



# Application of the Indigenous evaluation framework to a university certificate program for building cultural awareness in science, technology, engineering, and mathematics

Christine Velez<sup>a</sup>, Bridget Nuechterlein<sup>a</sup>, Susan Connors<sup>a</sup>, Grace RedShirt Tyon<sup>b</sup>,  
Timberley M. Roane<sup>c</sup>, David C. Mays<sup>d,\*</sup>

<sup>a</sup> The Evaluation Center, University of Colorado Denver, 1391 Speer Boulevard, Suite 340, Denver CO 80204, United States

<sup>b</sup> University of Colorado Anschutz Medical Campus, Colorado School of Public Health, Centers for American Indian & Alaska Native Health, Nighthorse Campbell Native Health Building, 13055 East 17th Avenue, Mail Stop F800, Aurora, CO 80045, United States

<sup>c</sup> University of Colorado Denver, Department of Integrative Biology, Campus Box 171, PO Box 173364, Denver, CO 80217, United States

<sup>d</sup> University of Colorado Denver, Department of Civil Engineering, Campus Box 113, PO Box 173364, Denver, CO 80217, United States

## ARTICLE INFO

### Keywords:

Indigenous evaluation  
Culturally responsive  
Decolonizing methodologies  
Equitable evaluation  
STEM education  
Indigenous STEM education

## ABSTRACT

This paper presents a case example of the Indigenous Evaluation Framework as applied to a science, technology, engineering, and mathematics (STEM) education pilot program. Indigenous methodologies include knowledge and data that are inclusive of historically marginalized groups, are highly meaningful, valid, and useful for all. A paradigm shift from Western evaluation methodologies to Indigenous evaluation is necessary when evaluating STEM programs that are committed to increasing recruitment, retention, and graduation of students from historically marginalized groups. This paper describes the use of the Indigenous Evaluation Framework during the first two years of the newly created Environmental Stewardship of Indigenous Lands program at the University of Colorado Denver. We discuss the importance of the Indigenous Evaluation Framework and how it informs the development and continued improvements to the program that also provides agency to program leads and participants.

## 1. Introduction

Western methodologies are the social science methods that originated in the Euro-Western sphere. Inherent in Western methodology is the power dynamic between the evaluator and the subject of the evaluation. That is, the evaluator “establishes rules about what can be known and how it can be known ... and holds the power to label, name, condemn, describe, or prescribe solutions to challenges in former colonized, Indigenous peoples, and historically oppressed groups” (Chilisa, 2012, p. 7). Evaluators hold power in deciding what questions to ask, what data to collect, and what stories to tell (McKinley, 2020). Recognizing the historical context in which evaluation evolved and the systems in which evaluators have been trained begs the question about the role of evaluators in buttressing systems of racism and oppression (Waapalaneekweew, 2018).

Western concepts of evaluation are centered on ownership of data, knowledge, and intellectual property (Brugge & Missaghian, 2006;

Chouinard & Cousins, 2007; Christopher, Watts, McCormick, & Young, 2008; Waapalaneekweew, 2018). By contrast, the Indigenous Evaluation Framework (IEF) (American Indian Higher Education Consortium, 2009) centers Indigenous wisdom, reclaiming power, and deconstructing the belief that the Western evaluation framework is the only framework of value. Indigenous evaluation is grounded in being “caretakers of knowledge, community, or family ... and relational interactions and responsibilities to all things in nature, the spirit world, and each other” (Waapalaneekweew, 2018). Accordingly, broadening our perspective to embrace the IEF addresses a known barrier to broadening participation in science, technology, engineering, and mathematics (STEM), namely, to mindfully rebuild the STEM enterprise to embrace the perspectives and knowledge of people regardless of gender, race, and identity (Agrawal, 2002; McGee, 2020). Further, the IEF provides a means by which to stop the cycle of harm that has historically been inflicted on Indigenous communities by evaluators and instead build relationships that honor and respect Indigenous

\* Correspondence to: University of Colorado Denver, Department of Civil Engineering, USA.

E-mail address: [david.mays@ucdenver.edu](mailto:david.mays@ucdenver.edu) (D.C. Mays).

<https://doi.org/10.1016/j.evalprogplan.2022.102066>

Received 17 December 2020; Received in revised form 23 September 2021; Accepted 1 March 2022

Available online 5 March 2022

0149-7189/© 2022 The Authors.

Published by Elsevier Ltd.

This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

self-determination (Cram, 2018; Bowman, Dodge, & Tyndall, 2015).

The American Indian Higher Education Consortium (AIHEC), comprised of 34 American Indian Tribal colleges and universities, developed the IEF. With the guidance of American Indian scientists, educators, evaluators and cultural experts, the AIHEC team started their journey in the development of the evaluation framework (LaFrance & Nichols, 2010). Too often in education, evaluation uses comparisons of underrepresented groups to whites, employs deficit thinking, and makes judgment based on those comparisons (Andrews, Parekh, & Peckoo, 2019; Harper, 2010). AIHEC's intention was to design a framework that would be "grounded in Indigenous epistemologies, be responsive to cultural values, and embraced by the communities that [the evaluation] is intended to serve" (LaFrance & Nichols, 2010). As such, the IEF also rests within the context of a growing body of literature that articulates how to build collaborative relationships based on respect, reciprocity, and trust (Barnhardt, Kawagley, & Hill, 2000; Grossman et al., 2010; Louis & Grossman, 2009; University of Hawai'i, 2018).

Indigenous evaluation approaches and methodologies have been applied in different contexts such as in public health and education. Firestone et al. (2019) provides a case example of data collection methods that honored "stories and knowledge of those who participated" in the evaluation. Grover (2010) discusses how the IEF was used to evaluate the implementation and outcomes of a public health project, finding that funder requirements for quantitative methods challenged the need of the community to tell their own story using culturally relevant qualitative methods. An Indigenous evaluation approach has also been used in the evaluation of place-based educational programming. Mamaril, Cox, & Vaughan (2018) describes the importance of an Indigenous evaluation approach when evaluating educational programs that not only offer learning but serve "as vehicles for cultural resurgence and perpetuation." In this example, Mamaril, Cox, and Vaughan identify the crucial role that context, values, and Indigenous ways of knowing play in evaluation design and the articulation of program outcomes.

Kirkhart (2010) contends that "multicultural validity requires congruence between theory and context." She describes the foundational elements for congruence as needing to acknowledge that culture is multidimensional, encompassed by individuals, groups, organizations, and systems; culture is not fixed but fluid and ever changing based on location, time, and space; and that "culture is not neutral. Power is attached in varying ways and degrees to different dimensions of culture in different contexts." She goes on to describe how cultural congruence can be attained through the IEF.

