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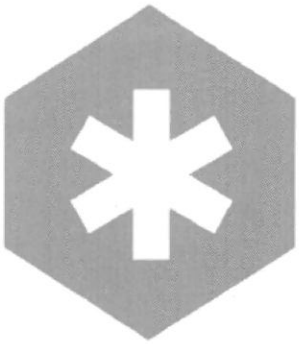

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Traditional Elders in Post-secondary STEM Education

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Abstract: Native/Aboriginal students are underrepresented in Western science, technology, engineering, and mathematics (STEM), due in part to perceived cultural irrelevance. Yet many Native people continue to engage in Indigenous science, such as through traditional medicine and food systems. Recently it was shown that Aboriginal university students are significant users of natural health products (NHP) and learn about NHP from Elders. Thus, in post-secondary educational settings, the presence of Elders may positively impact Native students' interest in science-related topics. At the First Nations University of Canada, partnering of STEM-trained faculty with Elders occurs in community-based research and education endeavours. This paper highlights these efforts, which include a traditional medicine room teaching laboratory. Medicine walks with Elders have been videotaped and used in live and online classes. Workshops have led to the development and publication of traditional foods and medicine booklets. A prairie medicine wheel garden on campus serves to reinforce Aboriginal values in the appreciation of native prairie plants. An evidence-based ethnomedicine course engages STEM-trained PhDs and Indigenous science Elders as co-educators in the online environment. In these applications, Elders share cultural knowledge to ensure relevance to Natives and to positively impact student interest in science. Future directions include a pedagogical experiment to determine the impact of Elders as educators upon post-secondary student interest in STEM. This ongoing work should facilitate a discourse regarding Aboriginal science education, and illuminates downstream policy implications regarding science literacy, Native retention in science, indigenous science, and the role of Elders in post-secondary STEM education.

Keywords: Aboriginal, Community-based, Indigenous Science, Native American, Pedagogy, STEM

Introduction

The workforce in science, technology, engineering and mathematics (STEM) is a fast growing sector in the U.S.A. (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline et al. 2011). Whilst underrepresented minorities comprise approximately 30% of the U.S. population, only approximately 10% of this subgroup is college-educated in STEM (Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline 2011). Underrepresented U.S. minorities may include: Women, African Americans, Latin Americans, and Native Americans. Native Americans are the least represented minority group in academia (National Science Board 2012), have the highest attrition rates amongst post-secondary students (Demmert and Towner 2003), and are poorly represented in STEM fields at all levels (Czujiko 2010; Aikenhead and Michell 2011).

In Canada 23% of non-aboriginal adults completed a university degree whilst only 8% of Aboriginal Canadians attained a degree (Canadian Council on Learning 2009). Academic performance amongst Natives improves when culturally relevant fields of study and/or culturally supportive networks are provided (Demmert and Towner 2003). Whilst science is generally not well received by Natives as a field of study (National Science Board 2012), reception improves when cultural relevance is clearly indicated and/or supported (Carroll and St. John 2010). In Canada, efforts are made at the provincial level to balance Eurocentric science and Indigenous science in school science (Aikenhead and Michell 2011).

Tribal Colleges and Universities (TCUs) were created in the 1970s to address such issues (NCELA 2011). The American Indian Higher Education Consortium (AIHEC) includes 37 TCUs located in the USA and Canada. Increasingly, STEM-related programs are offered and research is conducted at TCUs. Recently we surveyed students (n=963) at a mainstream

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university (University of Regina; UofR) and a TCU (First Nations University of Canada-Regina (FNUniv-Regina)), and found that Native/Aboriginal students learn information about natural health products from Elders, significantly more so than non-native students (Alkholy and Gendron 2013). Whilst this is likely not surprising to those within the Native culture, this is the first quantitative report of this information. Elders are respected in the Native community and often viewed as traditional educators for the younger generations.

