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Native Philosophies as the Basis for Secondary Science Curriculum

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Abstract

The Western approach to teaching science can create barriers for Native American students because it is often in opposition to Native philosophies of thought and worldviewIf we taught science through a curriculum based on Native philosophies, would we be able to minimize barriers and make it more accessible and appealing? By focusing on concepts such as relatedness, TEK, place, indigenous realism, and pluralism found in Native philosophies, epistemologies, and ontologies we could make science more aligned with Native students interests and priorities, thus increasing the number of Native American students choosing to take science courses and study a Science, Technology, Engineering, and Mathematics (STEM) field in college. While it may seem paradoxical to put Western science together with Native philosophies to construct a science curriculum, if we approach the challenge from a Native perspective perhaps it is not. By creating a curriculum and environment that represents Native science and Native students, it is possible to encourage more Native students to take STEM courses and follow STEM career paths who can then help us change the goals of STEM, improving STEM and science for Native students, and all students.

Keywords: Native Science, STEM, Native philosophy, Traditional Ecological Knowledge

Introduction

Native students face barriers when enrolling in and experiencing Science, Technology, Engineering, and Mathematics (STEM) courses in middle and high school. Many of these barriers are created by the philosophy behind the pedagogy and curriculum of science and math courses. While there are multiple theories as to the reasons for this, one prime argument, and the one I choose to focus on, is the fact that Native students find barriers to engaging with the science curriculum taught in our middle and high schools because it is often dismissive of, and in opposition to, Native philosophies of thought and worldviews. Native knowledges and ways of knowing are often treated with disdain and disparaged at best, but more often openly met with derision in the context of Western learning environments. In order for science education to be accessible and inviting to Native students, we need to adapt, replace, or transition our science pedagogy and curriculum to better serve these students.

The current system of education in the United States is not adequately serving our Native students, giving us an obligation to modify or replace the current Western-based curriculum to better represent these students, and so that these students are better represented in STEM fields at the university and professional levels. If, instead of teaching science to secondary students in the conventional Western way, we taught science through a curriculum based on Native philosophies, would we be able to make it more accessible and appealing to Native students? What if we took a Native worldview and taught science to secondary students with that worldview as a basis for curriculum and focused on concepts such as relatedness, Traditional Ecological Knowledge (TEK), place, indigenous realism, and pluralism? Might we increase the number of Native American students that then choose to take more science courses and study a STEM field in college? If we change science pedagogy so that Native philosophies are the starting point for the science curriculum Native students experience, will Native students therefore have better experiences and outcomes with science?

In order to accomplish this paradigm shift, we must recognize that STEM in its current form is assimilationist and a project of colonization. Programs that simply attempt to attract and retain Native students into STEM courses and fields are part of the ongoing process of colonization. Native peoples are brilliant at recognizing this, and resist in multiple ways. If we are going to bring more Native students into STEM, we need to change STEM, we need to attempt to decolonize it, and we need to make "a strong commitment to educating students in not just *culturally appropriate* ways, but *culturally inherent* ways" (Simpson, 2002, p. 17). To base a STEM curriculum and pedagogy in Native science and Native philosophies is a move toward decolonization and self-determination.

Barriers for Native students in Western science education

There are a number of significant barriers that Native students face in their STEM middle and high school careers. These classes are based on the Western conception of science and rarely include an indigenous perspective, let alone teach with curriculum based upon Native philosophies and worldviews. This Western conception of science does not recognize the values inherent in science, and that those doing the science invariably bring cultural standards with them, and promotes itself as objective and value-neutral. Students also face cultural erasure in schools and STEM classrooms. In traditional Western secondary science education curriculum, there is little to no use of TEK and/or place as a way of centering knowledge, of the concept of

relatedness among all things, of the possibility of pluralities, or of contemporary Native identities, all of which are critical for Native students to be interested and successful in their studies.

