

Working Group #3

Relating Indigenous Knowledges and Teaching Mathematics

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Introduction

Significant curricular initiatives in mathematics have been undertaken across Canada to appropriately and respectfully consider Indigenous knowledges and perspectives. These initiatives, which call on teacher educators, teachers, administrators, and students to reconsider their received understandings of Indigeness, challenge inherited conceptual frames derived from the lengthy colonial process of looking for mathematics in cultural activities and by doing so validating the activities as mathematical from a Euro-Western perspective.

In May 2009, a group of mathematicians and mathematics educators of non-Aboriginal and Aboriginal descent, came together to engage in conversations as we investigated the following questions: What do Indigenous knowledges offer for teaching and learning mathematics by both Aboriginal and non-Aboriginal students and teachers? What role does language play? What role does place, community, and culture play?

Narcisse Blood, a member of the Kainai Nation and recognized as an *Iitsitskopa* (emplaced-for-a-reason, or elder), led our conversations and offered guidance and wisdom in our endeavour to better understand the relationship between Indigenous Knowledges and teaching mathematics.

It's all about Relationships and Respect

We began our time together by listening to Narcisse's stories. Prior to the first meeting, we had offered Narcisse a gift of tobacco. Our understanding of this protocol is that in accepting the gift, Narcisse gave his consent to guide our conversations. His first words were about relationships of place and putting mathematics into a setting that the students find relevant. He connected his work with that of Melania, Harley, and Caroline

(his daughter), and talked about Theresa's students thus demonstrating the interconnectedness of this group. We were blessed to hear his stories of the Buffalo stone in the context of learning from place. It was more difficult to hear his stories of residential school, of the silent (and sometimes not so silent) resistance of the students, of the history of schooling in Canada, and of his own experiences learning mathematics. He shared that there was an expectation that Indians were going to fail. Narcisse suggested that these attitudes are still evident.

In his work with Melania, Harley, and Caroline, he has grown to understand that there are many ways of doing mathematics. Melania met Narcisse when she organized a First Nations mathematics education workshop in 2006 through the Banff International Research Station for Mathematical Innovation and Discovery. At this workshop, mathematicians and mathematics educators who had been working with First Nations communities came together to find ways to move forward in promoting mathematical opportunities for Indigenous peoples. Harley and Caroline were participants in the workshop. Melania shared her experiences when she asked mathematicians and mathematics educators to add five numbers in five different ways at this workshop. She was impressed by the variety of ways people engaged in the addition process. She stressed the importance of allowing opportunities for people to engage in doing mathematics in multiple ways.

In our group conversations, it became apparent that respecting personal ways of doing mathematics is part of our research and pedagogy. When Caroline shared her story of having a high school mathematics class taught by a member of the Blackfoot reserve, she emphasized the importance of respecting alternative ways of doing mathematics. For many in our group, these experiences were significant in helping us reconsider the nature of mathematics.

Narcisse's words prompted us to reconsider our received understandings of Indigenousness. In sharing stories about Indigenous worldviews, the emphasis again was on respecting alternative ways of knowing. Our working group conversations shifted from our experiences of learning mathematics to describing how we have attempted to challenge inherited conceptual frames of looking for mathematics from a Euro-Western perspective in cultural activities of Indigenous peoples. Narcisse encouraged us to think about the meaning of culture. His suggestion to us was not to "throw a bead and feather in there." We grappled with how to respectfully and appropriately integrate Indigenous perspectives into our mathematics teaching.

Challenging Tokenism: Multiple Perspectives

It was clear to us that relating Indigenous knowledges and teaching mathematics depends on relationships that we have with Aboriginal communities. To avoid tokenism (throwing in a bead or feather), or colonialism through validating cultural activities as mathematical from a Euro-Western perspective, we considered our work in the context of relationships with the various Indigenous communities.