At FNUniv, Elders have a prominent role in the fabric of the campus life. At each campus (Regina, Prince Albert, and Saskatoon) there is office space for the campus Elders, who interact with students, administrators, and faculty members. Elders serve as indigenous mentors and role models to students and facilitate learning and self-confidence by improving cultural contact (Aikenhead and Michell 2011). A key role of Elders in administrative interactions is de-colonization of the institutional practices and impacts. Interaction of Elders with faculty members is believed to facilitate the intersection of Native and non-native ways of acquiring knowledge in courses and other educational settings. Non-native instructors who foster a life-long learning approach to become students of the culture become more competent teachers of a community's Indigenous knowledge in the science classroom (Aikenhead and Michell 2011). At FNUniv-Regina, science faculty members and Elders have collaborated on many projects to facilitate the intersection of traditional knowledge and STEM.

In this paper we provide further information and discussion regarding the practical applications of the role of Elders in post-secondary science and traditional knowledge intersections successfully implemented at FNUniv. Specifically, the Medicine Room teaching laboratory, Medicine Walk videos, Traditional Food & Medicine booklets, Medicine Wheel prairie garden, and an online Ethnomedicine course with Elder co-educators will be highlighted. These endeavours have implications for future pedagogical research to be outlined.

Medicine Room Teaching Laboratory

Traditional knowledge, or Indigenous science, is not separate from the indigenous worldview, or from the indigenous experience (Snively and Corsiglia 2001). Indigenous science is considered more 'holistic' than WMS (western modern science; white man science) and less reductionist. It is contrary to the Native worldview to understand something without somehow being a part of it, without experiencing it (Aikenhead and Michell 2011). Understanding can come in many ways, and stories can provide a way to facilitate culturally relevant understanding. Efforts to 'improve retention/persistence' and 'reduce attrition' of Natives in science should not be an exercise in assimilation into the mainstream; rather it should be an effort to acknowledge the place of Indigenous science amongst the sciences of the world. More intrinsically, it should be an effort to honour the individual, family, and community within the context of a learning environment that generates a level of trust for an individual to be inquisitive regarding the wonders of their world. Problem solving can thus occur in a safe environment that is culturally supportive. Herein a student can develop self-confidence in a manner that allows answers to be revealed to the learner when the time is appropriate.

The traditional way of learning about plants and their medicinal uses is to spend time with Elders out in nature. As this is not always possible, the FNUniv faculty and Elders collaborated in the development of a Medicine Room (Gendron and McKim 2013). Native plants are variously displayed in this teaching laboratory. Students and community members are invited here to spend time with Elders, who share their knowledge about plants and their medicinal properties.

Thirty-seven species of plants were collected during the 2009 growing season under the guidance of an Elder. Most plants were collected before, during, and after flowering. This was done to illustrate what the plants look like at different life stages, and not just what they look like at the preferred time of harvest. In accordance with the Aboriginal protocol, the Elder made an

offering of tobacco and prayed before harvesting each plant. The plants were then dried in the shape that they are found in the prairie to facilitate their recognition. Each specimen is currently stored in a display case with a protective glass cover. We include labels with their names in Latin, English, and when possible, Cree, Nakway (Saulteaux), Nakota, Dakota, and Dene; these being the five most predominant tribal languages in Saskatchewan.

The First Nations University of Canada offers free workshops to university students, school groups, and community members. These visits are usually 45 minutes long and participants have the option of touring the university after their time with the Elder. Although the visits are free, the university offers an honorarium to the Elders. During these visits, an Elder shares his/her knowledge about the plants and their traditional uses. As protocol is an integral part of these visits, the Elders will pray and smudge themselves and the plants with sage before each visit. The Elders share their knowledge by telling stories, showing the displayed plants, and/or bringing fresh plant materials for sharing. At the end of the visit, we ask participants to fill out a survey about their experience. Results from the fall 2011 survey reveal that the participants appreciated learning about native plants and medicines (Gendron and McKim 2013). The survey results also reveal an appreciation by the participants for the opportunity to interact with Elders and to hear traditional stories.

