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Aiming for Equity in Ethnomathematics Research

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> Walking along a forest path with a Mi'kmaw teacher, I listen as he tells me about mathematics done in his community. Trying to be helpful, he asks me yet again, "Is that what you want? What else do you want me to say?" In the background, I notice his wife using mathematics without fanfare to measure the depth of a puddle for their son who wants to jump into it.

The above narrative comes from Wagner's reflections on a conversation intended to inform mathematics teaching in a Mi'kmaw community on the east coast of Canada. It was the first of many conversations involving various people in this Aboriginal community, all of whom had some relation to mathematics learning and a stake in the cultural issues at play in the community. This initial conversation and the ones that followed it illustrate that there are multiple actors involved in any mathematics learning situation and the form of their interaction relates closely to equity concerns. It is never straightforward to understand how these actors relate to each other in the development of mathematical ideas. In this chapter, we will describe the development of our interactions, which were motivated by our concerns for Mi'kmaw students doing mathematics with little connection to their culture. In these interactions, we found ourselves increasingly attentive to discourse patterns and we intentionally shifted our positioning within the community in response to what we noticed.

Before considering three interrelated series of interactions that illustrate the development of our relationships in our research, we will describe the key scholarship from which we draw, and also the nature of the Mi'kmaw people's marginalization, especially in relation to mathematics learning. The three sets of interactions relate to attempts to address this marginalization. The first set of interactions we discuss involves ethnomathematical conversations with elders and community leaders, aiming to uncover mathematics at work in the communities. The second arose out of our critique of the first situation. For this, we draw on examples from student ethnomathematical engagement and the instructions they received for doing this work. Thirdly, we reflect on connections between the ethnomathematical

conversations in the community and others outside. As part of this reflection, we analyze excerpts of mathematics texts that demonstrate an overt desire for cultural sensitivity. These three accounts of interactions comprise our reflection on our roles as researchers bringing our agenda into the communities as part of our response to encouragement from the communities to work together to address mutual concerns for the children.

Context

The lack of interest in mathematics among Mi'kmaw youth has been a long-standing concern in Mi'kmaw communities. While it is difficult to gather accurate statistics on the number of Mi'kmaw students pursuing educational paths involving mathematics and the sciences, community leaders recognize and articulate concern about the disengagement of their students from these subjects. Similarly, interested parties across Canada have expressed concern about the relatively low participation of Aboriginal students in mathematics- and science-based post-secondary programs. The Canadian government's national working group on education has said that a key area to be addressed in Aboriginal education in Canada is the development of culturally relevant curricula and resources in areas of mathematics and science where there is currently an identified weakness (Indian and Northern Affairs Canada, 2002). Although not specific to Canada, an NCTM publication also identified this need, saying that Aboriginal people in North America have the lowest participation rates of all cultural groups in advanced levels of mathematics (Secada, Hankes & Fast, 2002).

Ezeife (2003), Secada, et al. (2002) and others have identified a key reason for the disengagement of Aboriginal youth from mathematics and science—the discrepancy between their own cultures and the cultural values embedded in school-based mathematics programs. Cajete (1994) stated that when science is taught from a Western cultural perspective it acts in opposition to the values of traditional culture for Aboriginal students, which affects their performance in mathematics and science because it simply is not connected to their daily lives. Lunney Borden (2010) has shown that the lack of attention to value differences and the use of inappropriate pedagogical strategies to be among the factors that result in a disconnect between school-based mathematics and Mi'kmaw ways of reasoning mathematically. As a result, many children choose to opt out of mathematics because the cost of participation is too high, demanding that they deny their own worldview in order to participate in the dominant view of mathematics. Doolittle (2006) and Gutiérrez (2007), each in their own way, have elaborated on this cost of participation. The incidence of conflicting worldviews has led many Aboriginal students either to ignore the possibility of studying science or mathematics or to struggle within these disciplines. This disengagement is a serious issue for Aboriginal communities that look to younger generations to acquire the skill and knowledge needed to move their communities closer to the realities of self-government in this modern age.