In Western science, and Western science education, the general consensus is that there is one correct, objective way to "do science." This conception of science ignores the embedded cultural aspects that are present in science, in schools, in curriculum, in teachers and students, and in STEM courses. Medin & Bang (2014) "see the culture of science and the science of culture as closely intertwined, as two sides of the same coin" (p. 5). For Native students who have learned at home that science is part of everyday life and that culture influences values and those values translate into learning, going to school and being taught that science is "objective" can create a sense of disconnection between home and school. Disconnect between home learning and school learning is a barrier for these students in STEM classes"Given that science instruction is seldom recognized as a set of cultural practices, many Native students may perceive a sharp divide between everyday practices and what takes place in school" (Medin & Bang, 2014, p. 183), highlighting one way in which STEM classes can become problematic for Native students who may feel alienated in Western science courses. If school knowledge is so vastly different from home knowledge, and in fact is dismissive of home knowledge, then how can we expect students to be interested and invested in STEM courses?

Whitt (2009) writes that "the ideology of western science, wedded as it is to the thesis of value-neutrality, insists that issues of power do not enter into knowledge making or shape the dynamics of knowledge systems" (p. 219). In contrast to a view of Western science as value neutral, scientists don't leave their values, belief systems, and world-views behind them when they ask, research, and answer scientific questions. These values and belief systems influence the questions that become feasible to ask, as well as the possible and impossible ways to answer those questions. This then causes questions to be both asked as well as answered in particular ways by those scientists who come from a Western background, and to be potentially regarded in a different way by those from a Native background. Conceivable questions, and answers, as well as ways to get to those answers become relevant to Native students when we take science into the classroom. "We have documented cultural differences in epistemological orientations and, on our view, they should affect science learning, precisely because science is necessarily taught from an epistemological orientation, and a culturally infused one at that" (Medin & Bang, 2014, p. 180). Science is not value free, neither Western science nor Native science, and our Native students recognize this. How science, and science education, gets done is a reflection upon who is doing it, and is in no way value neutral or objective. It is one of the disparities and barriers Native students face when encountering a science course that is based in a pedagogy and curriculum that comes from Western philosophy.

Western science and STEM courses are most often conducted as an individualistic endeavor, rather than by and for a community. This in contradiction to the way that Native people do, and think about, science. Medin & Bang (2014) tell us that Native science is "a cooperative enterprise drawing on many different approaches and strategies. Each science-related activity embodies perspectives and values" (p. 233). While there are times in STEM courses that work is done cooperatively, it is not the norm and the product required is usually individual. In addition to the work being singular, the focus in Western STEM courses is on the human, and for the benefit of humans, usually Western and white humans, at the expense of other beings. As Bang and Marin (2015) tell us, "dominant constructs of nature-culture relations have typically positioned humans as distinct from and a part from the natural world" (p. 531).

Native students can find this to be a barrier as they are used to working together with those in their family and community toward a goal that is for everyone, not just for the individual, and for the good of all in the community which includes Mother Earth and their nonhuman relatives

Another barrier Native students face both in science courses as well as school in general is their cultural erasure in most curriculums found in schools in the United States. It is valuable to interrogate curriculum in respect to its bias toward the dominant culture and perpetuation of colonial practices, and to think about how this can be changed, how the curriculum can be decolonized and decolonizing. This privileging of the dominant culture is prevalent and pervasive in science curriculum, just as in other subject areas, and arguably more so in STEM. The prevailing curriculum in schools is responsible for the continuation of colonial practices and colonial outcomes. Tupper and Cappello (2008) write about the fact that "the role of schools has helped to ensure that Aboriginal ontologies and epistemologies are never part of the mainstream" (p. 562) and that "curriculum is itself a 'white box,' created by and for the dominant group to solidify and sustain privilege" (p. 562). The current pedagogy and curriculum in practice in schools and science classrooms continues to marginalize and colonize Native students. Decolonizing the curriculum may very well mean completely starting over, and starting from a Native worldview and philosophy of thought

According to Tupper and Cappello (2008) "at a simplistic level, curriculum documents privilege certain content over others: some material gets included and other material gets left out" (p. 566). I argue that some epistemologies and ontologies also get privileged while others get left out. What is currently being left out are the Native epistemologies and ontologies, and this is causing a lack of interest in, and a barrier for, Native students in STEM courses. We need to look at our curriculum and realize that teaching science from the Western perspective is harmful to our Native students' identities (and probably all students, though they are not my current focus)Tupper and Cappello (2008) make it clear that:

> Curriculum and the ways in which teachers enact curricular documents are implicated in the tacit and overt reproduction of dominant cultural norms: attitudes are shaped, knowledge is sanctioned or castigated, relationships to knowledge are formed or deformed, access to cultural capital is given or denied (or both) across the boundaries and intersection of the multiple identities in which students are located. (p. 567)

In light of these issues, changing our science curriculum so that it is based in Native philosophies and rooted in TEK and place can be an effective way to actively engage Native students in science classrooms while affirming their identities and making connections to their learning at home and in their communities. While this may seem to be a daunting task, and knowing where to begin can seem overwhelming, there are brilliant Native scholars who provide us a direction and a place to start.