Elders are respected culture bearers who encourage Native students to think and to disclose in a way that reinforces the development of Native identity, so important for confidence and learning. A common concern that arises in the Native student encountering the foreign educational system is reconciliation of the Native identity and the pursuit of the foreign path (Aikenhead and Michell 2011). When Native identity is deeply established, a holistic fortitude and clarity of mind allows the student to freely explore, and experience with internal consistency another worldview that might otherwise be rejected for being compartmentalized (not part of self) (Kirkness and Barnhardt 1991). It is equally important that mainstream students benefit from multicultural science education (Aikenhead and Michell 2011).

Traditional Elders who teach about plants do so in a cultural context; the context is traditional knowledge or Indigenous science. In teaching about a plant's use, for example, the stories told may reveal the traditional knowledge regarding the use of the plant for food and medicine, its role in ceremonies, and its kin affiliations. Inherent in this science education is spirituality (Doige 2003). Elders establish a safe learning environment through imparting their confidence, derived through long experience often passed across generations. From the Native perspective, this confidence derives from a strong identity that includes, or makes room for spirituality. Spirituality is central to Native identity (Kirkness and Barnhardt 1991), and thus central to Indigenous science. Spirituality is not something to be studied -or kept separate- from science, but rather needed for understanding and problem solving. A good teacher awakens the student to confidence in their place in their world, and in their ability to be curious and seek understanding of their world. In this environment, mutual respect prevails between the traditional teacher, mainstream teacher, student, and topic of interest. In this way, a multicultural exploration of science occurs with cultural support and encourages student responsibility through participation.

Medicine Walk Videos

During the harvest of plants for display in the Medicine Room, a series of five videos were filmed (Gendron 2013). The first four videos were filmed with Elder Betty McKenna (Anishinabe First Nation) in a native mixed grass prairie in Moose Jaw, SK, at different times throughout the growing season to illustrate how plants change during their growth. In these videos, Elder McKenna shows the audience the plants in their natural habitat and tells us about their spiritual and medicinal properties. She strongly emphasizes that it is important to follow the

proper protocol when harvesting plants. In the fifth video, Elder Walter Lavallee (Piapot First Nation) shares with us the importance and the meaning of giving tobacco to the Creator.

The best way to learn about traditional knowledge is by spending time with Elders and attending ceremonies. Unfortunately, this is not always possible and video clips such as these described can help students connect with this important knowledge. By making the videos available online, students can have access to them and it is easy for instructors to use them in live and online courses. Viewing these clips is often a first glimpse at traditional knowledge for most non-native and Native students who don't have any contact with Elders. The videos are used on a regular basis in the classroom at FNUniv. Students watch the videos, select a plant, and fill out a worksheet whereby students explain the uses of the plant and provide a picture of the plant. This assignment is done in the biology course unit on plant groups, life cycles, and structures. The videos give students the opportunity to see what these native plants look like in their natural habitat and learn how they are used traditionally. The videos were filmed in a Saskatchewan natural prairie, thus allowing for student recognition of the native plants they may have seen on other occasions. Students can make the connection between these native plant species and their traditional uses, with their own personal experiences.

Traditional Food & Medicine Booklets

Dakota and Lakota Traditional Food and Tea

Elder Lorraine Yuzicapi (Standing Buffalo Dakota First Nation) offers across Canada workshops in which she shares her love of cooking with traditional foods and herbal teas for health maintenance. During her workshops at FNUniv, she brings samples for participants to try. She explains how the foods are collected, prepared, and stored. This traditional knowledge is so important that an educational booklet was developed in collaboration with her (Yuzicapi and van Dusen 2013). People who are not able to attend her workshops can use the booklet in order to learn about these traditional foods. Examples of foods discussed in the booklet include: fish, buffalo, hazelnuts, corn, wild turnips, cactus, rose hips, and chokeberry.