We note that disengagement goes both ways. As Canada's majority culture continues to marginalize Mi'kmaq[1] and other Aboriginal peoples, these marginalized people reject many of the dominant discourses of the majority. Individuals in Mi'kmaw communities could also be said to be ignoring, moving away from, or marginalizing mathematics because of the cost of participation, just as the forms of mathematical instruction leave their needs unaddressed. When a dominant culture positions a community in a way that marginalizes the people, the people in

[1] Like Orr, Paul and Paul (2002), we use 'Mi'kmaw' for adjectives and 'Mi'kmaq' for nouns following the usage adopted by the Atlantic Canada Mi'kmaw/Miigmao Second Language Document (DOE, 2002). Applying Mi'kmaw grammar within written English is not straightforward.

that community, in their response, may resist engagement with the dominant organizations and people. There are various ways of resisting, however, including spurning dominant culture values or transforming aspects of the dominant culture's modes of promulgating its values and the associated positionings. Some of the dominant culture's values are closely connected with mathematics education—for example, the privileging of mathematical knowledge and the kind of objectivity that is suggested in mathematics.

Ethnomathematics

Our research efforts have been aiming to address the disconnect between Canada's dominant culture and Mi'kmaw communities, as described above, particularly as this disconnect relates to mathematics education. An aspect of this work has been to engage in ethnomathematical conversations within the Mi'kmaw communities.

Most important to us, ethnomathematics positions all mathematics as being culturally contingent. School mathematics responds to needs and problems that have arisen in particular cultures (usually not Aboriginal traditions, which are rooted in close connection to the environment) just as mathematical practices in Mi'kmaw communities respond to needs and problems in particular times and places with particular values.

Gerdes (1997), in his survey of the first decade of ethnomathematics, highlighted its way of uncovering mathematics in communities that are unaccustomed to recognizing the mathematics in their practices. Ethnomathematics can thus be seen to have emancipatory power because the uncovered mathematical practices can inspire confidence in students who may assume they cannot do mathematics. Likewise, we hoped and continue to hope that as Mi'kmaw children learn to recognize mathematics in their cultural practices they would be more likely to expect success in mathematics. Furthermore, we believe that ethnomathematics can make them better equipped to understand school mathematics by making connections between it and their cultural practices.

Since Ubiritan D'Ambrosio coined the word 'ethnomathematics' in the early 1980s (for his early writing on it, see D'Ambrosio, 1985), it has become established in mathematics education research and also subject to significant criticism. D'Ambrosio (e.g. 1997) himself has raised criticisms, which relate mostly to the way ethnomathematics is received, and thus by implication to the way ethnomathematics research is done and presented—for example, "Much of the research in Ethnomathematics today has been directed at uncovering small achievements and practices in non-Western cultures that resemble Western mathematics" (p. 15).

With a criticism similar to D'Ambrosio's, Dowling (1998) has challenged Gerdes' claim for emancipation. In describing the "defrosting" of mathematics frozen in a woven button, Gerdes (1988) had celebrated the mathematics that was already present in Mozambique. He had claimed that the ethnomathematics "stimulate[d] a reflection on the impact of colonialism, on the historical and political dimensions of mathematics (education)" (p. 152). Dowling (1998) responded, calling this an example of the "myth of emancipation," noting that the "difficulty is that it appears that a European is needed to reveal to the African students the value inherent in their own culture" (p. 12) and that this revelation is to be done in European terms.

This critique weighed on our minds in the development of our conversation amongst the Mi'kmaq. Indeed, our initial conception of the research had the potential for the problems that D'Ambrosio and Dowling warn us about. In our account of the shifting storylines, we will answer Dowling's criticism of ethnomathematics as seemingly requiring a Western arbiter. The problem identified by D'Ambrosio, that small achievements are compared to Western

mathematics, is not so easily addressed. However, we will address this criticism in our account of the shifting storylines as well.

Positioning Theory

Positioning theory has provided for us a framework for critiquing our interactions in the research. Our sense of positioning theory follows the social psychology work of Harré and van Langenhove and its consideration in the context of mathematics education by Wagner and Herbel-Eisenmann (2009). In Harré and van Langenhove's (1999) edited book, the general description of *positioning* refers to the way people use action and speech to arrange social structures. This positioning theory claims that, in any utterance, clues in the word choice or associated actions evoke images of known storylines and positions within those stories. For example, as researchers, anything we say or do evokes certain storylines, and the people with whom we interact may comply with or resist a storyline we initiate by responding in expected or unexpected ways.