To our knowledge, few examples exist within academic literature of the implementation of IEF in the evaluation of STEM higher education. One collaborative project of note is the "man in the maze" model created at Tohono O'odham Community College (Newberry, Quijada, Guarin, & Lopez, 2016). As Tohono O'odham Community College integrated the preservation and strengthening of their core values (health, respect, teamwork, and spirituality) into their curriculum, the authors describe how Western evaluation methods were inadequate in assessing the degree to which core values were enhancing program curriculum. They recount their journey of developing an Indigenous education STEM curriculum and assessment based on cultural metaphor. First, they engaged in college-wide training in Indigenous evaluation. They also collaborated with elders and faculty to create the "man in the maze" model, a symbol deeply rooted in Tohono O'odham cultural traditions. In addition to successfully assessing the curriculum, the process and the implementation of the model provided opportunities for reflection, discussion, and strengthened positive relationships among faculty and elders.

The context of our program evaluation is quite different from the Tohono O'odham example: we are situated in an urban university that serves a wide array of students. As such, we offer our experience as an example of how IEF can guide evaluators on building relationships and collaborating in Indigenous contexts and community that are not located on Tribal lands or reservations. Chilisa (2012) argues, and we agree, that

Western and Indigenous methodologies are not a choice of either/or. Rather, successful and collaborative exchange of ideas and approaches can occur if certain elements are present, including (among others) that Indigenous knowledge, perspectives, and values (Chilisa, 2012, p. 13) inform the evaluation design.

It is important to note that in this case, evaluators are non-Indigenous while having a deep commitment to and respect for Indigenous self-determination. We are dedicated to deepening our cultural awareness, checking our own power and privilege, and valuing the strengths and contributions of the communities with whom we collaborate (Hopson, 2009; Nelson-Barber, LaFrance, Trumbull, & Aburto, 2005; National Science Foundation, 2002). We believe the IEF has the potential to strengthen evaluative practice, not only for Tribal communities, but also for non-Indigenous researchers and community partners.

In this paper we describe how the IEF was used to guide the evaluation of a STEM program for Indigenous students that was co-designed with the contribution and commitment by Indigenous partners from academia, government, and Tribes. We explore how the evaluation was guided by four of the six IEF principles, specifically:

- Indigenous framing for evaluation incorporates broadly held values while remaining flexible and responsive to local traditions and cultures.
- Responsive evaluation uses practices and methods that fit our needs and conditions.
- By defining evaluation, its meaning, practice, and usefulness in our own terms, we take ownership. We are not merely responding to the requirements imposed by Western practices.
- Evaluation is an opportunity for learning from our programs and effectively using information to create strong, viable Tribal communities.

The two additional components (listed below) are important and were carefully considered by the evaluators; however there is not sufficient evidence in the program evaluation to claim that these components were fully implemented. While our evaluation supported partners' perspectives, individual ownership of the evaluation, and prioritized traditional values and cultural expressions, we did not focus on tribal sovereignty or self-determination.

- American Indian tribes have ways of assessing merit or worth based on traditional values and cultural expressions. This knowledge should inform how evaluation is conducted and used in our communities.
- Evaluation should respect and serve tribal goals for self-determination and sovereignty.

## 2. Evaluation setting

Environmental Stewardship of Indigenous Lands (ESIL) is a community partnership and academic certificate program at the University of Colorado Denver (CU Denver), which is a research-intensive, doctoral degree granting public university located on the traditional territories and ancestral homelands of the Cheyenne, Arapaho, and Ute Nations. Specifically, this area is the confluence of the South Platte River and Cherry Creek, historically, the epicenter for trade, information sharing, planning, community, family, and ally building, as well as conducting healing ceremonies for over 45 Indigenous Nations, including the Lakota, Kiowa, Comanche, Apache, Shoshone, Paiute, Zuni, Hopi, and many others.

According to 2010 U.S. Census Bureau data reported by the Colorado Commission for Indian Affairs (CCIA), 46,395 people identify as American Indian or Alaska Native in Colorado's urban areas, not including those who also identify with another race (CCIA, 2021). Thus, by absolute numbers, Colorado's urban population of Indigenous people is among the largest in the United States, although it represents only

0.92% of Colorado’s urban population of 5,029,196 in 2010 (U.S. Census Bureau, 2012, Table 1). Moreover, Denver is within a 6–12-hour drive of numerous reservations in Colorado and the neighboring states of South Dakota, Wyoming, New Mexico, Arizona, and Utah. ESIL benefits from its geographic location in “a hub for Indian Country” (CCIA, 2021).

ESIL’s community partnership is organized following the principles of collective impact, a framework for social change that describes how multiple organizations can strengthen the impact of their work by identifying a common agenda, establishing shared measurement systems, conducting mutually reinforcing activities, and engaging in continuous communication with support from a backbone organization (Kania & Kramer, 2011). A full analysis of the ESIL partnership in the context of the collective impact framework will be the topic of a separate study. The partnership comprises three academic departments, two campus diversity offices, three Tribes, three federal government agencies, one Colorado government agency, and one professional evaluation organization.

ESIL is first and foremost a program by Native Americans for Native Americans. ESIL partners are members of the Diné Nation, Lumbee Tribe, Mescalero Apache Tribe, Oglala Lakota Nation, Eastern Shoshone Tribe, Northern Arapaho Tribe, Southern Ute Indian Tribe, Potawatomi Nation, and Three Affiliated Tribes (Arikara, Hidatsa, and Mandan). The strength of the partnership is its diversity among Tribal Nations with representation from whites and historically underrepresented groups such as African Americans, Latinx, and immigrant communities.

ESIL’s mission is to broaden participation of Indigenous students in STEM through education and community partnerships that promote healing and stewardship of Native lands and territories (University of Colorado Denver, 2020). To our knowledge, ESIL is a first-of-its-kind certificate program that prepares STEM-trained professionals to liaise on environmental issues between Tribal and non-Tribal organizations. This need, identified through ongoing conversations between CU Denver faculty and partners in the Denver Indian community, responds to the legacy of water reallocation and environmental degradation that began with European invasion and colonization in the 1600 s and continues to this day. Examples of environmental issues facing Indigenous communities include uranium mining (Miles & Richards, 2019) and pipeline development (Spiegel et al., 2020). But beyond these issues—whose environmental and cultural impacts are manifest—there are deeper structural barriers to incorporating Indigenous perspectives, for example within the context of the U.S. National Environmental Policy Act (Dongoske, Pasqual, & King, 2015) and on global research on climate change (David-Chavez & Gavin, 2018). ESIL seeks to train scientists who will work for the protection of sacred sites, maintain and strengthen a connection to the land. ESIL is based on the premise that an individual can simultaneously and authentically claim membership in an Indigenous community and in the STEM community, while recognizing that the current structure of the STEM community presents numerous and significant barriers to this premise. Accordingly, and remarkably, ESIL is a STEM education organization striving to support the cultural aspects of what it means to be an Indigenous STEM student or STEM professional.

