BALANCING EQUATIONS AND CULTURE: INDIGENOUS EDUCATORS REFLECT ON MATHEMATICS EDUCATION

EDWARD DOOLITTLE, FLORENCE GLANFIELD

Florence: I am a mathematics educator of Métis/English descent from Northeastern Alberta From the time I was five years old I wanted to be a teacher; I believe I was given the gift of teaching. I am also passionate about teaching mathematics and thinking about how teachers come to learn to teach mathematics.

Edward: I started thinking about my career at a young age too. I first started thinking about mathematics when I was four: I saw a series of pictures showing a unit represented by a cube; a ten by a line of cubes; a hundred by a square of cubes; and a thousand by a large cube of cubes I was particularly fascinated by the large cube, how it seemed to have so much hidden structure. When I was eleven, I decided I wanted to be a university professor When I was eighteen, I made a commitment to serving my people, *Kanyen'kehake* [1], the Mohawks, and saw mathematics education as the best way to do that.

Florence: About a year ago you gave a powerful talk at the annual meeting of the Canadian Mathematics Education Study Group (CMESG). The title of the talk was *Mathematics as medicine* (Doolittle, 2007) It was one of the most profound talks that I'd ever experienced. Emotion welled inside of me; and, if you remember, I could barely thank you. Could you please describe the talk?

Edward: It's gratifying to hear your description of my talk I tried to give the talk from the Indigenous perspective. Too often, our conversations on those issues are about Indigenous people rather than with Indigenous people Using stories, jokes, Mohawk language, quotations, and pictures, I tried to give voice to the people

I gave the talk without notes, so that it would be 'from the heart'; the version in the CMESG Proceedings is different, and perhaps less passionate On the other hand, I included a story in the proceedings that wasn't in the talk I came across it in Chamberlin's recent book, *Horse,* some time after giving my talk. Although it's a story I had heard before, I didn't realize how closely related it was to my thinking about mathematics until recently. The story goes something like this:

> A poor boy wished to obtain secret power A powerful water spirit - an old man - who lived in a lake took pity and told his son to bring the boy to see him at the bottom of the lake. "Hold onto my shoulders and close your eyes," the son told the boy. "Don't look until I tell you to do so My father will offer you your choice of animals in this lake. Be sure to choose the old mallard and its little ones "
>
> After meeting the old man and explaining his wish, the boy asked the old man for an animal. The old man offered him his choice. The boy asked for the mallard and its young. The old man replied, "Don't take that one. It is old and of no value " But the boy insisted Four times he asked for the mallard. Then the old man said, "You are a wise boy. When you leave my lodge my son will take you to the edge of the lake, and there, in the darkness, he will catch the mallard for you. When you leave the lake don't look back."
>
> The boy did as he was told He walked away from the lake for some time, leading the animal behind him At daybreak he turned and saw a strange animal: a horse. He mounted it and, using a rawhide rope as a bridle, rode back to camp. Then he found that many horses had followed him. The boy showed his people how to use horses for packing [2], how to break them for riding and for the travois [3], how to chase the buffalo on horseback, and how to use horses in crossing streams The boy grew older and became a great chief, the leader of his people. Since that time every chief has owned a lot of horses.

I've been asked to explain the meaning of this story. However, it is inappropriate in my culture to explain stories, since others may have a different understanding, no less valid. However, I think it might be a good idea to explain what I personally get out of the story. It really resonates for me - the issues that it raises can be summarized in one simple question: can we substitute 'mathematics' for 'horse'?

My aim is to integrate two aspects of my being, as a Mohawk and a mathematician, which at first seem inconsistent or incompatible So, I'm interested in ways of incorporating powerful new "technologies" like horses into Indigenous culture. In my understanding of the story, the bottom of the lake is like school; the mallard and its young are like school mathematics, which looks to be about as useless as an old mallard while we're in school; and the business about becoming a great chief isn't a personal goal of mine, but rather indicates to me the great value of horses to the people. Could mathematics, in Indigenous culture, ever be held in as high regard as the horse? Will it bring benefits to all, or just to a select

few? Is the power of mathematics universal, or is it just powerful within a Western context?