What is Native Science?

I would like to acknowledge that I use the terms "Native philosophy" and "Native science" as if they are each a finite entity, and this is problematic as there are many different Native philosophies and ways of knowing. People from various traditions would tell you that they are quite distinct from one another. However, I need a way to write, think, and talk about these concepts as they differ from the Western conception of STEM. I will continue to use the terms,

at least for now, as there are Native scholars much more knowledgeable and experienced than myself, such as Daniel Wildcat, Vine Deloria Jr., Gregory Cajete, and Megan Bang, who have also done thisBut it does lead to an important question: What is Native science?

When thinking, talking, and writing about Native science, I believe that we should begin with Traditional Ecological Knowledge (TEK). TEK gives us a place to begin to answer the question of what exactly Native science is and how and why we should teach it and teach with itTEK has many different definitions, dimensions, knowledges, concepts, and conceptions. There are, however, commonalities that occur within many of these traditions that we can use to help define TEK and Native science. Most Native scientists and philosophers agree that TEK originates within and from a particular place, the land and place have taught the people indigenous to that particular region over many generations, and that TEK is the basis for indigenous peoples languages, cultures, and worldviews. I particularly appreciate Linda Tuhiwai Smith's (2012) summation when she writes that TEK is "indigenous entities—environments, bodies, stem cell lines, identities, historical and contemporary practices, lores, laws, values and belief systems, knowledge frameworks, ways of thinking and knowing, products and creations, concepts, designs and materials, images and representations, songs, a performance, visual arts – and all the other diverse parts of whole living cultures" (p. 221). TEK can often be thought to include items found in nature such as plants, animals, medicines, and the knowledge associated with how to find and use these, as well as knowledge for survival. Smith deepens our understanding by extending TEK to include cultural artifacts, epistemologies, ontologies, and cosmologies. This is critical to thinking about TEK as the base for Native science because it helps us understand that Native science includes so much more than just the items found in the natural world and our understanding of how they work and how we can use them. Smith explicitly connects the natural world to culture and ways of knowing.

Kyle Whyte (2013) argues for TEK as a collaborative concept that "serves to invite diverse populations to continually learn from one another about how each approaches the very questions of "knowledge" in the first place, and how these different approaches can work together to better steward and manage the environment and natural resources" (p. 2). This concept works quite well when we think about schools, teaching and learning, and STEM courses. Whyte's suggestion seems to me to be the essence of what STEM courses should be. Having a collaborative concept, where teachers and students can learn from and with each other creates an environment where multiple knowledges and worldviews can coexist, thrive, and improve everyone's understandings and circumstances

In much indigenous teaching and learning, and in virtually all TEK, place plays an essential role. In contrast to Western knowledge traditions, indigenous worldviews start with the assumption that all things are connected and related. Wildcat (2009) writes that knowing reality "requires respect for the relationships and relatives that constitute the complex web of life," (p. 9) a concept which he calls "indigenous realism." The place in which one lives provides the connectedness of all things, the relationships between all things, and therefore place gives us a base for teaching about the natural world in the context of science curriculum in secondary education. Bang and Marin (2015) offer that science education is an important area in which nature-culture relations are described, broadened, and limited. How place can teach us, what place can teach us, and why we should learn from the place in which we live is remarkably worthwhile in a science curriculum, and noticeably absent from Western science curriculum. Teaching that Indigenous communities and their knowledge systems position nature-culture

relations as intertwined and reciprocal, teaching from a place that assumes the interconnectedness and relatedness of all, and using this concept as the base for our curriculum, we can connect our Native students much more solidly with the place in which they live, the science curriculum they learn within, and their culture

In his book *Look to the Mountain*, Gregory Cajete (1994) discusses Native ways of, and perspectives on, teaching and learning. Native education traditionally happens in a very social context that emphasizes the importance of the individual to the group. He explains that