### 3. The evaluation

#### 3.1. Laying the foundation

Before expanding on the details, we ask readers to consider *commitment* as the essential intention underlying the evaluation (Cram, 2018). To do this work, there needs to be more than just an understanding of the setting; there must be a commitment to implementing Indigenous evaluation. Indeed, we ask whether using the same boilerplate framework for every study could lead to concerns with validity, because we believe that methods must be chosen mindfully to match the audience and the context. For example, Indigenous individuals experience colonized perspectives regularly and are attuned to these

**Table 1**  
Quantitative and qualitative phases of evaluation.

QUANTITATIVE		
Instrument	Intent	Response rate
<p><b>The Partner Survey</b> Online survey to measure the development of the collective impact model among the ESIL partnership. The survey was informed by a cross-site study of 25 collective impact initiatives (Lynn, Stachowiak, Akey, &amp; Gase, 2018), a Collective Impact Forum evaluation guide (Preskill, Parkhurst, &amp; Juster, 2014) and from a survey developed by Karen Peterman Consulting’s, Earth Connections evaluation tool. Survey constructs were adapted into interview questions and tailored specifically to the ESIL program. As an additional step, evaluators sought input from Jessica Presley, an Indigenous evaluation consultant.</p>	<p>To assess member perception of where the partnership was in its development of the five components of collective impact. The survey also sought to educate evaluators on Tribal perspectives of how change can and does happen.</p>	<p>April 2018 baseline data collection. Response rate was 73% (8 of the 11 partners responded to the survey). October 2019 follow-up data collection. Response rate was 57% (8 of the 14 partners responded). Five partners completed both the baseline and follow-up surveys.</p>
<p><b>The Student Survey</b> Online survey co-developed with partners to ensure that results would be meaningful and used to inform the program on areas of strength and opportunities for improvement.</p>	<p>The pre-post survey was designed to capture overall satisfaction with the ESIL program, as well as students’ satisfaction with distinct program components, confidence in skills and knowledge, and institutional connectedness.</p>	<p>September 2019. Response rate 63% (5 of the 8 ESIL students completed the survey). May 2020. Response rate 69% (11 of the 15 ESIL students completed the survey). Three students completed both surveys.</p>
<p><b>QUALITATIVE</b> <b>Key informant interviews</b> The interview protocol was informed by themes that emerged during the initial partner meeting in April 2018. Questions were also asked that informed the development of a program logic model.</p>	<p>The interviews were an opportunity for the partners to reflect on the work that had been started at the initial partner meeting and voice their perspective on the impact they each hoped the initiative would have within Tribal communities and on STEM professions. The interviews were a forum by which the partners could express the cultural, historical, and political context in which this initiative was being realized.</p>	<p>All eleven partners were interviewed, three in person, and eight over the telephone. All interviews were audio recorded and transcribed. Evaluators conducted content analysis of the interview transcripts using a codebook developed based on the interview prompts. Based on the coding, evaluators identified key themes and illustrative quotes. As a further analysis step, evaluators facilitated a data interpretation session during an online ESIL partnership meeting in July 2018 (Pankaj &amp; Emery, 2016). Partners provided insights to assure meaning was considered within the context and intended outcomes of the program.</p>

(continued on next page)

Table 1 (continued)

<b>Reflective writing</b>	After each workshop, students were asked to share what they learned and to describe the most important information or messages they took from each workshop. The partners at CU Denver were asked to reflect on the first academic year and share what impact they felt the ESIL workshops were having on students.	Reflective writing was collected after eight workshops. The written reflections provided by the ESIL students and CU Denver partners were collected by the evaluators and coded to discern major themes and findings.
<b>Journey Mapping</b>	Partners wanted to better understand the factors that facilitate Indigenous students' path to higher education. Partners would use this information in their program recruitment efforts, understanding all the ways that students enter CU Denver. It would also provide insight to the support students need upon entering the university.	In August-September 2019, three ESIL students participated in a journey mapping process conducted by evaluators. During individual sessions, an interviewer asked each student, "In thinking about your journey to higher education, what have been key events or people that helped guide you along this path?" Students then prepared their journey maps using drawings or words, as they preferred. As a final step, the interviewer asked each student to narrate their maps to better understand their stories.
<b>Observation</b>	The observation tool captured discussion, activities, interaction, and dynamics among partners and students.	Evaluators conducted thematic coding of the observations of the in-person partnership meetings held in April 2018 and October 2019. Data were triangulated with the partner survey. Illustrative examples highlighted traditional customs and values.
<b>Document Review</b>	The intent was to supplement the self-reported progress from the partner survey. The meeting minutes provided concrete examples and evidence of the progression of the partnership in the first two years of the program.	Evaluators conducted thematic coding of minutes and notes from the first two years of the program. Discussions and activities were coded to the five elements of collective impact and also the infusion of traditional customs into the ESIL processes and activities. Because of the contextual nature of qualitative coding, some activities were represented in more than one element.

perspectives within traditional evaluation methods and assessment tools. Accordingly, our approach is to acknowledge the experience of ESIL partners and students through participation and guidance within the evaluation.

Further, Indigenous evaluation calls upon evaluators to examine their own perspectives, biases, and levels of understanding of the context and the community (DeLancey, 2020; Grey et al., 2018; LaFrance, 2004). Indigenous evaluation acknowledges that evaluation is

not objective (LaFrance, 2004). In fact, the way that data are collected, analyzed, and presented can exacerbate the power dynamic between evaluator and the subjects of the evaluation; it can reinforce systems of structural racism (Brown, Kijakazi, Runes, & Turner, 2019; Geneviève, Martani, Shaw, Elger, & Wangmo, 2020; Kirkhart, 2016; Rogers, 2016). A foundational principle of the IEF is that the evaluation incorporates broadly held values while remaining flexible and responsive to local traditions. That is, the evaluation itself should be reflective of the intended cultural values and perspectives.

At the outset, the evaluators committed to data collection, analysis, and dissemination that would be culturally relevant and meaningful. For example, we knew that the time-honored tradition of storytelling is important within Indigenous communities. Storytelling was incorporated throughout the evaluation through reflective writing, journey mapping, and open-ended prompts within surveys and during partner discussions to capture narratives that honored individual experiences and collective purpose and direction.

Building trust was an equally essential ingredient to the ESIL evaluation. Evaluators had to build trust with students and partners. Trust built over time; it started with listening. Early conversations focused on listening and honoring program and partner needs. The evaluation benefitted from a national three-day convention attended by one evaluator and two partners, a requirement by the funder. This time together allowed for relationship building, discussions and a deeper understanding the historical conditions of the ESIL program. Context is rich, multi-faceted, and multi-layered; investing time in conversation and in developing relationship was necessary for increasing the evaluator's awareness and insight. Additionally, the exchange of ideas in these early conversations set the stage that assured partners that the evaluation was not intended to be extractive nor exploitive.