Harley spoke about working closely with elders and community members to videotape people engaged in traditional activities that can prompt connections to mathematics, to history, and to the role of people. For example he has worked with an

elder and grades 5/6 class in a tipi raising and has interviewed and videotaped an Aboriginal woman who does birch bark biting.

Cynthia shared her experiences as part of a research collective, the Transformative Education for Aboriginal Math and Science Learning (TEAMS-Learning), at the University of British Columbia. She emphasized that this group is composed of graduate students and faculty members who pursue research partnerships with teachers, parents, elders, schools, and communities to improve math and science teaching and learning at the K-12 level. One of her projects focuses on creating and living culturally responsive mathematics education in both rural and urban settings. She challenged us to consider the question: How can we use community, culture, and place as inspirations for math? She emphasized the importance of forming strong relationships with Aboriginal communities.

Florence, a participant with Métis and English ancestry, described her research as being in community as a team of co-researchers working together. She was invited by the community to work on mathematics achievement and was able to find a way of building community by listening. A community member told her, “You listen real well, you listen between what’s said.” Her work is informed by relationship, responsibility and recursion.

Theresa, of Cree and Irish-Canadian decent, talked about her experiences of teaching in Siksika, one of the member nations of the Blackfoot Confederacy. She has observed the silent struggles with identity as her students long deeply to learn more of their proud history and accumulated knowledge while being profoundly involved and invested in a global world. Her experience has taught her that teaching from an Aboriginal perspective is best accomplished by focusing on the perspectives of the Siksika people with whom she works. With community support, she has been involved in learning from place and believes that teaching from an Aboriginal perspective is simply finding what is meaningful and relevant to the students; finding what honours the ancestors of the host territory in which teachers live and teach. It means teaching the curriculum and addressing silent identity issues simultaneously by revering the land and people from which the students came.

As we continued to discuss the importance of working alongside community members, we realized that Indigenous languages are connected to how we are relating.

Mathematics and Language

Caroline, a member of the Kainai First Nation, described her experience teaching at Tatsikiisaapo’p Middle School, a First Nation school. In her experience of teaching mathematics and attending conferences such as BIRS and PIMS, it had become apparent that there was a lack of success in mathematics for First Nation students not only in her own community but also across the country. She shared her belief that there was a different viewpoint that had not yet been tapped into. She described mathematics as having its own language that we need to be able to teach the students so that they will be math literate to understand what is being asked of them.

Lisa and Cynthia introduced us to the writings of Bill Barton (2009) on the links between language and mathematics. Barton claims that by examining different languages and how these languages express mathematical ideas, a picture of mathematics as a

subject that is relative, contingent, and influenced by human experience emerges. Barton uses geometry as an example of this:

If it is true that geometry built up from the way humans conceived of the space and shapes around them, then it has been shown that geometry could have at least started differently, using different basic concepts, and that other graphical representations could have become more familiar. (p. 63)

Drawing on Barton's work, our conversation considered mathematics as a verb-based language.

Melania and Harley helped us better understand the link between language and the recent history of geometry as impacted by the Bourbaki movement. A verb-based language was much more evident prior to the 1930s when the influence of Bourbaki began. Many people believe Bourbaki reduced geometry to abstract algebra by eliminating diagrams and pictures from school textbooks. Indeed, this flowed into the New Math movement where mathematical structure through abstract concepts was emphasized and textbooks were solely algebra, static, and words. Diagrams were not allowed. The language of mathematics changed as mathematical ideas became objects, not processes. Circling, for instance, was an action and that was replaced in textbooks. Harley gave an example of slope that was something in flux or motion and is now static. This demonstrates the changing nature of mathematics.

