

Indigenous Ways of Learning STEM for All Multiplex Synthesis: October 2022

At the heart of Indigenous knowledge systems are notions of community and its concomitant survival; an understanding that lived experience is a very important form of knowledge (and subsequently informs theory); the importance of relationality, respect, and reciprocity; as well as recognition of the importance of place/space and land. In this paradigm, the survival of Indigenous community is more important than any individual. This is because individuals, through the continual process of self-discovery and selflessness, become whole; thereby ensuring community survival (Brayboy et al, 2012, p. 16).

"Ways of learning" include *why* someone is learning, *where* and *how* learning is situated, and most fundamentally, *who* it is that's doing the learning. The scholarship represented in the [October Theme of the Month](#), and presented by our expert panelists, brings insights about Indigenous ways of learning which have important implications for STEM learning for all communities, and add new dimensions to our understanding of the way that culture shapes learning across the generations.

These ways of learning, which can be seen as different facets of what has been characterized as "Learning by Observing and Pitching In to family and community endeavors" (LOPI; Rogoff & Mejía-Arauz, 2022; Rogoff et al., 2003), are radically different from the mainstream "grammar of schooling" (Tyack and Tobin 1994) which has dominated Western schooling. These other ways of learning are typical in many Indigenous learning settings, though not confined to them, and contrariwise, the "mainstream" or "Assembly Line Instruction (ALI)" model can also be found in Indigenous settings. As Rogoff and Mejía-Arauz (2022, p. 497) point out, "LOPI and ALI are not opposites; they are two ways of organizing learning among many others."

One reason we see for describing the coherent features of LOPI is that we see LOPI as one promising alternative paradigm that could be used more broadly in middle-class families, schools and other institutions where ALI prevails (Rogoff et al., 2001). We hope that articulating the coherent defining features of LOPI as a multifaceted paradigm could facilitate understanding of this way of learning and inspire systematic descriptions of other alternative paradigms for learning. (Rogoff and R. Mejía-Arauz 2022, p. 498-9)

The Expert Panel

[Dr. Barbara Rogoff](#), UCSC Foundation Distinguished Professor of Psychology at UC Santa Cruz facilitated the month's Theme and moderated the expert panel. The expert panelists included [Dr. Zoe Higheagle Strong](#), a citizen of the Nez Perce tribe who is Vice Provost for the Native American relations and tribal liaison to the President and is Associate Professor in educational psychology at Washington State University; [Dr. Tiffany Smith](#), a citizen of the Cherokee Nation of Oklahoma, and a descendant of the Muskogee Nation, who is the Director of Research at AISES with research focused on Indigenous students and professionals in STEM disciplines; [Dr. Nuria Jaumot-Pascual](#), an immigrant and a Research Scientist at TERC, a nonprofit in Cambridge, Massachusetts; and [Andrew Dayton](#), a citizen of Cherokee

Nation, and a Ph.D. candidate in Developmental Psychology at the University of California Santa Cruz. ([See full bios.](#))

In introducing the webinar, Barbara Rogoff elaborated on how the LOPI framework construes learning:

In LOPI, learning is understood to be a process of growth, a process of becoming responsible community minded contributors. To learn, people observe and pitch in within the ongoing activities of the community. And they're also guided by other people and by community expectations that everyone contributes.

Giving Back to the Community as a Motivation for Learning

Nuria Jaumot-Pascual and Tiffany Smith spoke to the importance of giving back to the community, of being able to contribute to the good of the community as a motivation for learning. They reported that in one part of their research, more than 80% of respondents considered giving back to their communities to be an activity that supported their persistence in STEM (Page-Reeves et al, 2019; Silva et al., 2021). Participants thought it was important to share their STEM knowledge with communities and to solve specific problems within Native communities. They saw their education in STEM as a conduit to help strengthen their families and Native communities, and they talked about different types of giving back, such as protecting the community and natural resources, increasing the visibility of Native scientists, mentoring, and opening the door to STEM for other Native people. Tiffany commented,

As a Native person myself, this is of no surprise that wanting to live in reciprocity and responsibility and giving back to our communities is a large motivator and indicator of continued learning in these fields.

