finding strength in Native identity

- rather than 'two worlds, identity is multidimensional, being NA is an asset as scientist

Finding balance

- navigating identity conflicts, contradictions

Belonging and giving back

- sense of community, STEM experience precipitates identity awareness, individual and cultural renewal are intertwined

Fitting-in in STEM

- in the face of separateness, erasure, internalized inferiority

Rejecting colonial confinement

- pushing boundaries, claiming space in STEM

Being and becoming a STEM professional

- possible selves, having a plan, taking advantage of opportunities
- dichotomy presents a fear of losing identity that isn't really experienced

Native Science (Education)

- Convergence and divergence of Western and Native Science
  - Recognizing the history of Indians and Formal Education
  - e.g. merging Navajo philosophy of learning and engineering design process
- Re-conceptualizing Native Identity as multidimensional
  - Moves beyond unidirectional cultural change---Power, ideology, empowerment
  - General First Nations culture vs. the various nations/cultures
- Frameworks for Native Science Education
  - Community-based approaches=Culturally based epistemological orientations and their relation to the cultural practices associated with science instruction
  - Native Research Teams, mentoring approaches
  - Curriculum as lived (refusing to separate content and process)

Perspectives on the Indigenous Worldviews in Informal Science Education Conference Venkatesan & Burgasser (2017)

Commonalities

- **Oral traditions and storytelling as a way of life and communication.** Whether this takes the form of a Native or tribal creation story, or Big Bang cosmology, we share the tradition of passing on the story of our knowledge and our broader context.
- **Learning as a measure of being alive** (e.g., "when you stop learning, you die").
- **Youth leadership.** Junior folks are the peers of, or sometimes even lead, the elders.
- **Assessment and re-evaluating evaluation.** In the IK context this is framed as lived or shared experience; in the Western context this is framed as testing hypotheses with evidence.
- **The power of language.** Specifically, that some languages describe mathematical and scientific concepts more effectively than English (e.g., Chinese counting system,[11] deaf sign language for physics concepts[12]).

Distinctions

- **Chaos and order.** In Western culture, the world is viewed as chaos and complexity overlying a fundamentally ordered system at the smallest scales (e.g., the standard model); in IK, order emerges on large scales from underlying and fundamental chaos and flux.
- **The nature of knowledge.** IK sees knowledge as holistic and renewing; Western science approaches knowledge from reductionist and cumulative perspectives. In particular, IK integrates wholeness, spirituality, and relationships into its worldview, whereas Western science aims to separate and isolate these aspects.
- **Exploration vs. sustainability.** Western science is often motivated by "let's do this and see what happens"; a Native scientist will ask "what factors are necessary for our existence?"
- **Process vs. product.** Western knowledge-making is often a goal- or results-oriented process, leading to a "tyranny of the outcome" (consider how we justify funding). IK knowledge-making is more process and people oriented, growing from developing relationships. This results in much longer timescales for learning and development, and less rigid definitions for progress. The longer timescales for sustainable outcomes in IK practices do not align with the practices of Western institutions and national granting agencies.
- **Classification vs. relationship.** Much of Western science builds from an edifice of classification – of species, of stars – whereas IK focuses on relationships, allowing for a greater fluidity of definition.
- **The myth of lone achievement.** A powerful myth of Western achievement is the self- focused, self-driven, solitary genius,[13] whereas the medium and measure of IK success is contained within a community. Isolation runs as a common (negative) theme in the low numbers of underrepresented minorities in STEM.
- **Collaboration vs. assimilation.** In Western scientific culture, there are established norms of the community that may suppress novel, creative thought[14]; in IK, science knowing is a dynamic ecosystem that reflects the differing viewpoints within (Littlebear: "Uniformity is the path to the end.").
- **Place and space.** Learning in harmony with a particular place and time is a key aspect of IK and indigenous identity, reflected in the diversity of architecture of buildings and monuments of indigenous cultures on all continents, in contrast with the building you are likely working in now.

Growing Our Own: Building a Native Research Team

Gray & Carter (2012)

Native Science at the University

- Cohort of American Indian students, staff, and faculty interested in research related to substance abuse and mental health
- Describes the team growth (to 28 students in 4 years), structure, student needs, and faculty/staff roles
- Important Learning Outcomes for graduate students:
  - Commitments to ethical NA research and appropriate protocols
  - Social support and cultural resilience necessary for student success
  - Appreciate vast diversity between and within tribes
  - Individual and group mentoring, often outside discipline

Research Gaps

- Accounting for differences in NA experience and identity
  - Need to present identity as constructed rather than a set of embodied values
  - Traditional to contemporary worldviews
  - Levels of acculturation/identification
- Need for more nuanced portrait of successful Native STEM professional experiences, STEM education, and career thinking
  - What constitutes effective career mentoring? How do we define success?
- Calls for both culturally-driven AND explicit career development
  - What are the implications of native science frameworks within the context of engineering education and career preparation?
  - This is easier said than done

Open Discussion

- Are you a NA STEM professional…
  What is your career journey?
- Do you work with NA students…
  What is your experience?
- Do you research NA STEM learning…
  Where do you publish? challenges?
- Do you work in engineering education…
  What diversity efforts address NA?