Four Directions Medicine Wheel

This booklet describes the Medicine Wheel utilized in several Aboriginal cultures and the importance of Saskatchewan native plant species as medicines (Gendron 2013). The booklet was developed when the FNUniv-Regina native prairie was restored. Through discussions with Elders, the restored prairie features several components that celebrate the First Nations culture. The booklet is a way to describe these components. For example, it explains the parallel between the big buffalo rock in the prairie garden and education. In days gone by, Indians hunted the buffalo to acquire food, tools, and clothes. Today, Aboriginal students hunt for knowledge through education, to provide these life essentials (Gendron 2013).

Gitchi Mando Miyew (Creator Given): Traditional Supports for HIV/AIDS

This booklet discusses protocols and ceremonies and how a person suffering from HIV/AIDS can benefit from plant medicines (Gendron 2013). When attending a ceremony for the first time people can be intimidated; Elders who collaborated on this booklet thought it was important to explain how to fully benefit from the plants and ceremonies.

These booklets are accessible to teachers who can make use of them in the classroom or otherwise integrate them into science curricula (Gendron 2013). Both the videos and booklets are valuable additions to the Medicine Room, Medicine Wheel prairie garden, and the online Ethnomedicine course at the FNUniv.

Medicine Wheel Garden

Urban garden programs can serve as an important vehicle for teaching and learning science, despite that science education often is not the focus of the program (Rahm 2002). Garden programs promote the intersection of work, community, and science to create an open learning environment. Cultural educators such as Elders can learn from students, and students find themselves teaching others whilst learning (Aikenhead and Michelle 2011; Ferreira and Gendron 2011). The scientific learning from these interactions and from experience with the garden is authentic and not systematically contrived by a 'science curriculum'. Participants develop their scientific knowledge and skills through engagement in garden-related activities and interpretations that promote their individual ethnic and gendered contexts. Allowing participants' choice in the object of activity (e.g., weeding or seeding) promotes engagement in science as a naturally embedded life activity (Rahm 2002), rather than as a withdrawal to a forced and isolated scientific activity in a structured laboratory setting.

Through gardening activities and observation of the garden, participants become members of their practice community (Rahm 2002). The type of science learning that occurs becomes science in and for the community. The community in this case could be students interacting with cultural Elders and university instructors, or it could be workshop participants interacting with one another. In either case, a loosening of conformation to strict science standards makes room for cultural knowledge to be situated within the learning community. Science is thus grounded in the everyday activities and work experiences in relation to the community, and so 'citizen science' literacy develops (Roth and Lee 2004).

The native prairie located at the FNUniv is a 6000 m^2 public area that was restored and seeded with native grasses and forbs in 2003. The purpose of this project is to create a space where people can learn about native plants and their traditional uses. People often come to look at the plants and some people collect sage for ceremonies. There are interpretive signs in the tree/shrub bed and in the demonstration garden. The interpretive signs in the tree/shrub bed have been developed with the help of Elders. Here is an example of one of the signs:

> We use the sap of the Manitoba maple as sugar and preservatives. Male and female flowers are found on separate trees and I use the seeds of female trees for building bones as they contain a high level of calcium. This is especially useful for young girls on their moon time. The seeds have to be boiled until they turn brown.

During the summer of 2008, a Four Directions Medicine Wheel garden was established at FNUniv-Regina. The medicine wheel is one of the sacred components of the Native North American culture. The design of the native prairie garden with its different beds is the result of several meetings with Elders. One female Elder shared with us the design for the Four Directions Medicine Wheel garden. Structurally, the Medicine Wheel garden has a diameter of 20 metres and there are four quadrants with plants of different coloured flowers: Yellow (east), Blue (south), Red (west), and White (north). There is a buffalo rock in the middle and on the outside of the wheel there are seven stones that serve as benches. These stones also symbolize important qualities for people to develop: adequacy, order, growth, security, social approval, self-esteem, and love. Four pathways dividing the Medicine Wheel quadrants were established with rocks of different colours. The paths symbolize another medicine wheel that represent the four racial nations of the world. All nations of the world are welcome to travel a path to the FNUniv Four Directions Medicine Wheel Prairie Garden and learn about these native prairie plants.