Within STEM fields, Nuria said,

What we see is that the way that people bring their ways of knowing is trying to see both Western knowledges at the same level as Indigenous knowledges and bring them into their work. They try to do work that benefits their communities such as, specifically in computing, we had examples that had to do with preserving Native languages and improving cybersecurity for their tribe's website.

Fluid Collaboration: Where and How Learning Happens

Learning by observation and pitching in is situated in purposeful activity — community problem solving, home or community activities, investigations in the science classroom, scientific research projects. The group of participants has many of the characteristics of a community of practice (Lave and Wenger 1991): people with various levels of expertise with the relevant practices, some shared history and also shared vision for the outcome, and the assumption that learning is reflected in changes in how one participates.

Andrew Dayton introduced research on the ways that these situated activities are organized in Indigenous communities. The research, which is taking place in a variety of contexts, from early childhood to adult participation, has identified patterns of collaboration and activity regulation that has been called *fluid collaboration* (Alcala et al. 2018, Mejía Arauz et al, 2007). This way of working and being together is shaped by an understanding that the individual is not separate from the community, and indeed that one intention of all shared activities is community harmony.

These assumptions about the individual-in-community result in a kind of collaboration that differs in significant ways from what is usually understood as collaboration. Andrew said,

Many people when they hear about collaboration, they're really thinking it's negotiation, some form of dividing up the roles and dividing up the tasks, so that everything is either balanced or that the task gets done. The Indigenous approach to collaboration involves including everybody together in the shared direction of the group. So, we argue that for folks in Indigenous families and communities and in certain settings, the goal of the group is often to maintain the harmony of the group, as or possibly above the stated explicit goal of the task.

This is characterized by "mutual and fluid negotiation of responsibilities and consensus-based decision making" which is manifested in a horizontal organization of activity and exchange of expertise (Rogoff et al. 2003) in contrast to the more hierarchical structuring to which most of Western culture is accustomed, with its emphasis on clear divisions of labor and role definitions for the accomplishment of a pre-agreed goal.

Intergenerational Sharing and Identity Work

A respect for Indigenous ways of learning includes an informed awareness of the identity work that Indigenous learners are doing, as they encounter STEM or Social Studies, or Language Arts curriculum developed on the assumptions of the dominant culture. People engage in their local communities and are part of a "figured world" where their activities are structured by the myriad forces that shape their self-understanding (Holland et al. 1998). Identities, formed in the process of making sense of local experience and local knowledge, can come into conflict with dominant norms in education, and in STEM fields, as well. A lack of educator awareness about this dimension of diversity within their community, and its educational potential, impoverishes STEM learning to the detriment of all learners, but especially those from Indigenous communities.

The intergenerational nature of Indigenous learning was the focus of Zoe Higheagle Strong's contribution to the expert panel. Her project highlights the importance of learning from elders, as well as the essential value of inclusion of the next generation, and their learning for the continuation of the community itself: "content learning" is integrally connected to the need to preserve the people's language and culture. "It's about survival. It makes me take my role more seriously as a researcher and an educator." This is true especially since the dominant culture's educational system has — often by intent — inflicted damage, even extinction, upon many Indigenous cultures and languages (in the USA, but also in other countries around the world). The Federal Indian Boarding School system is one of the most heinous ways this damage has been perpetrated, but mainstream education continues to have the effect of separating the learner from the community and inhibiting or preventing the intergenerational learning that keeps a culture alive and thriving. Zoe said,

The work we do, it's heart work. And I often have to think about that, that when you look about the boarding school experiences and how that's still is really evident within the learning with students currently. We have to really take care of people's hearts, and also work on projects that do think about tribal communities and how can we sustain the culture, protect the culture, really allow tribal sovereignty to lead our projects and how we go about this work?

Nuria commented on how collaboration with Indigenous researchers has led to the use of more culturally sustaining and decolonizing research methods (Smith, 1999) — since typical research methods are shaped by the assumptions of the dominant culture, and can therefore not be suitable, or even effectual, in exploring Indigenous community practices and ways of knowing:

For us, what has been really important is being able to collaborate with Native researchers, so that we create spaces where there isn't a continuation of those colonizing practices for research that are so common. So, we take very seriously being taught new ways of doing research, new ways for those of us who are not Native, and we try to learn those new ways and sometimes it might be things as basic as the language we use to refer to things.