In their contribution to the Harré and van Langenhove book, Davies and Harré (1999) focused interpretive attention on 'immanent' practices, in contrast to the common scholarly focus on 'transcendent' discourse structures. Using Saussure's distinction between practice and the system of a discourse in which the practice is situated, they differentiated: "*La langue* is an intellectualizing myth—only *la parole* is psychologically and socially real" (p. 32). This approach helped us map out the many people connected with our actions as researchers. Temporarily forgetting about the discipline of mathematics, the cultural practices of Mi'kmaw people, and our goal of bringing these forces together helped us focus on the people and the interactions.

Though this approach focuses attention appropriately on human interaction, we note with Wagner and Herbel-Eisenmann (2009) that myths are the stories people live by, and thus have power and are in this sense real. For example, in this chapter we consider as real the discourses of mathematics and of cultures in conflict in colonialism though positioning theory may seem to encourage us to ignore their force. Following the argument of Davies and Harré, however, we recognize that human interactions are more real than discourses in the sense that they are more local, alive and dynamic; they are relatively receptive to a participant's contributions through action and speech. This view highlights the possibility of alternative structures of interaction.

Taking seriously the existence and force of mathematics, Mi'kmaw and European (Western) culture, and colonial history, though they are transcendent discourses, helps us to identify storylines at work in our research interactions. One chapter in the edited book on positioning addressed the production and use of stereotypes, but it is, even by the authors' admission, not very developed. In that chapter, van Langenhove and Harré (1999b) explained that social psychology (the field in which the book theorizes positioning) does not address stereotypes well. They recognized that stereotypes appear to be positions or characters in storylines, and that these stereotypes might be changed on a local basis by taking up new storylines, but they admit that they have no recommendations about how this might be done on a large scale. We see our efforts to shift the nature of our positioning in our research interactions as an example of the development of new storylines.

Any discourse is static in comparison to the dynamic possibility available to individuals and collectives in any instance associated with that discourse. Thus, the only available site for transforming a discourse is in individual interactions in the moments of action. The discourse is constituted by the sum of its many interactions. And so, we claim, there is emancipatory power in focusing on the real interaction of any moment and ignoring transcendent discursive systems.

The following accounts of our interactions in and relating to the Mi'kmaw communities considers the nature and challenges of this emancipatory power.

SHIFTING STORYLINES IN THE RESEARCH CONVERSATIONS

First Steps

The opening quotation in this chapter comes from the beginning of our ethnomathematical field work. We had invited this particular Mi'kmaw leader and his family to walk with us in the forest to talk about mathematics practices (both traditional and current practices) in their community. He was trying to be helpful by telling us what we wanted to hear. We were grateful for this spirit of cooperation because, according to our planning, it would help us create culturally-appropriate resources for students in his and other Mi'kmaw communities. However, we were a little disturbed that he kept asking if he was saying what we wanted to hear. On reflection we recognized two concerns. Firstly, we did not see ourselves as the ultimate audience of his observations, yet he and we together had positioned us as his audience. Secondly, we worried about authenticity because he seemed to be subjecting himself to our agenda and we did not talk about his agenda(s) at this time.

Further, it was interesting that he was talking about mathematics in his community, while his wife was in the background doing mathematics. We were listening to talk about mathematics and apparently ignoring mathematics in action. The leader's wife had used a stick to measure the depth of the water and compare that depth with the height of her son's boots to demonstrate for him the foolishness of his wish to jump in the puddle. She had said nothing during this episode, and very little in our long walk together. Nevertheless, her non-verbal message had been heeded by the boy.

Thinking about our conversation in terms of participants (using the lens of positioning theory), we envisioned something like the diagram in Figure 1. In it we refer to the teacher from the situation described above as a community representative. His status as a representative of the community came from at least two distinctions. He held community honours that recognized his knowledge of traditions. He was also respected as a teacher who understood the traditions and values of the dominant culture and who was thus well-equipped for intercultural interaction. The people we refer to as being outsiders include a wide range of people, including scholars who would read our research reporting, teachers in Aboriginal schools for whom we would write accounts of the mathematics we would illuminate, and Aboriginal students who would be exposed to these accounts through their teachers who will have read of them and through materials generated by the research.