Florence: For me, the resonance in your talk last year was the notion of power and the power that mathematics seems to hold in our society.

Edward: The notion of power is something we don't shy away from in my culture. Our three main principles are *skennen, kahsha'sten'tshera, ka'nikonhriyo*: peace, power, and good mind. We cannot have peace without power; we cannot have power without good mind.

Florence: I'll share a story or two regarding the power of mathematics in our society. I remember when I first started studying at the university that when asked what I was studying I would reply, "Mathematics." I could feel people withdrawing from our conversation, like I was different. I didn't fully understand the feeling I had at that time but over the years I've come to have a better sense of it. On reflection, I think that I felt like I belonged to some 'secret' society, the society that actually likes mathematics, when people would withdraw. Now, with more experience, I've noticed the incredible power that mathematics has within our culture.

Edward: That's something I have to deal with regularly too. Our elders set an example of breaking down barriers, of equality, to enable the free sharing of our gifts for the benefit of all, not just the lucky few. Sadly, mentioning the word 'mathematics' seems to automatically raise a barrier.

Florence: I'll share two stories that live with me. The first involved my brother-in-law. The company that he'd worked with as a printer for many years decided to close their print shop. They offered each of their employees in the print shop an opportunity to re-train in a different area, as long as the employee met the criteria for entering a different trade. The company would pay for all of the re-education. When making the decision about in which trade an individual would be re-educated, a key decision was whether or not the individual had completed high school mathematics, in particular a grade 12 (the last year in secondary school) mathematics course. There were several options for those who had completed such a course and fewer and fewer options for an individual who had completed less than that. Of the ten people in the print shop, only my brother-in-law had the full range of trades available to him. He was the only individual who'd completed a grade 12 mathematics course.

Edward: The question I always have when I hear stories like that is whether mathematics is really a requirement for all of those trades, or whether it is being used as an arbitrary filter. My first teaching job at the university level was as a teaching assistant in the mathematics course for a commerce program. Our task, as I understood it, was to arrange matters so that one third of the 1500 students would drop the course, and one third would fail, leaving only 500 students for the 500 seats in the commerce program. That is surely a brutal oversimplification, but that was the assessment of the course coordinator, a full professor with a long career.

One might argue that a certain amount of mathematics is necessary to succeed in commerce. I'm not so sure that the 'certain amount' includes calculus. Nursing is another program in which the graduates don't use all the mathematics they had to learn. A priest once told me about having to take a course in Euclidean geometry in his theological school. It might (or might not) be a good thing for all those people to know some mathematics, but is all the mathematics that is taught in those particular programs really necessary?

Florence: The second story is about my cousin who did not complete her teacher education program because she could not pass the required university mathematics class. From the time my cousin was a little girl she wanted to be a teacher, and may never fulfil her dream because of one mathematics class. I think about this a lot as I've worked with so many elementary pre-service teachers over the past nine years. So many of these beginning teachers do not want to take a mathematics course; and actually dread even thinking about teaching mathematics. (Some actually think that mathematics must be the easiest to teach because all you do is tell people a series of rules to follow.) As I've come to work with each of them, I've discovered that they've not had a chance to explore the way that they think about mathematical ideas; that their ideas and notion of mathematical relationships have been silenced over their years in formal schooling.

Edward: We often talk about the value of mathematics education, what the students gain from knowing mathematics. A question that I have is, what is lost? I don't think the question is merely academic: I believe the fear of loss may be keeping some of our people from succeeding at mathematics. Do we need to give up our natural, innate mathematical understandings when we take in school mathematics? Worse, do we lose our culture to some extent? Indigenous culture has ancient, powerful ways of understanding the world, ways that are sophisticated and strong enough to have enabled the people to survive since creation. But those ways of understanding may actually be supplanted by mathematics education, which is not just mere knowledge, but a Trojan horse full of Greek philosophers wielding *Logos*.

Florence: My teaching has changed dramatically since I've interacted with these pre-service teachers; I want them to come to see themselves within mathematics and come to celebrate that they can see relationships within mathematics, that they can teach about these relationships, and that mathematics does not exist of a series of disconnected ideas.