> It was an educational process that unfolded through mutual, reciprocal relationships between one's social group and the natural world. This relationship involved all dimensions of one's being, while providing both personal development and technical skills through participation in community life. It was essentially a communally integrated expression of environmental education(p. 26)

We can see the way that Western science education assumes students as individuals who objectively study unconnected phenomena is in direct contradiction to this belief of connectedness and responsibility to community and social group. Teaching science based on Native philosophies requires us to ground our pedagogy and curriculum in a sense of relatedness and reciprocity to and with all living beings. In a Native world-view this will include a broader acceptance of what counts as a living being, and should be based on TEK and traditional teachingsIn a science curriculum based on Native philosophies, the focus must be brought back to connections and the relatedness of all beings, as well as include an expanded understanding of who counts as a member of the community. Native philosophies tell us to understand ecosystems as webs of related beings/persons that all need to be respected, listened to, and understood. As Wildcat (2009) tells us "indigenous knowledges offer insights into living well on Mother Earth because they are fundamentally cooperative and collaborative constructions" (p. 77). Science education according to this approach would be for the benefit of all persons in the ecosystem, rather than just the humans, specifically the Western white humans. This is much more closely aligned with the teaching and learning that Native students experience within their communities and tribes, and could make the transition to college STEM courses more engaging and appealing.

Indigenous knowledge systems allow for an epistemological pluralism and knowing the world through diverse perspectives, including that of non-human persons. These systems allow for a recognition that there are many ways of knowing and being in the world, and that differing epistemologies and ontologies should be respected even if not subscribed to. Access to other ways of knowing can only be received because they are shared by other beings, and usually by non-human beings or persons. Indigenous knowledge systems are also integrated with experience and imagination, allowing for a connection with the perspectives of other beings, even those much different from us. Whitt (2009) writes that "knowledge within indigenous knowledge systems is always knowledge of relations" (p. 38). Therefore, "construing knowledge as relatedness, as a matter of appreciating how we are bound to other entities and processes, makes integration with them possible, desirable, and necessary for survival" (p. 38). Not only should multiple ways of knowing be respected, learning about and with them is beneficial and vitalOne way to bring experience and imagination to the community and the classroom is through stories, which are a common tool within Native ways of knowing, learning, and teachingStories could easily be integrated into the science classroom to assist with starting and keeping relationships with those different from us, to understand the contrasting perspectives of others, and to relate empirical knowledge of the relationships that connect us to the world and to one another. This

type of knowledge is both bound to the land and specific places, as well as to a time, and will be different for each tribe and/or community.

Teaching with Both

One might ask how we can put Western science together with Native philosophies and come up with a science curriculum. This may seem, at first glance, to be paradoxicalSome will ask if this is what we should do, and perhaps they have a good point. However, if we approach the question from a Native perspective, the two are not so incompatible. "Science is pluralistic. By this we mean that alternative theoretical perspectives within the same domain or scope of inquiry may each yield useful insights, depending on the questions of interest and the goals and values in play" (Medin & Bang, 2014, p. 234). By looking at science education through this pluralistic lens, we can envision multiple ways of "doing" science, of learning about the world, and of teaching science, that although different are nevertheless valid and informative in multiple ways. We can also privilege the Native science for Native students, rather than diminishing its value and worth we can promote its beauty and integrity, as well as legitimize the value, identities, and worth of the students that bring these knowledges and worldviews.

Gregory Cajete advocates for what Luther Standing Bear called being "doubly educated", that is, having Native students know their traditional tribal ways and knowledges and also learn the Western science paradigm. Science curriculum should be based on cultural and traditional values, and be contemporary and relevant for the here and now. TEK and Native science and philosophies support both of these goals. In conjunction with this type of Native philosophy based education, a Western science paradigm should be taught, seeking out the most appropriate pieces of the Western offerings. Cajete writes that Native education is based in basics of human nature, and should include aspects of relationship with the environment, tribal community, traditions, and more. In his own words, "the study of science from American Indian perspectives can provide invaluable bridges for cross-cultural learning and understanding" (Cajete, 1994, p. 197), and because the barriers our Native students currently face include the philosophical basis for curriculum, how curriculum is presented, lack of cultural sensitivity and recognition, and the Western view of science as objective, reaching out to a Native way of thinking could help build the bridges that Western science has not yet seen as necessary or desirable.