Over the next two years, from mid-2018 through mid-2020, evaluators spent a great deal of time with the ESIL team, attending weekly ESIL meetings, monthly ESIL student workshops, and semiannual Tribal and government partner meetings, first in person, and then via remote video connection during the COVID-19 pandemic. Serving as embedded evaluators and focusing on building relationships (Brown & Di Lallo, 2020; Shepard & Graham, 2020) provided insider knowledge and understanding that would not have been possible with an external evaluation approach. Evaluators understood the partners' struggles, where the program was going, and the changes in the conversation. The initial investment of time also contributed to building trust over the course of the evaluation.

### 3.2. Building the Frame

In the previous section, we asked readers to consider *commitment* as the essential intention underlying the evaluation. Here, we ask readers to consider *the learning process* as the essential intention underlying the design (McKinley, 2020). This re-framing stems directly from the IEF, which asks us to contextualize our methods and approaches to assist in gaining validity. Rather than espouse a standard study design from the outset, the evaluators in this work focused on learning together. Instead of starting with preconceived notions, evaluators sought to allow knowledge creation to happen from the ESIL community, including CU Denver faculty, external Tribal and government partners, and students. This was further facilitated by the fact that ESIL was a nascent program and evaluators were involved from the beginning as the program was being developed.

As a first step, the evaluators developed a logic model (a visual representation of a program's resources, activities, outputs, outcomes, and impact) from notes and observations from the first ESIL meeting that included partners and students, and from subsequent key informant interviews with each of the partners. During these interviews, evaluators asked open-ended questions to identify logic model components and measurable outcomes. This modification to the standard approach generated deeper insights, as partners articulated answers to questions

such as, “What does success mean?”; “Who benefits?”; and “Where do you want to see the program five years from now?” In other words, the evaluators proceeded in a way that worked for the team and that honored knowledge creation among all the partners.

In combination with the IEF, evaluators implemented a complementary Western evaluation approach called developmental evaluation. Developmental evaluation is an approach that is responsive to context and to new learning as innovations emerge and evolve within complex systems. Unlike traditional evaluation, the developmental evaluator’s role is collaborative. The approach prioritizes developing partnerships and positions the evaluator as a team-member. In addition, the developmental evaluation approach is flexible and responsive to new measures and goals as the program evolves over time (Patton, 2006). Developmental evaluation has successfully been used in other evaluation work with Indigenous communities (Blanchet-Cohen, Geoffroy, & Luz Marina Hoyos, 2018; Laycock, Bailie, & Matthews, 2019). These specific evaluations describe how the co-creation and collaborative nature of the approach supported Indigenous values and culture.

### 3.3. Using the Tools

The ESIL evaluation used a mixed-methods approach using both quantitative and qualitative methods to assess the impact of the program on students and on the partners. Table 1 outlines the data collected within the first two years of the ESIL program.

### 3.4. Indigenous Evaluation Framework in Action

Principle: Indigenous framing for evaluation incorporates broadly held values while remaining flexible and responsive to local traditions and cultures. The evaluation was designed to measure outcomes identified by the partners; however, evaluators focused on remaining open and flexible, listening intently for questions being posed by the partnership and among the students. When issues or questions were surfaced by ESIL partners or students, evaluators worked collaboratively with partners to design and collect data that informed the decision at hand and to understand what was happening in the broader sense. Further, observations and data triangulation were framed within the context of Indigenous values such as respect, truth, generosity, and wisdom.

The ESIL team allowed for evaluators to participate and observe ESIL weekly team meetings, workshops, and partner meetings. This was imperative for increasing awareness to the traditions and the unique perspectives of Indigenous people. For example, interviews with partners were scheduled so as not to interfere with Tribal ceremonies that occur over several weeks. The timing of the data collection was responsive to annual rituals; this ensured everyone had the opportunity to provide input and all voices were heard. The collaborative development of evaluation tools also ensured that the evaluation would be useful to the program. We tailored questions in existing tools and developed new ones. At each turn, the ESIL partners provided input on intent, process, language, and timing. We also used conversations and meeting notes to develop tools. For example, the student survey was informed by partner meeting observation notes and discussions of what partners believed were important skills and knowledge for students to gain in the ESIL program. While some evaluators meet with clients to discern information, our case was unique since information emerged naturally over a period of time, because evaluators were integrated into meetings and program activities from the beginning.

Principle: Responsive evaluation uses practices and methods from the field of evaluation that fit the needs and conditions of the Indigenous community. In this case, evaluators used data collection methods that aligned with the time-honored tradition of storytelling. Further, the close collaboration with ESIL partners ensured methods were not only culturally appropriate but also culturally meaningful. While surveys were used in a few instances, the evaluation relied heavily on qualitative methods because it allowed for individual and collective experiences to

be captured through personal narrative and storytelling. By necessity and design, the evaluation of a two-year pilot program must be formative in nature. That is, the ESIL team needed to understand the ways in which the program was affecting students’ thinking, sense of self, and the intersection of identities as Western scientists and Indigenous people. Partners needed to discern if and how students were grappling with new information, academically but also in social-emotional ways. Students were asked to reflect and write about what they learned that was either surprising or caused them to think about things differently. They were encouraged to share about how their understanding or perceptions changed. Evaluators then summarized these reflections and shared the summaries with the ESIL team within days. This allowed the ESIL team to add program content to address concerns or delve more deeply into student questionings.

Principle: By defining evaluation, its meaning, practice, and usefulness in our own terms, we take ownership. We are not merely responding to the requirements imposed by Western practices. The collaborative development of the logic model served as the building block for the evaluation plan. Evaluation tools were designed and adapted with input from ESIL partners and Indigenous evaluators to meet program needs. This participatory approach was new to ESIL partners and set the stage for partner investment in the evaluation. Over time the ESIL team began to take ownership of the evaluation. They came to see evaluation not just as a funding requirement but rather a tool that could help them make decisions.

One practice that we used to support the shared ownership of the evaluation was to conduct data interpretation sessions with partners. For example, at the beginning of the initiative, we conducted in-depth interviews with each of the partners about their expectations for the partnership related to communication, decision making, anticipated challenges, and support needed for success. During a subsequent partner meeting, we shared key themes emerging from the interviews. We guided partners through the information and asked, “What about the data surprises you? In what areas do you see a coalescing of ideas among the group?” During the data interpretation session, partners discussed each theme and used these data to identify action items and next steps. This facilitated process created space for the partners to discuss what the data could mean and how to move forward, thereby encouraging collaboration among the partnership. This practice of mutually interpreting data contributed to trust building among the partnership and with the evaluators.

Another example of how the partners were taking ownership of the evaluation happened in the first six months of the program when faculty were hearing concerns from students. This prompted the partners and the evaluators to ask how they could capture the dynamics of what was happening in the program on an individual and collective level. In response, the evaluators developed reflective interview questions to encourage each faculty member to share their observations of the students’ experience. This data collection was not part of the initial evaluation plan, but it was needed to capture the dynamics happening with students and the faculty. As a result, the evaluators provided data to the ESIL team that stimulated faculty discussions, reinforced ESIL’s mission, and established accountability for individual roles.