Nuria noted that by using culturally relevant methods like photo elicitation (Minthorn & Marsh, 2016) that center participants' voices, we have access to stories that otherwise may not have surfaced with research methods that stem from the dominant culture.

As another concrete example, she described how images created by participants are powerful tools for elicitation of conversation with study participants:

We use photo elicitation and other kinds of artwork. So, we have those images and then the captions or snippets of conversation that go together with those images and the combinations are really powerful... It creates a relationship with the participant that sometimes it's startling how quickly the conversation goes into depth.

Responsibility and Reciprocal Accountability

The expert panelists provided insight into developing authentic and respectful relationships with Indigenous people as collaborators. Andrew stressed that,

What we can do is we can be mindful of the long-term commitment that we make either to our team or to our research participants or to the communities in which we work and bring our best heart to that work. ... What we have to do is to remain cognizant of some of the relational commitment that we make. Not only to the people that we learn from within the community or within the school setting, but also to the people that came before us and the people that we're working with now.

Andrew also highlighted two key assumptions about the relationship between humans and the community, and humans and the world, that are articulated in the dominant culture only by some radical streams of thought (e.g., Emerson 1836, Naesse 1989, Dewey and Bentley 1949):

...there's only one living system, living things can't be divided from other living things. The earth only has one living system.... we are ourselves, not separate from our phenomena of interest, from the context in which the so-called phenomena exists.

Non-Indigenous researchers who want to study Native ways of learning should work with Indigenous partners — scholars, teachers, school children, community members — in such a way that the health and reality of the relationship is respected and sustained. Zoe added,

I want to practically be able to have regular engagement with the tribal communities that I research or work with, and ask myself: "Do I want to work in this community long term?" Because once you go there, it should be a kind of life lifelong relationship.

Conclusion

The research on Indigenous ways of knowing has identified and theorized distinctive ways that communities organize learning as a sociocultural process. This conceptual lens is in turn enabling educators to recognize how practices for research and evaluation, as well as pedagogy and curriculum

design, can be shaped by these ways of learning. A deepening understanding of Indigenous ways of learning promises important benefits to STEM education and to the STEM fields:

- It can encourage and sustain Indigenous communities, including STEM students and researchers, by articulating Indigenous learning practices and cultural resources in a way that recognizes their validity and importance alongside other ways of knowing that are well established in mainstream discourse, practice, and policy. (Rogoff and Mejía-Arauz 2022)
- It can enhance learning for students and teachers of all backgrounds. (Rogoff et al. 2003)
- It can enrich STEM practices by bringing in the diverse perspectives that Indigenous scholars can contribute, because science thrives on the diversity that stimulates new ideas, new problems, new methods. (Medin and Bang 2014)
- It can deepen our understanding of learning, cognition, and practice as encultured human activities within and across cultures. (Scribner and Cole 1994)
- It can help institutions learn how to be more welcoming to Indigenous students by implementing practices that support their ways of learning, such as providing practical opportunities to implement the STEM skills they are learning in the context of helping their communities. (Ong et al., 2022)

Recommendations for Researchers

Researchers on LOPI have proposed that this way of organizing learning can be found in most communities, including communities of practice. Yet they also note that Indigenous cultures reflect fundamental conceptions of the integration of the individual and the community, and the individual and the world, that are not shared in dominant epistemologies. Where pedagogical and assessment practices reflect these assumptions, what cognitive and affective results are seen in learners? In what ways do these practices challenge or reinforce learning and teaching based on mainstream assumptions about learning and about knowledge construction?

Recommendations for Teacher Leaders, Policymakers, and Administrators

Teacher leaders, policymakers, and administrators can take intentional steps to become acquainted with the research on Indigenous ways of knowing — the resources and references collected for Theme of the Month provide a good starting place. They can make such materials available for study groups or other learning experiences within the school and district, to encourage wider knowledge of this approach.

They can also examine the cultural diversity present in their own community and schools, to understand where Indigenous ways of learning may already be part of their students' funds of knowledge (Gonzalez et al. 2006) and learn how such resources can enhance how STEM subjects are learned and taught.

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Written
by: Brian
Drayton,
Co-Director for the
Center for School
Reform at TERC.



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