Traditional notions of Western science typically prescribe a very narrow and humanistic perspective, in other words, one right way of objectively "doing science." The Native view, on the other hand, is much broader and allows for a pluralism in ways of knowing. Scholars of curriculum and science education could certainly use Western science, but inserted into the larger context of Native epistemologies, ontologies, and philosophies. This would mean teaching with a Native science first, in contrast to what is currently happening. It also means examining the power of the dominant science paradigm currently in place, and changing the dynamics of who has power in the classroom. Part of the way we do this is by recognizing that Native science, TEK, and Native ways of knowing the world and the knowledge gained in that process, should be given priority when teaching Native students science. Native students would first enter into science by understanding and reaffirming knowledge gained through TEK and Native ways of learning about and knowing nature. Doing so would be a natural extension of the world, their culture, and the knowledge gained through it, in which these students already exist. Western science would be brought in occasionally at first, then more often as the students get older and learn more, as well as are more entrenched in their Native identities, to show the connections

between the two, as well as to show another perspective. Doing so would support Native students finding Western science accessible as well as valuable, within the context of Native philosophies and science, and could provide a groundwork and linkage for students to continue to learn about Western science. If Native students begin with a Native science curriculum based on Native philosophies, and then can add in Western science paradigms to their already existing knowledge base, they will be more likely to find science applicable to them and their own lives as well as their families and communities.

Daniel Wildcat (2009) introduces us to the concept of "indigenous realism" which tells us that knowing reality "requires respect for the relationships and relatives that constitute the complex web of life" (p. 9) and the implication is that we have responsibilities as well as rights in our interactions and daily lives. We have obligations to our Native students, our communities, to the places we live, and to the relations we share our place with. Along with concepts of pluralism and the relatedness of all things, indigenous realism can be a portion of the basis for a science curriculum that is open and accessible to Native students and that honors our responsibilities. Cajete embraces the concept that Native science is a way of understanding and experiencing the natural world, which is, in some ways, similar to the Western perception of science. Cajete and Wildcat both make it clear that within Native understandings, the world and all its creatures are connected and related, including humans, and these relationships imply a responsibility to one another. If we are to set up our science curriculum based on Native philosophies, we must start with the process being non-linear and focused on the connections between, and the relatedness of, all beings.

Brayboy & Castagno (2008) call for a revisioning of the goals of science education to "encourage students to learn both Aboriginal and Western science and technology in a way that empowers them to make everyday choices between (1) participating in a First Nations cultural setting, and (2) participating in a dominant cultural setting" (p. 740). Indigenous students should be empowered to learn both Native science and Western science, while at the same time science learning must "facilitate the learning of the culture of science without also facilitating the assimilation of students into that culture" (Brayboy & Castagno, 2008, p. 741). Native students need the opportunity to learn science in the traditional ways of their own culture, while at the same time learning Western STEM as they live in a society where that knowledge is also valuable. Native students should have an open and welcoming opportunity to be doubly-educated, to learn Western science without being pressured to assimilate exclusively, or even primarily, into that way of knowing, thinking, and being. In our current society, this gives our Native students a stronger ability to be, and help their communities be, self-determining.

Examples of Native education

Deloria and Wildcat (2001) write that "modern science tends to use two kinds of questions to examine the world: (1) "How does it work?" and (2) "What use is it?" (p. 63). They also suggest that in an indigenous way of thinking another question would always be involved in the knowledge process. To the previous two they add: "What does it mean?" I believe we can and should add another question: Why does it matter? If we used these four questions as a basis for science curriculum at the secondary level, perhaps more Native students would be interested in taking science courses and exploring a STEM degree at the college level. These questions can give a starting place for what Native science education might look like.