We also had ethnomathematical conversations with other community leaders, including elders. The diagram reflected the interaction patterns for any of these conversations.

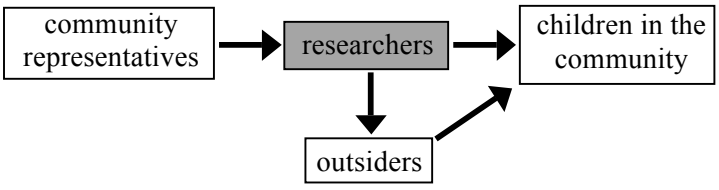

Figure 1: initial ethnomathematical interaction

In the diagram, we highlight (with gray) our position as researchers to indicate our privileged authority. The teacher was telling us what *we* wanted to know, and reminded us regularly of this fact, with explicit questions but most often with his eyes and his expectant pauses interspersed through the sharing of his knowledge about traditional practices that could be deemed mathematical. According to the storyline that we were constructing mutually, we as researchers would decide what and how to pass the knowledge on to people outside the community and to the children in the community.

It is important to note here, that this teacher and others in the community welcomed this research, trusting our judgment about how the community could best accomplish its general wish to make mathematics more relevant to the children of the community. This level of trust is not easy to come by in the Aboriginal communities, which have suffered much even from well-intentioned research and well-intentioned colonialism.

For example, the government policy White Paper entitled *Statement of the Government of Canada on Indian Policy* in 1969 purported to be acting in support of Aboriginal people, but ended up creating harm. This document claimed to have consulted Aboriginal people in an effort to create policy that would allow for "full, free, and non-discriminatory participation" (Department of Indian Affairs and Northern Development, 1969, p.5) yet this policy was perceived by Aboriginal people as an effort to eliminate treaty rights. It prompted a response commonly known as the Red Paper that claimed they felt "stung and hurt by [the Minister's] concept of consultation" (Indian Chiefs of Alberta, 1970, p.2) and argued that the recommendations of the white paper would harm Aboriginal people. The red paper response demonstrates vigilance within the communities with respect to interventions from outside the communities and claims of consultation.

Another policy that claimed to be helping Aboriginal people was that of residential schools, yet these schools caused considerably more harm than good and negatively impacted the larger Mi'kmaw community (Knockwood, 1995). As Battiste (2000) has stated, "these schools broke relationships among the people with themselves, with their own guardian spirits, their parents and communities, as well as with the land and environment" (p. 4). The trail of government decisions relating to policy regarding residential schools is outlined in Malloy's (1999) book *A National Crime.* These experiences and others are behind the communities' requirement that research within the communities be reviewed and formally approved by a council of Mi'kmaw leaders. We are honoured to have had our research approved in this process and informally approved by the ongoing relationships that have been central to the research.

Though we had approval for the kind of research with which we began, it was not our intention to be controlling. Though in any situation every participant has the opportunity to exercise agency, the way we positioned ourselves at the centre of the conversations described here positioned other people in roles that seemed to have limited choice—primarily the choice to follow our storyline or not, complicity or resistance. The storyline we initiated follows the Gerdes' (1988) rationale, described above, and was approved by key people in this Mi'kmaw community. Though this situation generated some interesting revelations (see, for example, Wagner and Lunney Borden, in press) the enacted storyline, to our embarrassment, was reminiscent of our region's colonialist history, which is a distasteful storyline: yet again, outsiders and their agenda are welcomed amongst the people of a generous and patient community, taking what they want from the people.

As with any situation, this one was complex because we were not necessarily seen as outsiders. Lunney Borden, who had worked in this community for over a decade, and who was

learning the local language, Mi'kmaq, was taken as an insider more often than she was taken as an outsider. However, this conversation was Wagner's first in the community. Lunney Borden bringing him in complicated her position as an insider. Together we were positioned as representatives of an institution (the university, and academia in general) while at the same time being taken for who we were as individuals, a well-known ally and her colleague, whom she trusted.

