

First Nations Math Education (12w5076)

Objectives

In June 2006 mathematicians and educators interested in working with First Nations communities came together at BIRS to find ways to promote mathematical opportunities for aboriginal students. Aboriginal students' access to math and science education was the focus of this group discussion, as well as the challenges aboriginals face with the educational system. The goal was to look for possible ways of addressing key issues of concern.

The workshop was based on the assumption that First Nations/Aboriginal student participation and success in school math programs is limited. This assumption was readily confirmed by data presented.

Presently only 2% of BC's Aboriginal population completes Principles of Mathematics (POM) 12 compared to a completion rate of 25% for the whole BC population. This discrepancy in completion rate is one of the issues this group wanted to address given that successful completion of POM 12 is a compulsory entrance prerequisite for many post-secondary programs in British Columbia, and the statistics are similar in the other provinces.

Canada's Aboriginal population is growing faster than the general population, increasing by 20.1% from 2001 to 2006. Population projections estimate that Aboriginal people could account for 4.1% of Canada's population by 2017, but this proportion would be significantly larger in Saskatchewan (20.8%) and Manitoba (18.4%) (Statistics Canada).

Due to the fact that Aboriginals make up a growing portion of the student population, in the future they will become a substantial proportion of the population that should be participating in the workforce. If we do not address the great disparity in educational achievement of aboriginals compared with the rest of the population, the repercussions will be disastrous.

It was agreed by participants that successful achievement in math programs is critical for Aboriginal students if the outcome of cultural, political and economic equity for Aboriginal peoples is ever to be realized. Several participants in the workshop described barriers to success for Aboriginal students and identified the shortcomings of current approaches. Most prominent among these were: the cultural and social dissonance between school and students' Aboriginal society; the inhospitable nature of public education systems for Aboriginal students in that their history is ignored and their potential unrecognized; the

absence of math programs that lead to success, for all students; and the lack of teachers trained to successfully teach math. These factors, when considered together, constitute insurmountable barriers to success in math for Aboriginal students.

The workshop presenters provided examples of inspiring initiatives that are overcoming one or more of the above barriers. Other experts shared information about the powerful and effective traditional mathematical knowledge of First Nations peoples, which should become part of every teacher's lexicon when presenting mathematics

Through well-coordinated discussions the group worked to utilize the information presented into practical approaches for overcoming the challenges. The most relevant strategies discussed included:

1. Educate teachers to effectively teach math:

- train pre-service teachers to teach math more effectively; increase their capability, confidence and attitude with regard to math
- educate teachers in the pedagogy of indigenous knowledge of mathematics
- educate teachers to strive for and expect success for all their students, including Aboriginal students
- make teachers the harbingers for institutional change by changing their attitude toward and teaching and learning of math and toward Aboriginal learners

2. Implement effective, research-based, math programs:

- teach math in the cultural context of the students; recognize the historical and practical role of math in the traditional and current lives of First Nations/Aboriginal people and introduce the rich history and its current significance in the field of math;
- incorporate meta-cognition strategies so that students understand their own learning process for math;
- teach the basics of math and expect all students to success at learning
- teach basic skills and problem-solving early and keep building on the skills students need to succeed at higher levels.

3. Include Elders in this important discussion. It is imperative that if we are to be successful in these areas, that we begin to allow a bridging of Indigenous Ways of Knowing with contemporary areas of study.

Participants were invited to share their experiences on particular case studies or to describe ongoing research on these issues. They were also interested in learning about any significant studies/data on these topics.

At a second meeting in 2007, Elders and teachers were invited to participate. The first goal was to start a conversation between Elders and Mathematicians, centered on traditional ways of knowing and how mathematics plays an important role in the knowledge of any culture in particular aboriginal culture. This was a significant development since this was the first time this conversation was attempted between these two groups.

For this meeting we had in mind different objectives for each group:

For teachers, we held a series of workshops during the meeting in the hope that the materials presented would help them acquire a deeper understanding of various mathematical concepts. They also became more in tune with aboriginal knowledge and traditional ways of knowing and how to implement this information in their classroom, as they engaged with the Elders throughout the meeting. For Elders, this was an opportunity to reflect on how mathematics is embedded in their teaching, knowledge and cultural activities and how this newly acquired awareness can be passed onto the next generation. As for mathematicians, it helped them to acquire a better understanding of traditional ways of knowing and they learned how mathematics are developed and used in everyday life in various cultures.