Edward: You hear the word 'relationships' all the time in Indigenous discourse. Mohawk has an incredibly complex and nuanced system for talking about human relationships, and of relating everything in the cosmos to ourselves. For example, we speak of Yethinistenha Owhentsyakekha, she-to-us-is-mother the earth. But I think a lot of Indigenous people see their understanding of relationships devalued, and another system promoted, in formal mathematics education.

Florence: The emotion for me is what part I might've played in contributing to our culture valuing mathematics in such an extreme way that decisions about people's lives are impacted regularly? I've been involved in decision-making about the mathematical topics that should be taught in high schools; I've been involved in meetings at universities where we talk about the mathematics courses that 'must' be taken by people for certain programs; I've been involved in meetings that talk about the mathematics courses that 'must' be taken for people who are going to study a particular trade.

Edward: *Logos* is a total system that has allowed us to accomplish many extraordinary things, but it also bounds us. If I argue that this or that bit of knowledge may or may not

be required for people in a particular trade, I'm implicitly assuming that we can reason about such things. Contrast that with a traditional Indigenous education, in which people are encouraged to develop their own sophisticated, personal responses to situations and natural phenomena.

Florence: I wonder to what degree 'we' as a group of people who belong to that 'secret society' are conscious of the way in which we've contributed to the powerful position that mathematics currently holds in our culture? I find this so contradictory to what I know as an Aboriginal person. In my Métis family experience we were encouraged to find our passion and live it out; as Aboriginal scholar Eber Hampton [4] said in a recent talk, "you need to find out what you are fixed up to do," or as elder Ken Goodwill says, "discover your role in life." Your talk resonated with me because I think that you raised my consciousness of the role that I might've played, in the work I've done, to continue to live out the story of mathematics as powerful.

Edward: I'm not so sure that mathematics educators can take so much of the blame for the powerful position that mathematics holds in the dominant culture. It is true that mathematics is like a secret society; after all, modern mathematics originated with the Pythagoreans, a prototypical secret society. The story of Hippasus, the Pythagorean who was drowned by the society, is relevant. Hippasus is believed to have discovered irrational numbers, which was deeply disturbing to them, but legend has it that his greatest transgression was teaching the secrets of mathematics to the masses. For that he is something of a 'democratic' cult hero. However, Hippasus is still operating within the bounds of *Logos*: he apparently rationalized his actions in an anti-Pythagorean treatise. It's really just more of the same.

In that story, the masses wanted to learn mathematics: there was a demand for Hippasus's teaching. I think the real culprit is something greater than any individual or secret society. Following Franklin in *The real world of technology*, I think the true culprit is mass production. If Indigenous persons want to make a bowl or basket or whatever, they gather up the materials, manipulate them, and dispose of the finished product however they wish. They have complete control over the process from beginning to end. But in mass production, the individual gives up total personal control and instead must match the output of one step of the production process exactly to the input of the next step; hence the need for counting, measuring, locating, designing, and explaining (Bishop, 1991). Once our work lives become mathematical, mathematics starts to permeate every aspect of our thought, including playing, politics, and even religion (which might be characterized as spirituality plus rationality).

Mathematics is in a powerful position because society's technological needs have made number and word critical to success. Many of the people see the economic value of mathematics and want to learn it; not only that, but they have built a culture of value around mathematics and logic, to the extent that it is nearly impossible to escape the bubble of reason even when no reasoning whatsoever can help (see White, 2007, for an interesting discussion).

Another issue that Franklin raises is that of obedience; the technology of mass production definitely has political ramifications as well as educational. Those who are obedient and can follow instructions are valued. On the other hand, it is interesting that the horse-creation story also raises the issue of obedience and commitment. I believe that there's a difference between the kind of obedience valued in a mass-production culture versus the kind of obedience exemplified in the story. In the story, obedience is only required for a short time: eventually the boy looks back to see the horse. He doesn't keep walking, eyes ahead, for the rest of his life.