As predicted by Harré and van Langenhove (1999), attending to positioning opened up new opportunities. Our critique came to a point of action when the two of us were talking about our undergraduate teaching and noting that too often our assignments have us doing most of the thinking for the students: we preferred assignments that would have students doing the conceptual work as much as possible. The parallels between our work with our undergraduate students and our research work became obvious, and thus suggested to us that we were positioning the community's students as our students, as children for whom we were accepting some responsibility. Further, why should we do all the ethnomathematical work? The concern was not to limit our work but rather to give others the opportunity to benefit from doing conceptual work that we had been doing following a model of ethnomathematics, and to position community insiders as most responsible to each other with children and others in the community responding to each other.

Reflecting on Morgan's (1998) research that underscores the importance of audience in students' mathematical writing, we realized that positioning the children as the ultimate audience in a chain of knowledge sharing affords them no opportunities to address an audience other than their teacher, and certainly no imperative to engage in real problems and issues faced by their community. It became clear that we should remove ourselves as medium of the transfer from elder to children. New storylines were necessary.

Changing Storylines

From this critique, we connected to a relatively new storyline in Canadian Aboriginal communities. As we agreed about the necessity of positioning Mi'kmaw children as collectors as well as receivers of knowledge, Lunney Borden identified a potential medium for the children's knowledge exchange. As part of the long-standing tradition of storytelling in Aboriginal communities, elders and others have recently begun to share stories and other forms of knowledge among communities across the country in 'contests', using the internet and real-time video conferencing.

Drawing on this storyline, we invited teachers and elders from some of the Mi'kmaw communities to gather and plan such a contest for promoting and exchanging students' ethnomathematical work. The "Show Me Your Math" (SMYM) contest, which was developed in this conversation, has now prompted over a thousand students from four provinces over a three-year period to undertake ethnomathematical investigations to show others the mathematics used in their communities.

In order to break the school tradition of students doing work for teachers as audience, the teachers and elders who came together agreed to develop a video prompt comprising Aboriginal people inviting students' participation and describing the parameters of the contest. It featured only Aboriginal people, including an elder, a middle-aged teacher, and children, all asking the viewer (the student) to "show their math." The elder featured in the video was party to some of our initial ethnomathematical conversations, and also part of the group that gathered to develop and plan the SMYM contest. The video prompt is available at

http://schools.fnhelp.com/math/showmeyourmath/VideoIntroduction.html. It begins with the elder, sitting in a classroom talking about mathematics. He says:

> What is Mathematics? Some people say it's what we do in math class or maybe what mathematicians do; but mathematics is much more than this. A mathematician named Alan Bishop has said that mathematics is counting, measuring, and locating. When you design, explain or play with counting, measuring or locating, you are doing math. If you think of mathematics in this way, you might begin to see it all around you.

This introduction is followed by community representatives noting possibilities for projects. These include an eight-year-old boy saying, "I'd like to ask my Grammy how to say 'an oval' in Mi'kmaq," a women saying, "I'm a plumber, I use math all the time," a 14-year old playing music on his guitar and saying, "Math is in music; I would like to find out more about that," and a middle-aged male teacher saying, "I would like to see some students [looking at how government is] making decisions using math as a tool." The video ends with the elder who introduced it saying, "Now, show me your math," followed by two elementary-aged children repeating with gusto, "Show me your math!"

In response to this prompt, school children interviewed elders, experts in crafts and others to explore mathematics that has been used in their communities' traditional practices and also more current mathematics in their communities. In some schools, elders and other experts were invited by teachers into classrooms. In other schools, students interacted with community members outside of school. Students published their work on the internet site used for the other 'contests' on which the SMYM contest was modeled (see http://schools.fnhelp.com/math/showmeyourmath/studentwork.html). Students also presented their work to the region's communities in a math fair. (For more detailed descriptions of student projects see Lunney Borden and Wagner, 2011)

Figure 2 represents our view of this set of conversations, again using the lens of positioning theory to focus on the interactions among individuals instead of on the powerful cultures at play, including mathematics and Mi`kmaw traditions. Because the web of interactions in this set of conversations was much more complex than our initial ethnomathematical conversations, it was harder to represent in a diagram. We had much less control and access to the relevant conversations, and there were significantly more conversations that related to the web.

