First Nations Math Education

We are a group of Elders, mathematicians, math educators and teachers who have come together to find ways to improve mathematics education among aboriginals while at the same time acknowledging the importance of traditional culture.

In June 2006 mathematicians and educators interested in working with First Nations communities came together 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 one's 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 experience 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.

In the second meeting at Banff 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 acquired a deeper understanding a 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 imbedded in their teaching, knowledge and cultural activities and how these new acquire 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 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 various activities developed. Several math teaching workshops were organized were mathematicians traveled to the reserves to work with teachers and Elders. Friendships among Elders and mathematicians were created as well as working teams which main goal was to improve mathematics education.

For the third meeting at Banff 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 focus 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 acknowledge.

We focused on numeracy and the following four possible four outcomes (Ginsburgh et al., 2006, pg. 5):

- Numeracy for Practical Purposes – addresses aspects of the physical world to do with the 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 subject with mathematical underpinnings and/or assumptions.

By focusing in 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 few and do not honour the similarities, difference, depth and richness of First Nations cultures.

The group was divided in 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 something that happen 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 artefacts: 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. Take a look at: http://www.math.sfu.ca/~vjungic/smaller.mov

3.- The Sweat Lodge: How a sweat lodge is built? Its proportions, direction and its geometry, as well as all the materials needed to construct it, ceremonies and tradition. 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 suppose to harvest or gathers all the food available but what is needed. This is an important environmental question: What happened when a population displays this type of behavior, how are resources affected?

5-.Games: In particular arrow and bone games were discussed. How are these games played, and by whom and how these games can be studied using probability and combinatorics. As an example we have the game of **Slahal** (**Lahal**) where two teams hold each a set 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 looses 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. The appendix section shows and example of some of the initial resources that the groups are working on.

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: http://www.statlit.org/pdf/2006GinsburgManlySchmittNCSALLnumeracy.pdf

Appendix:
What follow is one of the examples that a group work on and a movie on was develop.

What follows is a story developed by group 2. The group developed a little movie using this story.
Take a look: http://www.math.sfu.ca/~vjungic/smaller.mov

Small Number Counts to 100

Small Number is a 5 year-old boy who gets into a lot of mischief. He lives with his Grandma and Grandpa, who mpatiently put up with his antics, in a small settlement with 7 tipis arranged in a circle. One day Small Number wanders out into the woods and sees a beautiful black cat with a long white stripe down its back. Wanting to take the cat home to show Grandma, he tries to catch it and learns that the black cat is really a skunk.

Smelling strongly from the skunk spray, he runs home to Grandma, who quickly takes him out to wash the smell off him. As hard as she scrubs him down, she can't quite get rid of all the bad smell.

Grandma doesn't want Small Number spending time in their tipi until he smells better, so she decides to set him a task she thinks will take him a long time. She knows Small Number can count to 100. She tells him to start at their tipi, which is right beside the entrance to the settlement at the east point of the circle, and to walk around the circle of tipis by first heading south. His task is to count the tipis going round and round until he can tell her which tipi he gets to when he reaches 100.

Small Number starts walking around the circle counting. He starts at 1 at his tipi, and when he gets back there, he has counted to 8. When he gets to 15 and is back at his own tipi, he stops and sits down. He counts on his fingers for a while, and then runs in to see his Grandma and yells: "It is Auntie Rena's tipi!" which is one tipi south of his grandparents'.

Question: How did Small Number know that the 100^{th} tipi is the one just south of his grandparents' tipi without actually counting them?