Many people are interested in gardening with native plants. The FNUniv also offers workshops on gardening with native species. During the spring, we discuss how to grow the seedlings. In the fall, we offer workshops in the native prairie and show participants how to

collect seeds, such as prairie sage (*Artemisia ludoviciana* Nutt.), smooth aster (*Aster laevis* L.), and prairie coneflower (*Ratibidia columnifera* (Nutt.) Woot. and Standl.).

The native prairie grassland is also a great outdoor classroom. Student groups from local universities and other schools in Regina, SK tour the native prairie to learn about native species, including: Gum weed (*Grindelia squarrosa* (Pursh) Dunal), Indian breadroot (*Psoralea esculenta* Pursh), Purple coneflower (*Echinacea angustifolia* DC.), and prairie sage. The area is also used during the FNUniv Health and Science Camp. A team of Elders, FNUniv faculty, university students, and community representatives guide the summer camp program. The camp delivers programming at the interface of Indigenous science and WMS.

The biggest challenge with the native prairie Medicine Wheel garden is the growth of invasive species. Invasive species are non-native species that outcompete native species and thus cause harm to the native prairie ecosystem. A student is hired to weed the area, and sometimes community events are organized whereby participants volunteer to hand-pull weeds. Last year, 21 bags of weeds were collected during one evening! Such an activity allowed a conversation to naturally unfold regarding the topic of invasive species in the native grasslands.

Citizen science knowledge is collective, rather than personal, and thus it is distributed across the learning community. The social organization (e.g., workshop), not an expert individual, is the seat of knowing and learning (Roth and Lee 2004). Learning unfolds in the process of participation, and the person's changing relationship to participation should be the outcome of interest, not the possession of knowledge (Rahm 2002). Participating as a citizen scientist in the context of a community develops scientific literacy as a collective practice, rather than as an individual practice (Roth and Lee 2004). This facilitates understanding and development of a more socially appropriate form of science. Participation in a garden program helps to avoid a separation between 'doing and knowing' and the person and their context (e.g., gendered or ethnic) (Rahm 2002).

Science education reforms directed to 'science literacy for all individuals' can cause conflict for women and ethnic minority groups (Roth and Lee 2004), as subordinated members within a dominant science paradigm. Participants can instead be the co-creators of their 'science curriculum', through active participation in emergent learning opportunities in the garden program. The mentors (e.g., cultural Elders, science instructors) can then use science to guide rather than to drive the learning (Rahm 2002). In this way, the students negotiate various science-cultures in an authentic setting to relate meaningfully with the content, phenomena, and issues of science. Roth and Lee (2004) described a marked difference in the level of engagement of Aboriginal students in a summer science camp, once the workshop was taught by Aboriginal instructors. The instructors assisted in framing the activities in their Native context (Roth and Lee 2004). Effective instructors don't break students out of their societal contexts but provide them with opportunities to engage in activities that shape their own identities within the context of the learning community (Aikenhead and Michell 2011).

Teachers involve the students in the very real connections between work, community, and science, rather than to assist them in 'connecting' school science to real life (Roth and Lee 2004). Students don't just learn a collection of facts, but learn a culturally appropriate way of acting, talking, and becoming a member of the gardening program (Rahm 2002). By providing a variety of participatory modalities from which the learner can choose, the science educator or cultural mentor allows the student to direct their own learning guided by their interests in relation to the community.