As researchers, we positioned ourselves in reciprocal relationships with people in the community by setting the conversation in motion. Our aim was to remove ourselves as much as possible from the many conversations, and try to observe as much as possible. In this cloud of agency (all actors are in a gray cloud in the diagram), there were multiple conversations, each of which included the negotiation of intentions. Elders and other representatives of the communities had things to tell their communities' children. Children wanted to listen, and it became obvious that the more they heard, the more they wanted to hear. We, as researchers, wanted to hear what elders, children and others valued in their conversations and we were interested in the collection of ethnomathematical explorations being compiled by students. The children and others in the community eagerly accepted the invitation for them to talk to each other.

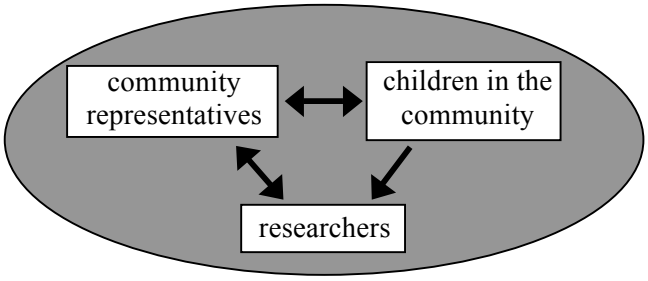

Figure 2: "Show me your math" interaction

Critiquing the web of interactions, we found ourselves once again most critical of our interactions with community representatives. We wrote the script for the elder to introduce the video. Thus, in a way, the video bears our words with his voice and face. However, the elder was not a mere front. He had been part of some of the initial ethnomathematical conversations and had demonstrated his acceptance and understanding of our account of ethnomathematics by giving multiple examples of mathematics at work in traditional practices. He was also part of the group that met to develop the SMYM contest, and had recommendations for the development of the video. This group asked us to make the video.

While this elder had been far from passive throughout these conversations, he was also complicit, suggesting his approval of our actions. We note that such complicity is a form of agency. He did not have to disagree to express agency. In fact, different cultures express active support in different ways; his form of support was expressed in a culturally appropriate way. He made more concrete suggestions and provided more relevant information than anyone in the group developing the contest. For example, one of the most exciting aspects of this planning came when he explained for us all some of the different ways of describing a circle in Mi'kmaq. There are many Mi'kmaw words for circle but none of them translate directly to the noun used in English — 'circle'. Rather, as is often the case in this and other Indigenous languages, there are verbs that relate to the idea that is represented in English by a noun. In this case, some of the ideas associated with a circle translate roughly as "it goes around" or "it is turning around". By contrast, in English it is natural to think of a circle as static and abstract because 'circle' is a noun. This part of the discussion prompted the inclusion in the video of the boy saying he wanted to ask his grandma for the Mi'kmaq word for 'oval.'

Though we brought ideas to the community, we were acting under the direction and invitation of the community, including this elder. Our actions included writing a script for the introduction, and omitting in the video some of the fascinating contributions from this elder and others in the planning. In the planning, we all agreed, after considerable discussion, that we would give brief examples to invite children to get their elders talking instead of deciding as experts what the students should be hearing. Thus the decision to omit elaborated examples in the video was a group decision.

The examples of ethnomathematics provided in the video were roughly outlined partly by our choices of who to ask to appear in the video and more so by us telling these people why they were asked to suggest examples. Unlike the elder`s opening statement, their words in the video were not scripted. Each statement related to the participant's own life experience or interest.

The script we wrote for the elder is also interesting in terms of the critiques of ethnomathematics we outlined above. The script includes what Prince, Frader and Bosk (1982) called an attribution hedge, which is any way of using language to shield oneself from critique

by attributing a proposition to someone else. Rowland (1995) considered this and other types of hedges in his analysis of mathematics dialogue. The elder's definition of mathematics borrows authority by attributing the idea to Alan Bishop, someone unknown to most of his listeners yet with apparently strong credentials: he is described as a mathematician from the other side of the world, and he has a white-sounding name, one which invokes church imagery (bishop).