Mathematics education can, and does, perform all kinds of questionable roles in our society: an arbitrary means of controlling the number of students in a program; a way of encouraging students to follow rules and obey; a way of facilitating mass production and destruction; a frame for questions which would otherwise be handled by spiritual means. As educators, we are not necessarily to blame for the powerful role mathematics plays in our culture; but we do have the capability and obligation to fight against misuses of mathematics. One of our tools is to show that other ways of being are possible. See how I've turned it around to show it's not just a question of how Western society can help Indigenous people, but how Indigenous people can help Western society?

Florence: This is important. In an Indigenous society do we not value all contributions? In a traditional Indigenous community, all individuals must look for 'their role' and are celebrated for their contribution to the community? That is, if we think about the medicine wheel and the four aspects, that a person cannot be 'whole' unless there is balance among mind, spirituality, body, and emotion? Thinking about the 'whole,' we might ask, in what way(s) can Western society become 'balanced' in valuing multiple strengths and contributions? Then we might ask, what role does mathematics play in contributing to the balance?

Edward: We'll never change the fact that some mathematics is required for those who want to succeed in the society that has risen around us. But to be truly successful as Indigenous people, we must find a balance. The same applies to non-Indigenous people too, I think, but they're harder to convince.

In the world in which we now live, it is easy to develop mind to the exclusion of all else. As teachers and learners we must find ways to develop all those other aspects of the person, even within mathematics. It is such a difficult thing to do, particularly because of the lack of role models, but it is so important. A crucial component of balanced development is knowing who you are and how you fit in.

After forty years, I finally feel like I know who I am, and I have a sense of my role in the bigger scheme. Now I feel like I can do mathematics without threatening my identity. I can really start accomplishing something. I just didn't feel ready before now. Indians are late bloomers, I guess.

Florence: From an Indigenous perspective ... is there a late bloomer? What does time really mean? Perhaps it is that you are now blooming ... do we not all bloom in our own time? How might we translate that into our teaching and work in mathematics education? In what way(s) do we contribute to a sense that all can 'bloom' in mathematics? That it may not happen when others are blooming but that we are each an individual who will bloom?

Edward: We all bloom in our own time. Society has to be more flexible and understanding, and find constructive

things for people to do even if they aren't yet ready to take on the hardest tasks that they will some day face.

We all want peace. As a Mohawk, I believe that peace can come from power, like the power of mathematics. But power itself is not enough: we need good mind too. We need to be strong not just mentally and physically, but also spiritually and emotionally. We need to understand something about tradition and culture, ethics and responsibility. Many of those parts are now missing from mathematics education. It's critical that we find a way to put them in.

Notes

[1] *Edward*: In the words *Kanyen kehake*, *kahsha'sten'tshera* and *ka nikonhriyo*, the apostrophes represent glottal stops. I use apostrophes because that is the way I was taught in my language program to transcribe glottal stops, but in some orthographies a symbol like a question mark without the dot is used.

[2] *Packing*: The transportation of goods by pack animal, chiefly North American. (Oxford English Dictionary).

[3] *Travois*: A kind of carriage without wheels, common with North American Indians. (For further information see http://en.wikipedia.org/wiki/Travois, accessed 11th September, 2007)

[4] Hampton, E. (2007) 'Marketing math and science to Aboriginal students', talk given as part of a panel discussion, *Dreamcatching 2007 conference*, Regina, SK

References

Bishop, A. (1991) *Mathematical enculturation: a cultural perspective on mathematics education*, Dordrecht, The Netherlands, Kluwer Academic Publishers.

Chamberlin, J. E. (2006) *Horse: how the horse has shaped civilizations*, Toronto, ON, Bluebridge

Doolittle, E. (2007) 'Mathematics as medicine', in Liljedahl, P. (ed.), *Proceedings of the 2006 annual meeting of the Canadian Mathematics Education Study Group*, Edmonton, AB, CMESG/GCEDM, pp. 17-25. [A slightly different version is available at http://www.math.uregina.ca/~doolittl/papers/medicine.pdf, accessed 26th August, 2007.]

Franklin, U. (1999) *The real world of technology*, Toronto, ON, House of Anansi Press.

White, C. (2007) 'The idols of environmentalism', *Orion*: http://www.orionmagazine.org/index.php/articles/article/233, accessed 26th August, 2007.