Principle: Evaluation is an opportunity for learning from our programs and effectively using information to create strong, viable Tribal communities. The evaluation was not only an opportunity to learn from the program but also to use the information to create a strong, viable Tribal community. The experience of journey mapping validated the importance of the individual’s experience. The themes from the journey mapping were substantiated during data sharing at the partner meeting where students and the partners described their own experiences and journeys. This led to conversations on the influence of role models and the power of positive messages. It also highlighted the importance of having culturally affirming experiences beyond those experienced on reservations.

ESIL faculty also noted that the IEF provided students with agency.

Students felt empowered by being able to tell their stories which had an impact beyond ESIL. Students shared stories about what motivated them to pursue higher education, specifically, higher education with a focus on environmental science and/or Tribal communities. They also shared that having a support network of peers, mentors, teachers, community members, and family was key to providing emotional and academic support. These narratives and experiences confirmed for ESIL partners the importance of strengthening program mentorship and providing opportunities for students to engage in positive cultural experiences. As a result, partners explored creative avenues centered around Indigenous values that could bring the program and its students together around STEM.

To be clear, evaluation findings can lead to intense but important conversations. How these conversations are approached can also create a stronger community. For instance, one student shared, “The ESIL program is a safe space for me. I am not nervous to present my ideas because I know any feedback has sincere intentions of making me better. I can be Indigenous without having to explain it.”

The focus on storytelling data collection and dissemination provided rich context that encouraged intentional conversations about needed action. For the ESIL community of partners and students, the evaluation provided an avenue for sharing perspectives and experiences confidentially. For example, a student noted that their initial university advisor was not able to understand their specific situation. However, because the relationship with an ESIL advisor, the student felt they had someone invested in them personally and who was supportive of their academic goals. “Having someone that could see from my perspective was really helpful.” Sharing the resulting themes allowed for conversations to happen at a level that not only led to program adjustments but a greater cohesion among members.

#### 4. Lessons learned: reflections on the IEF

Implementing Indigenous evaluation provided a vehicle by which the partners and the evaluators could learn and grow together. The aspiration of the IEF is that Western and Indigenous evaluation approaches can come together to create something innovative and inclusive. In many ways, this is analogous to the relationship and understanding that grew among partners and evaluators. Rather than experiencing evaluation as exploitive and extractive, the leveling of the power dynamic afforded by the IEF provided partners with the experience of evaluation that is useful to support program improvement.

The emphasis on relationships, listening, and learning acted as an avenue in facilitating collaborations with classically trained STEM faculty. As a rule, STEM faculty are trained only in quantitative methods, and this was the case for the ESIL faculty in biology, civil engineering, and environmental science. To those without training in qualitative methods and without prior experience with professional evaluators, evaluation itself may appear as a funder-imposed requirement with dubious benefits. Moreover, those without the appropriate training may harbor one or more misconceptions about qualitative methods (Harper & Kuh, 2007). By contrast, engaging faculty, students, and partners in reflection and discussion revealed the desire to embrace an Indigenous evaluation approach without any prior experience with the methods. As one partner said early on, they believed that telling the story of this collaboration would be valuable. They continued, “I think it’s going to showcase a very effective model of collaboration [among a] group of people from multiple places: a university in collaboration with federal entities, [and others] ...” Another said, “I think we become siloed. We don’t spend enough time [learning from] successes and failures.”

From the non-Indigenous evaluator perspective, using the framework of Indigenous evaluation facilitated evaluators’ learning from partners, students, and program contributors. Evaluators came to learn and experience their inherent values in the way partners, students and contributors engaged with one another, in the content of their discussions, in the stories that they told. Just as in science, there is the Western

perspective that sees natural phenomena from an inanimate, objective perspective. In contrast, Indigenous ecological knowledge has a holistic, relational, animate view of the natural world (Kimmerer, 2013). So too, the IEF guided the evaluators who were trained in the Western social scientific method to evaluate the program with a holistic, relational mindset. Compassion, relationships, generosity, and giving equal voice were important aspects of the evaluation approach.

We believe that without a relational mindset and building relationships (Shepard & Graham, 2020) evaluation risks being superficial or misaligned with the goals of the program. For example, during the first data interpretation session, one partner discussed a goal that had not been captured in the first version of the logic model. “One of our goals is to make a curriculum for STEM that is more appealing to a broader group. ... We want to avoid building an educational curriculum where people feel they don’t fit in ... not just from a technological standpoint but from a human standpoint.” Another partner continued, “We have heard from some students that they feel like they either have to be a scientist or a member of a traditional community. They feel they have to choose one. We ask people to consider that you don’t have to choose one. You could use science in any cultural context that you need. I think maybe that is one goal.”

The IEF also led to transparent communication among Indigenous students and partners as the methods used were culturally familiar and valued. This may have allowed for more honest expression within the evaluation process, thereby providing the opportunity for ESIL program partners to discover what would have been undiscoverable solely through Western evaluation methods. As one partner noted,

“Personally, participating in evaluation made me realize how colonized and alienating higher education is for a large number of students. In reflecting on my own education, I interpreted my own feelings of alienation as I wasn’t good enough or smart enough. Through what we’ve learned in ESIL and our students is that the alienation can come from the culture of higher education (as opposed to the culture of the student).”

As we reflect on our experience and how the IEF guided the evaluation, we can now see the blind spots that were not evident to us early in the process. We used the essential components of the IEF to guide our reflection. Our primary lesson learned was that we did not fully engage students in our processes related to three of the four guideposts as described below.

**CREATING THE STORY** starts with asking questions that guide the evaluation. This fostering of evaluative thinking and engaging in curiosity was key to our approach and set the foundation for the work to come. Partners were able to tell the story of what they hoped the program could accomplish. While the evaluators engaged in collecting partner perspectives and input, we did not engage students in creating the story. Upon reflection, we should have asked students many of the same questions we asked of partners early in the process and whose answers were used to build the logic model.

**BUILDING THE SCAFFOLDING** are the methods and means by which data are collected. Observation as to how the students, partners, and the program was evolving was a critical component. For this guidepost, we successfully gathered information from multiple perspectives, including those of students, through storytelling, discussion, surveys, and reflective writing. Change over time was assessed iteratively.

**PLANNING, IMPLEMENTING, AND CELEBRATING** was done collectively with partners and sense-making data sessions provided opportunities for celebration of program accomplishments and the values exemplified in the collective. Again, students were not engaged in this process which was a significant gap.