Considering this attribution hedge, we address Dowling's critique of ethnomathematics, which we outlined earlier in this chapter. Do Mi'kmaq need a white mathematician to tell them that their community practices include mathematical activity? We think the answer to this question is yes, because mathematics itself as a construct is external to the community. Though there is much evidence of mathematical reasoning and problem solving within the historical and modern practices of Mi'kmaw communities, we note that there is no Mi'kmaw word for mathematics. There are words to describe mathematical processes such as counting, measuring, navigating, and designing to name a few, but these were not initially seen as mathematics by the community members we spoke with in our earlier conversations. These cultural practices were evaluated according to how they address community needs, not in terms of mathematical values.

Mathematics is something brought into the community by outsiders through colonialist education (from past to present schooling). Thus, because mathematics is seen as being held (owned and represented) by outsiders, having an outsider with credentials release this hold opens up this field of study to invite Mi'kmaw people to contribute their ideas, approaches, and connections to the field of mathematics. This also relates to D'Ambrosio's criticism of the way ethnomathematics often focuses on small achievements in a culture and implicitly evaluates these achievements in terms of their connections to Western mathematics. There is no need for the word 'mathematics' in Mi'kmaw culture, except for its presence in the school system. Thus identifying community practices as mathematical by implication connects them to what happens in mathematics classrooms. Thus local cultural achievements are related to Western mathematics practices.

Along with the release of a colonialist hold on mathematics, we see greater significance in the students' need to be invited into a new way of seeing mathematics by a local elder, who releases them in another way. We described above how marginalization goes both ways. The elder in the video invites his community's children to connect the community's practices, which are very dear (and some even sacred), to mathematics, which has been connected to colonialism. The invitation structures a relationship in which the students address a local audience, contrasting the usual classroom interactive structure that positions the teacher as the audience. The teacher, in such a relational structure, represents another culture's knowledge and values, that of the prescribed curriculum and measures of achievement, even if the teacher is Mi'kmaq. The explicit switch of audience is represented in the faces of the Mi'kmaw elder and children imploring, "Show me your math." The students respond to a community need to know rather than an external institution's need to know. In this revised interactional structure, the teacher can represent and mediate both external, mathematical knowledge and Mi'kmaw community knowledge.

In addition to the shift in audience there is a shift in the construction of the student's identity. In the invitation, expressed both in the name of the contest and in the elder's and the children's call — "show me *your* math"— 'you' and the associated 'your' refer to the individual student, who is invited to address her or his community. Each individual is invited to work on his or her interests, not someone else's. By contrast, more typically in mathematics classrooms 'you' is used for generalizing—for example, "Your denominators must be equal when you add

fractions." This generalizing sense of the word 'you' has been theorized by Rowland (2000), and exemplified by others including Herbel-Eisenmann and Wagner (2007). The more personal 'you' and the presence of first-person pronouns—for example, the elder and children saying, "show *me* your math," and the teenager saying, "*I* would like to find out more about …"—together, with their recognition of person agency, have the opposite effect of generalizing pronouns, which pervade mathematics. Morgan (1998) has noted the absence of personal pronouns as having a distancing effect in the relationship between students and mathematics.

However, Herbel-Eisenmann, Wagner and Cortes (2010) have noted that in oral mathematics classroom discourse personal pronouns are more prevalent than in published mathematics resources. In fact, they are very prevalent in the most commonly used sets of words. In further analysis of these pervasive sets of words (called 'lexical bundles'), Herbel-Eisenmann and Wagner (2010) noted that there is still little room for personal latitude. Students are not invited to exercise their own choices very much. This research considered lower secondary-school mathematics classes, but we think the patterns extend into both elementary and upper secondary levels. In this research, Herbel-Eisenmann and Wagner describe a prevalent pattern in which students are positioned as doing things because their teacher 'wants them to.'

We argue, that in the case of the SMYM contest, the interactive pattern is similar in that students are responding to someone else's wishes, but that the situation is significantly different from typical classroom patterns because the students are responding to people in the community instead of their teachers, and they are invited to make choices about what they want to study. Nevertheless, the SMYM contest is introduced by their teachers, so there is still the possibility of taking the positioning to be similar to typical mathematics classroom positioning.