Recognizing that language is linked to mathematics, we wondered about the relationship of Indigenous languages and mathematics. Liz told us she was working alongside a group of dedicated elders, parents, and teachers of the Xit'olacw Community School, one of the oldest Band operated schools in Canada. She described their immersion program where students learn and understand Lilwat, St'at'imcets which is the Lilloet language. Liz shared with us her experiences while working on a project to translate the mathematics textbooks used in Grade 1 into this language. Funding was received from First Voices and Lois Joseph, team leader of the Lil'wat7ul Culture Centre, used the funding to get Elders together to start the intense discussions as to what language would be best used to describe the mathematical concepts that were in the books. New language had to be created to describe things like squares and rectangles, triangles, and core patterns and so the process was a collaborative living process of embracing and agreeing on new words that could and should be used.

Lisa and Cynthia reminded us that the connectiveness between mathematics and language is being lost because the language is being lost. Narcisse and Caroline explained how they think of language as 3-dimensional. To Narcisse, language involves feeling his grandmother's warmth, smelling her scent, and seeing the story. You see the story and it becomes an experience; that's why you remember it. It stays with you.

Melania prompted us to think deeper about the connection between language, mathematics, and story. She brought examples of children's stories that involve mathematics and showed us how a simple story like *Peter and the Wolf* could be used to engage students in addition, sorting, and counting. She has found this to be very successful for kindergarten and grade 1 students as the students learn vocabulary and make connections. We continued to investigate where we might find appropriate books to integrate mathematics and story. I shared my work with mathematics and story and provided examples of how stories could be used to place mathematics within a context.

While this may seem a departure from earlier discussions, we realized that stories provide a context for mathematics and allow students to see themselves in the story.

When using stories of Aboriginal people, Lisa reminded us to be constantly mindful of respecting the history and spirituality of the story. Using mathematical stories in Aboriginal contexts is not straightforward. Theresa explained that if you take a story that has multiple purposes in multiple settings for different people for different points in their lives, and you apply it to one possible meaning and then publish it, you are killing the live-ness of the story and the intent of the story. You cannot just translate it and apply it in one way.

Throughout much of our conversations, we grappled with our understanding of the relationship between Indigenous Knowledges and teaching mathematics. Cynthia shared with us a model for designing lessons and guiding research, based on her AERA conference presentation (Nicol, 2009) and Indigenous storywork research by Jo-ann Archibald (2008). We talked about how to incorporate Aboriginal perspectives. Florence felt that policy makers had created a grand narrative about Aboriginal perspectives and people were picking this up and creating a myth. Lisa reminded us of the importance of being in the community. Before she started her work in this area, she became part of the community. She spent time on the reserve and got to know the community and they got to know her. They got to trust her. She was an outsider but was asked to do this work and was blessed by the community.

Theresa suggested that maybe it was more important to build those relationships over time, to know your community, to develop sensitive and collaborative approaches than to find token units to meet the goals of the government in a mandated time period. The work that goes into this process is fundamental.

Narcisse shared his perspective that the academic model is a detached model. In research you pose a question. It narrows inquiry because you have a notion of the answer. When you work and compare the paradigms, you want to be wisely aware of what's around you. It takes away the approach of a narrow inquiry. There's perhaps more information around you that you don't see. In Blackfoot, this isn't quantified. Knowing that, you can integrate Indigenous Knowledges a bit better.

We concluded our time together with a sharing of the projects we had been involved in the past few years. Our own multiple perspectives are offered here to show possibilities to people not part of our conversation at this forum. Our multiple perspectives are contextually rich but not transferable. This is not prescriptive but a shared understanding of what it means to work in community.

Our Shared Understanding of Relating Indigenous Knowledges and Teaching Mathematics

When thinking about incorporating Aboriginal perspectives, Lisa offered three ideas: Know your kids, know your community, believe they can learn. This is good for all kids. In the spirit of her comments, we offer our experiences of working with students.

Lisa: "Show Me Your Math Project"

(<http://schools.fnhelp.com/math/showmeyourmath/index.htm>)

Teachers and students were invited to begin the process of exploring the mathematics that exists within their own community contexts both in current and historical eras. Students investigated and explored the mathematics around them and completed projects. Students presented their projects at a Math Fair and on this web site.