**ENGAGING COMMUNITY AND BUILDING CAPACITY** speaks to the level of ownership that Indigenous communities have over the evaluation and the knowledge gained and shared. As noted earlier, this

was accomplished among the partners. After the two-year pilot period had come to a close, a student's remark brought us to the stark realization that for all our efforts to adhere to the IEF principles, we had failed to share evaluation findings with the students. The evaluation had actually been extractive of student's knowledge and experiences without giving back in return. We had failed to adequately inform students of how their data were being used to inform program improvements; the purpose, intent, and results of the evaluation were not communicated (Chicago Beyond Equity Series, 2018).

This omission of the students' voice was remedied by a multi-prong approach. First, partners began to communicate the reasons for data collection requests and to share examples of how student input was used for program improvement. Second, the student newsletter included a note of gratitude to students for participating in ongoing evaluation efforts. Third, evaluators developed and delivered a two-hour evaluation workshop for students. Students were introduced to the IEF and evaluators discussed how knowledge of evaluation and evaluative thinking is another skill that would be important to their future careers. Students then engaged in a data interpretation exercise using their own aggregate survey results from the prior semester. The workshop was videorecorded for use with future students. Finally, IEF resources were posted on the student portal. After the workshop, one student commented, "Tribal liaisons should ask for feedback from the Tribes they are serving ... and make sure that the Tribes they are working with feel respected and valued." Another student said, "The Indigenous evaluation framework combines Western and Indigenous forms of evaluation with the goal of making evaluation more collaborative and meaningful. More common forms of evaluation are inherently rooted in Western science and ideologies, and therefore may not provide as useful information in all contexts."

Realizing very late in the process that students were not being fully included in the evaluation is an example of how easy it is to fall into familiar patterns. Paradigm shifts and effectively using frameworks like the IEF does not happen overnight. For those of us who have been trained in Western science, we have to unlearn old ways and exercise new muscles. Conducting evaluation in Indigenous contexts, particularly with Indigenous students in higher education, we had the responsibility to be a "trusted teacher who can help facilitate capacity building ..." (Bowman, Dodge, & Tyndall, 2015). We missed not only closing the communication loop with students but also neglected to fulfill our duty to build their skills and knowledge base. This process also validated the importance of being open, flexible, and responsive. Fortunately, we did not discount the remark of just one student. Instead, we placed a high value on what was said and strived to work towards a remedy. Valuing this one perspective opened our eyes to a missing piece, and we set out immediately to make it right.

Finally, the evaluation provided opportunities to educate others about cultural awareness and how cultural awareness impacts individuals, education, and society, all of which influence the educational experience of students. Further, partners expressed that the evaluation has helped ESIL realize it is more than an educational program but is a voice for Indigenous students within higher education. "I have realized that ESIL has a larger mission and because I now have language from our students, I can better advocate for better inclusion and curation within STEM, creation of safer spaces, and relationship building within and outside of the University."

## 5. Discussion

Our experience suggests the IEF has potential for application to other program evaluations in a variety of contexts. We found that adopting four of the IEF principles resulted in meaningful evaluation results for the ESIL program partners and supported their decision-making and learning for ongoing improvement of this pilot project. In our case example, the Western approach of developmental evaluation was strengthened with the implementation of IEF. These two approaches

complemented one another and provided the opportunity for evaluators and partners to co-create and prioritize Indigenous values and ways of knowing throughout the entire project.

As this is an on-going evaluation, we will continue to apply and refine this approach to the evaluation of ESIL. We hope to follow the student participants over time to learn about the impact of their ESIL training on their career success as tribal liaisons and the influence of their work on critical environmental issues. We hope that by sharing what we learned in this case, other evaluators will be motivated to successfully utilize and value IEF principles.

Further application of the IEF in a wide range of communities is needed to develop and refine ways to conduct culturally respectful evaluations. Additional case examples including all six IEF principles will add to our understanding and potentially identify the most essential components of the IEF approach. More studies that blend Western and Indigenous evaluation approaches will increase our understanding of how to meet the needs of all evaluation audiences including funders who often favor quantifiable outcomes. A larger body of evidence is needed to provide guidelines that assure evaluations are conducted in ways that are respectful, meaningful, valid, and useful.

## Declarations of Competing Interest

None.

## Acknowledgments

The authors thank the three anonymous referees whose insightful and constructive comments strengthened this work and its presentation. Funding was provided by the U.S. National Science Foundation through awards DBI-1744524 and DUE-1742603. Typesetting was provided by David Leech.

## References

- Agrawal, A. (2002). Introduction: In favor of indeterminacy. *International Journal of Social Science*, 54(173), 283–285. <https://doi.org/10.1111/1468-2451.00381>
- American Indian Higher Education Consortium. (2009). *Indigenous Evaluation Framework: Telling our Story in Our Place and Time*. Alexandria, VA: American Indian Higher Education Consortium.
- Andrews, K., Parekh, J., & Peckoo, S. (2019). How to Embed a Racial and Ethnic Equity Perspective in Research. *Practical Guidance for the Research Process*. Washington, DC: Child Trends.
- Barnhardt, R., Kawagley, O., & Hill, F. (2000). Guidelines for respecting cultural knowledge. *Sharing Our Pathways: A Newsletter of the Alaska Rural Systemic Initiative*, 5, 1–3.
- Blanchet-Cohen, N., Geoffroy, P., & Luz Marina Hoyos, L. (2018). Seeking Culturally Safe Developmental Evaluation: Supporting the Shift in Services for Indigenous Children. *Journal of MultiDisciplinary Evaluation*, 14(31), 19–31.
- Bowman, N. R., Dodge, F. C., & Tyndall, M. (2015). Culturally Responsive Indigenous Evaluation: A Practical Approach for Evaluating Indigenous Projects in Tribal Reservation Contexts. In S. Hood, R. Hopson, & H. Frierson. (Eds.), *Continuing the Journey to Reposition Culture and Cultural Context in Evaluation Theory and Practice* (pp. 335–360). Charlotte, NC: Information Age Publishing. <http://www.worldcat.org/oclc/910514029>.
- Brown, K. S., Kijakazi, K., Runes, C., & Turner, M. A. (2019). *Confronting Structural Racism in Research and Policy Analysis: Charting a Course for Policy Research Institutions*. Washington, DC: Urban Institute.
- Brown, M. A., & Di Lallo, S. (2020). Talking circles: A culturally responsive evaluation practice. *The American Journal of Evaluation*, 41(3), 367–383. <https://doi.org/10.1177/1098214019899164>
- Brugge, D., & Missaghian, M. (2006). Protecting the Navajo People through tribal regulation of research. *Science and Engineering Ethics*, 12, 491–507. <https://doi.org/10.1007/s11948-006-0047-2>
- Census Bureau, U. S. (2012). *Colorado 2010 Population and Housing Unit Counts, CPH-2-7*. Washington, DC: U.S. Government Printing Office.
- Chicago Beyond Equity Series. (2018). Why am I always being researched?: A guidebook for community organizations. *Researchers, and Funders to Help Get Us from Insufficient Understanding to More Authentic Truth*, 1. <https://chicagobeyond.org/researchequity/>.
- Chilisa, B. (2012). *Indigenous Research Methodologies*. Los Angeles: Sage Publications Inc.
- Chouinard, J. A., & Cousins, J. B. (2007). Culturally competent Evaluation for Aboriginal communities: A review of the empirical literature. *Journal of MultiDisciplinary Evaluation*, 4(8), 40–57.