Bang and Marin (2015) tell us that "while settled expectations of nature-culture relations act as restrictive structural principles in unfolding activity, we suggest critical engagement with cultural practices and pedagogical forms can cultivate expansive forms of time-space ontologies and thus expand nature-culture relations in learning" (p. 531). With a little unpacking, this gives us a way to use TEK, place and land as a way to teach and learn science, by thinking of the place and land as a teacher, and by thinking of Native peoples as the contemporary folks they are. There are many other Native philosophers who also write about using place and TEK as an example of teaching Native science. Wildcat (2009) provides ways to think about place and land as a base for curriculum in that "Indigenous knowledges are grounded in the human realization that the life that surrounds us can teach us valuable lifeway lessons, if we pay attention to our relationships and interactions with the land, air, water, and other-than-human living beings" (p. 74). With this bit of philosophy in mind, the idea that the place and land that we inhabit can teach us science, the question then becomes how to do this in a class. Bang and Marin (2015) offer a few beginning ideas:

> Through our analysis of practices, two important pedagogical forms emerged: (1) remediating time-space constructions through naming places, often through the use of Indigenous languages as well as English and (2) constructing non-humans as agentic place makers. We suggest that through the use of these pedagogical forms (Indigenous language, attentional directives, interrogatives, etc.) time-space constructions were (re) mediated and made Indigenous ontologies and epistemologies present. In addition, structures were transformed through repeated use of and reflection upon these pedagogical forms. We argue that the process of structuration through the use of pedagogical forms transformed the potential identities and forms of agency available to Indigenous youth. (p. 536)

One way to begin using a Native philosophy in teaching science to our Native students is to use Native place names, to learn on and with the land, and to allow for the reality and recognition that non-humans are living and have agency. Using place names that come from the land and that the people indigenous to that land have learned and passed down over many generations is one specific example of teaching Native science, and teaching with Native scienceGuiding students to know and use place names requires a teacher that knows the names and legends, such as an elder in the community. Stories almost always accompany place names, and there is much wisdom and knowledge to be found in the stories and legends. In her book *Anakú Iwachá,* Virginia Beavert writes Yakama legends for her people. These legends and stories tell about culture, the land and place including names, and the knowledge given to the people by the land and other beings residing there. These legends use the local place, local names, and the local beings as well as the relationships between them, to teach in a traditional way.

The lore of educators is going to be crucial to this project of basing science education on Native philosophies. We will have to look beyond the typical Western version of "educator" or "teacher." Looking to those with traditional knowledge, such as elders in the tribal communities, parents, grandparents, teachers, and to the students themselves is critical to success. Keeping open the possibility that the land itself and the non-human persons that live in and with the land, are also teachers will continue to be important. One potential way to do this is to use community-based design research to identify how science curriculum based on Native philosophies can best be implemented in contemporary classrooms in different communities and regions. This will be unique to each place and each community, and will not be an easy or quick process. Bang and

Marin (2015) argue “that community-based design research, as well as studies of everyday learning interactions, may be ways to disrupt settled expectations, recognize Indigenous presence and futures and enable robust exploration of possible socio-ecological futures” (p. 533-534). If we can combine the knowledge and insights of entire communities to envision science curriculum based on Native philosophies and place, we can successfully implement this strategy and better serve our Native students

Angayuqaq Oscar Kawagley (2016) gives a very specific example of what Native science can look like, in his case he writes about the education and worldview, the TEK, of the Yupiaq people of Southwestern Alaska. Kawagley takes the importance of TEK and learning from/with a place and writes about how his people do that and why it is so necessary. “The importance of linking education to the physical and cultural environment in which students and schools are situated has special significance in Indigenous settings, where people have acquired a deep and abiding sense of place and relationship to the land in which they have lived for millennia” (Barnhardt & Kawagley, 2016, p. 19). He also addresses how culture and science are intertwined, why we should not be attempting to pull them apart, and what it looks like in Yupiaq culture to teach science and culture together. “In Yupiaq culture, science is not separated from daily lifeTheir science is interspersed with art, storytelling, hunting, and craftsmanship” (Kawagley, Norris-Tull & Norris-Tull, 1998, p. 137). Kawagley infuses this principle, that science is everyday life, into his conception of what science should be. This requires paying attention to culture, and in order to be effective we must “infuse indigenous knowledge and worldview into the curriculum” (Kawagley, Norris-Tull & Norris-Tull, 1998, p. 141). Strategies promoted by Kawagley for use in science education include “modeling and guided practice, and that cooperative learning, peer tutoring, and hands-on learning are essential strategies” (Kawagley, Norris-Tull & Norris-Tull, 1998, p. 137). These strategies could be used with all students to improve their experiences with learning in STEM, so that they can see their culture and their ways of knowing modeled by community members as well as teachers, so that they can feel their knowledge and they themselves are valued in their classrooms, and to support their identities as Native peoples, as students, and as learners of STEM.

Why Natives in STEM?