Harley: “Games from the Aboriginal People of North America”
(<http://mathcentral.uregina.ca/RR/database/RR.09.00/treptau1/>)

Math Central includes a database of resources for teachers. In this project, Harley investigated games in Aboriginal nations. Three categories or types of games are presented in this project - games of chance, games of strategy and lifestyle-based mathematics.

Florence

Junior high school students at a First Nations school were invited to attend a math fair presented by University of Alberta students enrolled in a mathematics course. After this visit, the junior high school students returned to their classroom to prepare a math fair project. Florence arranged to have her undergraduate teacher candidates visit the school during their math fair. Both non-Aboriginal and Aboriginal University students and students at the First Nations school were involved in this collaborative venture.

Caroline

Students in Caroline’s middle school class were on their way from Kainai First Nation to Edmonton on a field trip. Enroute, Caroline asked students to choose between visiting the Okotoks Big Rock or swimming. Her students had heard stories of Okotoks and opted to visit this sacred Blackfoot site. Her students were greatly impacted as they grew to understand how vast their territory was, how their songs included this site, and that this was their home.

Narcisse: “Nitsitapiisinni – Stories and spaces: Exploring Kainai plants and culture”
(<http://www.galileo.org/plants/kainai/>)

Narcisse shared with us the importance of not losing knowledge of the land. He provided an example of students learning the plants. In this project, a grade 4 class investigated plants in the context of the sights and sounds of the land. Included on the website are audio and video interviews with elders and teacher resources.

Theresa and Gladys

Students in Theresa’s grade 8 class at Siksika Nation High School were involved in a number of projects. Setting aside the textbook, Theresa led her students in investigating how the students spent their days. This involved learning about fractions, exponential numbers, scientific notation, and graphs. The students compiled a book of images and written descriptions (in English and Siksika) of their activities.

Gladys and Theresa planned two field trips to sacred sites in order to investigate math in the land. With the grade 8 students, they visited Majorville Medicine Wheel. Members of the community were invited to come with them; Blair First Rider led the group in an offering and prayer and then told a story of the place. Theresa and Gladys had

planned a number of mathematics tasks on circle and coordinate geometry. The following year, Gladys and Theresa visited another sacred site, Okotoks, with the same students who were now in grade 9. Kent Ayoungman, a cultural teacher, told stories of Napi and the rock. Students investigated heights of objects using trigonometry, positioning using coordinate geometry, and perimeter and area using GPS technology.

Conclusion

Colonization was an intentional act. If we try to convince our students that the only mathematics that exists and is worth studying has its roots in Euro-Western traditions, then we are engaged in such an intentional act. By honouring multiple perspectives of mathematical thinking and knowing, we can come to know mathematics and ourselves in a different way.

The Common Curriculum Framework for K-9 Mathematics: Western and Northern Canadian Protocol (2006) states, “The strategies used must go beyond the incidental inclusion of topics and objects unique to a culture or region, and strive to achieve higher levels of multicultural education.” While we agree that token gestures of inclusion are inappropriate, we believe that relating Indigenous Knowledges and mathematics education is context specific. Multiple perspectives are necessary and embraced. Moreover, any project must be community initiated.

At the end of our time together, we were left with many questions: How do we teach in ways that are responsive to students and challenging of the systemic inequities? How do we invite others to think with us in similar kinds of critical reflexive research? How do we engage in our own decolonizing? In this report, we offer our stories and challenge others and ourselves with our questions. As we reflect on our experiences within this working group, we contemplate the next steps to be taken and invite others to walk alongside us as we attempt to live our lives differently:

Take our stories. They’re yours. Do with them what you will. Use them in your planning. Tell them to other educators. Forget them. But don’t say in the years to come that you would have lived your life differently if only you had heard our stories. You’ve heard them now. (adapted from Thomas King, 2003)

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