- Christopher, S., Watts, V., McCormick, A. K. H. G., & Young, S. (2008). Building and maintaining trust in a community-based participatory research partnership. *American Journal of Public Health*, 98, 1398–1406. <https://doi.org/10.2105/AJPH.2007.125757>
- Waapalaneekweew (Nicole R. Bowman-Farrell, Mohican/Lunaape). (2018). Looking backward but moving forward: Honoring the sacred and asserting the sovereign in Indigenous evaluation. *The American Journal of Evaluation*, 39(4), 543–568. <https://doi.org/10.1177/1098214018790412>
- Colorado Commission for Indian Affairs. (2021). Urban Indian Population, <https://ccia.colorado.gov/tribes/urban-indian-population>, (Accessed 9 September 2021).
- Cram, F. (2018). Conclusion: Lessons about Indigenous evaluation. *New Directions for Evaluation*, 2018(159), 121–133. <https://doi.org/10.1002/ev.20326>
- David-Chavez, D., & Gavin, M. C. (2018). A global assessment of Indigenous community engagement in climate research. *Environmental Research Letters*, 13, Article 123005. <https://doi.org/10.1088/1748-9326/aaf300>
- DeLancey, D. (2020). Indigenous evaluation in Northwest Territories: Opportunities and challenges. *Canadian Journal of Program Evaluation*, 492–512. <https://doi.org/10.3138/cjpe.68837>
- Dongoske, K. E., Pasqual, T., & King, T. F. (2015). The National Environmental Policy Act (NEPA) and the silencing of Native American worldviews. *Environmental Practice*, 17, 36–45. <https://doi.org/10.1017/S1466046614000490>
- Firestone, M., Syrette, J., Jourdain, T., Recollet, V., & Smylie, J. (2019). “I feel safe just coming here because there are other native brothers and sisters”: Findings from a community-based evaluation of the Niinwin Wendaanimak Four Winds Wellness Program. *Canadian Journal of Public Health*, 110(4), 404–413. <https://doi.org/10.17269/s41997-019-00192-6>
- Geneviève, L. D., Martani, A., Shaw, D., Elger, B. S., & Wangmo, T. (2020). Structural racism in precision medicine: Leaving no one behind. *BMC Medical Ethics*, 21, 17. <https://doi.org/10.1186/s12910-020-0457-8>
- Grey, K., Yamaguchi, J., Williams, E., Davis, V., Foster, D., Gibson, J., & Dunnett, D. (2018). The strength of Indigenous Australian evaluators and indigenous evaluation: a snapshot of “Ways of Knowing and Doing” reflecting on the 2014 Darwin conference of the Australasian Evaluation Society. *Indigenous Evaluation*, 159, 79–95. <https://doi.org/10.1002/ev.20330>
- Grossman, Z., Louis, R. P., Castagna, C., Dobbs, R., Hazlewood, J., Richmond, C., & Zeitler, E. (2010). AAG Indigenous Peoples Specialty Group declaration of key question about research ethics with Indigenous communities. *Association of American Geographers ((AAG))*. <http://www.indigenousegeography.net/IPSG/pdf/IPSGResearchEthicsFinal.pdf> (Accessed 4 January 2019).
- Grover, J. G. (2010). Challenges in applying Indigenous evaluation practices in mainstream grant programs to indigenous communities. *The Canadian Journal of Program Evaluation*, 23(2), 33–50.
- Harper, S. R. (2010). An anti-deficit achievement framework for research on students of color in STEM. *New Directions for Institutional Research*, 148. <https://doi.org/10.1002/ir.362>
- Harper, S. R., & Kuh, G. D. (2007). Myths and misconceptions about using qualitative methods in assessment. *New Directions for Institutional Research*, 136. <https://doi.org/10.1002/ir.227>
- Hopson, R. (2009). Reclaiming knowledge at the margins: Culturally responsive evaluation in the current evaluation moment. *the SAGE International Handbook of Educational Evaluation* (pp. 429–446). SAGE Publications Inc. <https://www.doi.org/10.4135/9781452226606>.
- Kania, J., & Kramer, M. (2011). Collective impact. *Stanford Social Innovation Review*, Winter, 2011, 36–41.
- Kimmerer, R. W. (2013). *Braiding Sweetgrass*. Minneapolis, MN: Milkweed Editions.
- Kirkhart, K. E. (2010). Eyes on the prize: Multicultural validity and evaluation theory. *American Journal of Evaluation*, 31(3), 400–413. <https://doi.org/10.1177/1098214010373645>
- Kirkhart, K. E. (2016). Equity, privilege and validity: Traveling companions or strange bedfellows? In S. Donaldson, & R. Picciotto (Eds.). *Evaluation for an equitable society* (pp. 109–131). Information Age Publishing Inc.
- LaFrance, J. (2004). Culturally competent evaluation in Indian County. *New Directions for Evaluation*, 102, 39–50.
- LaFrance, J., & Nichols, R. (2010). Reframing evaluation: Defining an Indigenous evaluation framework. *The Canadian Journal of Program Evaluation*, 23(2), 13–31.
- Laycock, A., Bailie, J., Matthews, V., et al. (2019). Using developmental evaluation to support knowledge translation: Reflections from a large-scale quality improvement project in Indigenous primary healthcare. *Health Res Policy Sys*, 17, 70. <https://doi.org/10.1186/s12961-019-0474-6>
- Louis, R. P., & Grossman, Z. (2009). Discussion paper on research and Indigenous peoples, Indigenous Peoples Specialty Group. *Association of American Geographers ((AAG))*. [http://www.indigenousegeography.net/ipsag/pdf/2009\\_research\\_discussion\\_paper.pdf](http://www.indigenousegeography.net/ipsag/pdf/2009_research_discussion_paper.pdf) (Accessed 4 January 2019).
- Lynn, J., Stachowiak, S., Akey, T., & Gase, L. (2018). When collective impact has an impact: A cross-site study of 25 collective impact initiatives. *ORS Impact News*. <http://www.orsimpact.com/blog/When-Collective-Impact-Has-Impact-A-Cross-Site-Study-of-25-Collective-Impact-Initiatives.htm> (accessed 6 May 2021).
- Mamaril, M. N., Cox, L. J., & Vaughan, M. (2018). Weaving evaluation into the Waipā ecosystem: Placing evaluation in an Indigenous place-based educational program. *Studies in Educational Evaluation*, 56, 42–51. <https://doi.org/10.1016/j.stueduc.2017.10.005>
- McGee, E. O. (2020). *Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation*. Cambridge, MA: Harvard Education Press.
- McKinley, G. (2020). Reflections on Being a Learner: The Value of Relationship-based Community Evaluations in Indigenous Communities. *Canadian Journal of Program Evaluation*, 34(3), Special Issue, 464–479. <https://doi.org/10.3138/cjpe.68857>
- Miles, M., & Richards, L. M. (2019). *Healing hózhó in the nukescape: Hózhó naashaa doo, Beyond Nuclear International*. <https://beyondnuclearinternational.org/2019/09/29/healing-hozho-in-the-nukescape-hozho-naashaa-doo/> (Accessed 21 November 2019).
- A. Hilton The Cultural Context of Educational Evaluation 2002. <https://www.nsf.gov/pubs/2003/nsf03032.pdf>.
- Nelson-Barber, S., LaFrance, J., Trumbull, E., & Aburto, S. (2005). Promoting culturally reliable and valid evaluation practice. In S. Hood, R. Hopson, & H. Frierson (Eds.), *The Role of Culture and Cultural Context in Evaluation*. Greenwich, CT: Information Age Publishing.
- Newberry, T. L., Quijada, A., Guarín, J., & Lopez, C. (2016). The man in the maze: An Indigenous education model at Tohono O’odham Community College. *Tribal College and University Research Journal*, 1(1), 1–19.
- Pankaj, V., & Emery, A. K. (2016). Data placemats: A facilitative technique designed to enhance stakeholder understanding of data. *New Direction for Evaluation*, 2016(149), 81–93.
- Patton, M. Q. (2006). Evaluation for the way we work. *The Nonprofit Quarterly* (Vol. 13, (1), 28–33. Retrieved via <http://www.scribd.com/doc/8233067/Michael-Quinn-Patton-Developmental-Evaluation-2006>.
- Preskill, H., Parkhurst, M., & Juster, J. S. (2014). Evaluating collective impact: Assessing your progress, effectiveness, and impact. *FSG Collective Impact Forum*. <https://www.fsg.org/publications/guide-evaluating-collective-impact>, accessed 6 May 2021.
- Rogers, P. J. (2016). Understanding and supporting equity: Implications of methodological and procedural choices in equity-focused evaluations. In S. Donaldson, & R. Picciotto (Eds.), *Evaluation for an equitable society* (pp. 199–215). Information Age Publishing Inc.
- Shepard, R. P., & Graham, K. A. H. (2020). Evaluation in Indigenous contexts: An introduction to practice. *Canadian Journal of Program Evaluation*, 34(3), 391–399. <https://doi.org/10.3138/cjpe.69010>
- Spiegel, S. J., Thomas, S., O’Neill, K., Brondgeest, C., Thomas, J., Beltran, J., ... Yassi, A. (2020). Visual storytelling, intergenerational environmental justice and Indigenous sovereignty: Exploring images and stories amid a contested oil pipeline project. *International Journal of Environmental Research and Public Health*, 17, 2362. <https://doi.org/10.3390/ijerph17072362>
- University of Colorado Denver. (2020). *Environmental Stewardship of Indigenous Lands*. <https://clas.ucdenver.edu/esil/>, accessed 9 June 2020.
- University of Hawai’i. (2018). *Kilana Noi’i, Hawai’i Sea Grant*. <https://seagrant.soest.hawaii.edu/kulana-noi/> (Accessed 4 January 2019).