We need more Native people in STEM for a variety of reasons. To decolonize the current system, to further self-determination, to change the goals of science education, to make science and science education better, to recognize and broaden the values in our scientists and scienceWe need to improve access to STEM for Native students with the goal of changing STEM education. This must be done carefully, while attempting to remain cognizant of honoring cultural knowledge without appropriation. It also requires consulting with elders, tribal members and holders of TEK and only moving forward as they see fit and when they feel it is appropriateWhile it may well be impossible to get agreement from all stakeholders at all times, science education for Native students needs to be done with and by Native peoples.

I have nothing against Western science, and in fact hold a degree in science from a university and think Western science is useful and should be incorporated into science courses for Native students. However, Western science subscribes to a very narrow view that constricts the knowledge, and the ways of knowing, students have access to. Using the Western paradigm is one way to “do” science, but it limits what we can learn and know, and it creates barriers for students that come from cultures whose epistemologies do not match with the dominant culture’s

ways of knowing. Western science is worthwhile, it is worth learning and knowing. It is simply not the *only* worthwhile way of learning about the world, and for Native students should not be the first way of learning about the world

The Western world-view sets humans apart from and above nature, and this influences the questions asked in/of science, as well as the answers that become possible and acceptedNative world-views put humans as part of the natural ecosystem, which produces a different set of questions and potential answers. The inclusion of researchers from different backgrounds can provide new perspectives in science, can lead to better science, and in addition can lead to better science education. In order to have scientists and researchers from different backgrounds, and importantly from backgrounds which value nature, human connection to and reciprocity with nature including other-than-human beings, we must remove the barriers Native students encounter with STEM courses, as well as support Native students interested in taking science courses and majoring in STEM degrees. This should start in middle and high school, if not earlier, hence the importance of modifying or replacing the current science curriculum taught to Native students, and the pedagogy behind that curriculum

In the state of Oregon, there are nine federally recognized tribes. These tribes, like others all across the US, employ Natural Resource professionals to help manage their land and resources. In the next ten years, a significant number of these mostly white professionals will be retiring. Replacing these professional positions with tribal members would be ideal. Tribal members have a strong connection to their people, reservation, communities, and resources and could have a large impact on land and resource use for the next generation, and many more generations into the future. This could create the conditions for greater self-determination for tribal communities. While the validity of the need for a college degree for indigenous peoples to care for the land could be argued, in our current society, the tribal members need to have a background in a science field, most likely a Bachelor of Science in a STEM field, in order to hold these jobs. We currently do not have enough Native students in our universities, especially working on STEM degrees, to make this happen. Perhaps by teaching science at the secondary level using Native philosophy as the basis for curriculum, we could change this and make a decolonizing move toward indigenous people controlling their land and resources even within the dominant Western culture.

By bringing Native peoples into STEM, by changing STEM education so that Native peoples are represented therein, we have the opportunity to change the way culture and science are considered by mainstream scientists and science educators. “We believe that one important factor in the underrepresentation of minorities in the sciences is that science education may recognize and value practices that white, middle-class scholars bring to the classroom, while ignoring or even overtly discouraging the science-related practices that other cultural groups bring to the classroom” (Medin & Bang, 2014, p. 240). Given this, science educators need to support the knowledge, orientations, and practices that students bring; we need to indigenize STEM and STEM education. For this to happen, we cannot ignore the history of colonization that continues to plague our schools, institutions, teachers, curriculum, and pedagogy. In the context of education, “few programs are designed to enable students to address the issues of colonization and colonialism in their communities, effect healing and decolonization at the individual, community and national levels, facilitate resistance strategies in response to current injustice, and promote the building of healthy, sustainable Aboriginal communities and Nations based on traditional cultural values and processes” (Simpson, 2002, p. 14). We need programs

and teachers that do address the issues that colonization has pressed upon our Native peoples, and that pay attention to the power and privilege inherent in the systems that we live, work, and teach in. “The historic (and often contemporary) relationship between Western science and Indigenous Peoples has been laden with racism, power imbalance, and oppressionAboriginal students need to be afforded the opportunity to express these experiences, seek validation, and heal from pain this has caused them” (Simpson, 2002, p. 22). We need to change STEM education so that it honors and benefits Native peoples, and we need Native peoples in STEM to make systemic changes that benefit all.

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