Rahm (2002) posits that the "integration of these multiple ways of knowing science needs to become an educational objective and perhaps even be seen as the essence of science literacy." Participation in a lived curriculum of culturally situated activities results in a knowing and learning relevant to the community -and as an outcome- a more authentic scientific literacy (Roth and Lee 2004). Even students who won't pursue science careers become citizen scientists in that their engagement in life-embedded science is valued as interesting and meaningful (Rahm 2002).

National agendas to pursue scientific literacy may be unsuccessful because they do little to address the need to redefine scientific literacy.

Online Ethnomedicine Course

Increasingly, distance-learning technologies are used to deliver coursework and programs at mainstream universities (Mayadas and Bacsich 2009) and with minority populations in general. Enrolment in distance post-secondary education by off-reserve Aboriginal adults is reported to be 18% in 2006 (Canadian Council on Learning 2009). Whilst many off-reserve Aboriginals are using E-learning (Canadian Council on Learning 2009), the overall lesser success of use of this technology with Natives is attributed to cultural issues (Newell and Adesope 2011). At TCUs, distance-learning technologies are used to deliver coursework and programs more successfully with Native students likely due to the cultural support provided by the TCU environment itself. Perhaps the presence of Elder co-educators in an online course could provide cultural support and relevance for Native students, and facilitate the learning of all students.

Web-based learning technologies have the capacity to transform the application of our pedagogical theories, educational modalities, and educational systems. These applications appear to be limitless; from 100% online courses, programs, and universities, to hybrid (blended) courses, programs, and universities. The benefits and detriments of online teaching and learning also fall upon a continuum. On the positive side, some student disparities might be alleviated, such as those observed between majority students and ethnic minority students. In contrast to what may occur in a live course, real or perceived racial/ethnic differences in the student body may be diminished in a more neutral online environment, as students interact with other students and instructors. Yet observed performance disparities between ethnic groups are not due to interactions with teachers or students within the E-course (Richardson 2012), but more likely due to student entry characteristics and learning patterns (Richardson 2010). Research indicates that entry characteristics such as student educational level, locus of control, and online learning readiness impact student learner satisfaction in an E-course (Yukselturk 2009).

In regards to the merit of online science courses, students in Malaysia report that the innovative tools of web-based technology make E-learning science more interesting (than a standard science course); these students also report a perception of 'learning more' in the online science environment (Seng and Mohamad 2002). Student perceptions are important to evaluate the nature and quality of educational interventions (Richardson 2010). An online study conducted in Florida indicates that for students participating in online course learning, self-regulation (e.g., time management and goal setting) is an important skill to develop for success (Hargis 2000).

Pedagogues recognize that many educational theories, such as constructivist (Hargis 2000), social constructivist (Zhu and Schellens 2009), objectivist (Hargis 2000) and Freirian postcolonist (Hussein 2012) theories are transferable to the online environment. A constructivist format can be applied to the online teaching and learning environment, to be consistent with real-life contexts. Students have freedom to discover ways to interact with the material in a way that enhances their learning pattern (Hargis 2000). For example, asynchronous discussion between students and instructors can take place, as well as problem-based learning. Social constructivist pedagogy theory posits that learning should be constructive, active, intentional, collaborative, conversational, reflective, and contextual (Zhu and Schellens 2009), all of which can be achieved in the online environment. Freirian pedagogy calls for the deconstruction of the dehumanizing forces internalized by oppressed students in a learning environment in which students merely are 'repositories' for knowledge 'deposits' by the oppressing knowledge bearers (i.e., colonial instructors/teachers) (Ferreira and Gendron 2011; Hussein 2012). The online teaching and learning space can be mindfully used to create a learning community embarking upon an adventure that stretches the frontiers of antiquated teaching modalities.

Recently, with the support of a UofR President's Teaching and Learning Award, we set out to develop and pilot an interdisciplinary and cross science-culture online course. This course was designed to be offered to mainstream majority students (e.g., White) and ethnic minority students (e.g., Native/Aboriginal), at research-intensive universities and TCUs in North America. This online course was piloted in the Spring 2012 at a research university in the USA to investigate these questions regarding the pilot course:

> Does the blending of Indigenous and Western knowledge provide a more holistic understanding of medicinal plants, not otherwise accessible?
>
> What are the perceptions of students regarding multidisciplinary team teaching and the quality of their learning experience?
>
> Does multidisciplinary team teaching provide instructors with new and effective ways of teaching and knowing?