**Christine Velez** is an Associate Director at The Evaluation Center at the University of Colorado Denver. Her work with Tribal communities began in 2003 as a member of the team that managed and implemented the Indian Housing Block Grant (IHBG) for the Department of Housing and Urban Development (HUD). From 2013–2016, she was on the technical assistance team for the IHBG Negotiated Rulemaking which included representatives from 23 Tribal Nations. She currently serves as the lead evaluator for two programs, Environmental Stewardship of Indigenous Lands, and Feasibility Assessment of Culturally Appropriate Substance Use Disorder Treatment in Native American Communities.

**Bridget Nuechterlein** is a Senior Evaluation Specialist at The Evaluation Center at the University of Colorado Denver. Her work includes the evaluation NxtGEN (a U.S. Department of Education Teacher Quality Partnership grant) and the Kempe Center’s leadership coaching program, among other projects. Bridget has a passion for conducting meaningful research and evaluation studies across a wide range of social impact areas. Her experience has allowed her to sharpen her skills as a data visualization specialist and storyteller.

**Susan Connors** Ph.D. is an Associate Director at The Evaluation Center at the University of Colorado Denver. She has 30 years’ experience as a public educator in K-12 schools and higher education institutions. Her work includes the evaluation NxtGEN (a U.S. Department of Education Teacher Quality Partnership grant), four National Institutes of Health grants to the University of Zimbabwe College of Health Sciences, and the Kempe Center’s leadership coaching program, among other projects. She is especially interested in providing credible and actionable evaluation data to increase the access of under-served populations to quality education and healthcare.

**Grace RedShirt Tyon** is an enrolled member of the Oglala Lakota Nation and is currently the Community Outreach and Engagement Specialist with the Centers for American Indian & Alaska Native Health (School of Public Health at the University of Colorado Anschutz Medical Campus). Gracie served as the Director for American Indian Student Services at CU Denver from 2016 to 2021, focusing on the support of Native and Indigenous students academically, emotionally, and culturally, while fostering an atmosphere of respectful collegial relationships, partnerships, community, and ally building. She serves on a number of committees at CU Denver where she brings the importance and value of the Indigenous voice and perspective to these groups. She has collaborated with professors, staff and leaders throughout the CU system and the Denver Indian community. Gracie serves as an advisor for the Environmental Stewardship of Indigenous Lands Certificate program (ESIL) where her knowledge and guidance help infuse a deeper understanding of the importance of traditional ecological knowledge and the Indigenous world view in STEM. Gracie helps in recruiting efforts and advising students enrolled in the program.

**Timberley M. Roane**, Lumbee Tribe of North Carolina, is an associate professor of microbiology at the University of Colorado Denver. She earned her bachelor’s from the University of California Davis, then earned her master’s from the University of Idaho and doctorate from the University of Arizona. Since joining CU Denver in 1999, she has taught

general microbiology, soil microbiology, and microbial ecology, led a research group studying applied environmental microbiology and ecosystem restoration, and co-directed the certificate and scholarship program Environmental Stewardship of Indigenous Lands.

**David C. Mays** is a professor of civil engineering at the University of Colorado Denver. He earned his bachelor's from the University of Pennsylvania, then worked at Teach for

America and Los Alamos National Laboratory before returning for his master's and doctorate from the University of California Berkeley. Since joining CU Denver in 2005, he has taught fluid mechanics, pipe design, and hydrology; led a research group studying flow and transport in porous media including filters, soils, and aquifers; and co-directed the certificate and scholarship program Environmental Stewardship of Indigenous Lands.