After this meeting various members of this group kept in touch and subsequent activities were developed. Several math teaching workshops were organized where mathematicians traveled to the reserves to work with teachers and Elders. Friendships among Elders and mathematicians were created as well as working teams whose main goal was to improve mathematics education.

For the third meeting held in 2009, nine Elders, ten mathematicians, four math educators and nineteen teachers who teach at schools with a substantial percentage of aboriginal population and/or in the reserves were invited to participate. In the case of most of the elders and mathematicians this was the second time they met at Banff, which made a difference in the direction and aims of the workshop. The main focus of this workshop was to come together as a group with all our different expertise and create lessons where the standards of mathematics learning would be high, and the aboriginal cultural context would be acknowledged. We focused on numeracy and the following four possible outcomes (Ginsburgh et al., 2006, pg. 5):

- Numeracy for Practical Purposes: addresses aspects of the physical world to do with designing, making, measuring.

- Numeracy for the Interpreting Society: relates to interpreting and reflecting on numerical and graphical information of relevance to self, work, or community.
- Numeracy for Personal Organization: focus is on the numeracy requirements for the personal organizational matters involving time, money, and travel.
- Numeracy for Knowledge: deals with mathematical skills needed for further study in mathematics, or other subjects with mathematical underpinnings and/or assumptions.

By focusing on the development of these four outcomes, we are able to honour the spirit of each student as an individual and as part of a community. This way of thinking is an integral part of many aboriginal cultures as well as a successful way of learning mathematics in any culture. The reality is that most of the aboriginal resources in mathematics are very simplistic and scarce, and do not honour the similarities, difference, depth and richness of First Nations cultures.

The group was divided into 5 groups which looked into different aspects of aboriginal cultures; they focused on the following ideas:

1.- The Tipi: Mary Ruth MacDougall (Elder) delighted us with a wonderful story during the first meeting about an incident that happened to her and her husband when they went to an Indian Day Encampment with their Tipi. Bob Meggison (mathematician) and Mary Ruth kept in contact after the second meeting in trying to develop a math lesson around this story. During the second meeting Mary Ruth and Bob were joined by a larger group of people who took her story and started to develop more materials around it. This is a perfect example of using stories that are not necessarily mythical but current and still have aboriginal context.

2.- Settlements and symbols and artifacts: how some aboriginal settlements were originally organized according to the cardinal directions and how some of the symbols like the medicine wheel are used to represent aspects in the daily life of people. A little story was also developed in this group which describes an aboriginal settlement and uses the circular nature of encampments to pose a question. A recently produced video based on this work can be found at: <http://www.math.sfu.ca/~vjungic/smaller.mov>

3.- The Sweat Lodge: How is a sweat lodge built? What are its proportions, direction and its geometry, as well as all the materials needed to construct it, ceremonies and tradition? Given its construction by using several pieces of bark, and how this bark is bent and attached, students can look into material resistance and flexibility in relation to several geometric configurations.

4.- Natural resources and food collection: acknowledging that in most aboriginal cultures people are not supposed to harvest or gather all the food available but just what is needed. This is an important environmental question: what happens when a population displays this type of behavior, how are resources affected?

5.- Games: in particular arrow and bone games were discussed, how they are played, and how these games can be studied using probability and combinatorics. As an example we have the game of Slahal (Lahal) where two teams each hold a set of sticks (usually 5 sticks per team). When a game starts one of the two teams will have a set of two "bones", one with a stripe and one without. When a team is guessing, the objective is to find in which of the opponents' hand is the bone without the stripe. When the team has the bones, the objective is to make sure the other team guesses wrong on the bones set. When a team guesses wrong it loses a stick, if it guesses right it gets the set of bones. A member from the teams which has the set of bones will hide the bones and swap them around from hand to hand while the rest of the team is drumming, chanting and trying to distract the other team. The groups are currently developing all these themes, and putting together various lessons together.

This multi-year project is still work under development, significant progress has been made but it is crucial to build on our success through workshops in a collaborative environment such as that afforded by BIRS. The goal of the meeting we are proposing is to continue with the type of activities outlined above, but also to develop ways of promoting materials originating from these interactions and making them available to various K-12 math programs around the country. Our main goal is to provide resources that are sound, interesting and challenging mathematically, with a factual and rich cultural context and to provide these resources to various venues of instruction in order to supply a more balanced curriculum where aboriginal culture can take its rightful place.

Bibliography:

Ginsburgh, L., Manly, M., Schmitt, M. J. (2006). Components of Numeracy. National Center for the Study of Adult Learning and Literacy: Cambridge, MA. Retrieved on March 3, 2010 from:

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