We continue to collaborate and expand the course entitled *Bioactive Plants and Culture: Evidence-Based Ethnomedicine* to be offered concurrently online at four institutions (USA and Canada) in spring 2014. The course objectives are to familiarise students with medicinal plants from the Great Plains and Great Lakes and their importance in Indigenous science. Course objectives include understanding the evidence-based properties of these plants in WMS. The novel distance-learning course is multi-institutional, multi-disciplinary, and multi-cultural (Indigenous science and WMS). The course is offered by three STEM instructors (biochemistry, biology, ethononutrition) and several Elder co-instructors. The instructors are affiliated with Saskatchewan's UofR and the FNUniv (3 campuses) and Michigan's Wayne State University, USA.

As discussed earlier, there have been some noted differences between ethnic groups in student receptivity to online courses/programs (Newell and Adesope 2011), student learning strategies in online courses (Zhu and Schellens 2009), and student performance outcomes in online courses (Richardson 2012). Yet, the distance technological applications to learning have been lauded as a means of increasing accessibility of higher education to underserved students. For example, such online courses and programs have been promoted to be a way to reach students in remote African communities (Hussein 2012) or Native Aboriginal American communities (Aikenhead and Michell 2011).

However, technology should not be systematically applied to all people without regards to ethnic culture, as the growing body of literature suggests. Technology, and a technology-based course, can be designed without acknowledgement of the cultural assumptions of the designer. Similarly, such a technology-based course can be delivered without regard to the cultural worldview of the student. This may be particularly notable in 'science courses', in which the dominant paradigm of WMS is presented in a manner which fails to acknowledge the existence of Indigenous science. A disservice is done to all students in such a WMS course. Whilst all students can benefit from an expansive and inclusive scientific worldview, we may be particularly harming Native/Aboriginal students, if we do not present Indigenous science perspectives in a STEM course (Aikenhead and Michell 2011). Furthermore, the published literature documents that underrepresented North American minorities in science fare better if they have a science identity that does not conflict with ethnic identity (Chemers and Bearman 2011). It has been shown that underrepresented minorities may benefit from having cultural mentors (Seyd and Zurbriggen 2012).

Future directions of this research should quantitatively and qualitatively assess strength and direction of the relationship between student science identity, the presence of traditional Elder co-educators in a STEM course, and student learning measures. It should be ascertained if science identity mediates the effects of cultural mentors (Elders) upon learning outcomes for all

students, and especially for minorities. It should be determined if the presence of Elders in a STEM course improves cultural relevance of the course, student learning outcomes, student interest in STEM, and perceived merit of Elders in post-secondary STEM education. Finally, it will be important to know whether science identity and cultural support predict students' learning outcomes in an online STEM course.

Conclusions

Traditional knowledge -or Indigenous science- is not incompatible with Western Modern Science (also 'White Man Science'; WMS). We have a successful model whereby traditional Elders collaboratively work with STEM-trained PhDs to teach university students science. The FNUniv Medicine Room laboratory, Medicine Walk videos, Traditional Food & Medicine booklets, Medicine Wheel prairie garden, and an Ethnomedicine course serve at the interface of Indigenous science and WMS. We hope to show that this model is transferable to the E-learning environment for the benefit of Native and non-native students. We encourage collaboration between STEM-trained PhDs and traditional Elder educators in novel pedagogical approaches and delivery modalities to reach university students worldwide, through live and distance delivery of health and science courses. Through these efforts we strive to impact STEM and health education policy, research, and pedagogy toward increasing underrepresented minority persistence in science, whilst benefiting all students.

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