A further complication in our representation of the positioning between students, their teachers and their community members relates to our lack of access to the many conversations that are associated with the SMYM contest. We as researchers do not have access to the conversations themselves, only to reports on these conversations, in the form of the student projects, and other accounts of these conversations, coming from our conversations with community members, teachers and students after the key teacher-student conversations and student-community member conversations have taken place. For example, we do not know how teachers have mediated the video for getting the students going. However, even if they do not show students the video, it would have a structuring influence on the teacher's sense of the positioning being encouraged for the SMYM participation.

We also do not know details about the language of communication in the interactions between students and community members. We do not know the word choices and grammatical structures and we do not even know how much of these interactions were in Mi'kmaq. From our discussions with students and teachers, we know that the interactions would have been mostly in Mi'kmaq, or in a hybrid of Mi'kmaq and English. In many communities, elders prefer to speak to children in Mi'kmaq and then occasionally translate into English. The elders would also have an expectation that the students make every effort to respond in Mi'kmaq. When English was spoken, it would have taken on grammatical structures of Mi'kmaq, which tend to be more verb dominant and dynamic than noun dominant and static (Lunney Borden, 2010). The choice of language in these interactions is significant in terms of privileging community versus mathematical traditions. We believe that giving students the power to choose interactions that would privilege a language that connects to their identity and that they do not use for mathematics has the potential to transform mathematical understanding for them.

Our analysis of the positioning of students in the context of their SMYM contest work appears to contradict itself in various ways. There are elements of privileging colonialist or western control of mathematics and elements of release from this control. There are elements of teacher-mediated directions for students and elements of release from that. Altogether, this offers an example of the inherent complexity of identifying positioning in mathematics classrooms, one that is theorized further in Wagner and Herbel-Eisenmann (2009). Nevertheless, we feel that the SMYM contest is worth doing because even at its worst, it invites children to make choices about what mathematics they want to explore, connecting it to their community. However, in our view, the best justification for the SMYM project is that the larger Mi'kmaw community shows many signs of wanting it, and this is not a naïve community at all.

Challenges of Representation

We have described above how the children in the community engaged with their community representatives in relation to the SMYM contest, and how we as researchers related to this. In addition to the positioning in the relationships within the community (including our work in the community), we all have positioned ourselves in relation to people outside the community. Students presented their findings on the internet (as stated above), and we as researchers have been and are reporting to scholars and other educators on our conversations within the community.

Figure 3, which is an elaborated version of Figure 2 to include connections with people outside the community, represents communications from the SMYM conversations moving outside the community and the effects people outside can have on the people of the communities involved, both the children and adults. The box representing the people outside the community is shaded grey to indicate these people's agency. (The people outside the community affect us as researchers too, both directly and through our concern for our friends in the communities, but our focus for this chapter is on the situation faced by children who study mathematics in school.)

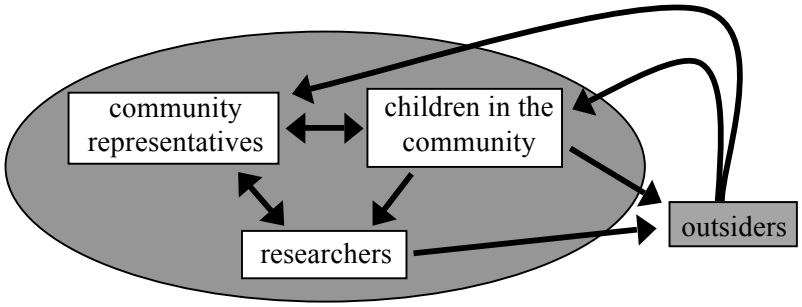

Figure 3: extended interaction

We note that the SMYM contest need not include the posting of student projects on the internet. There are a few good reasons for publishing the projects in this way. First, and foremost, many of the schools that have been active in the contest are part of a unique and relatively new jurisdictional agreement with Canada's federal government, giving the communities control over education. The communities are eager to demonstrate success within

their schools to avert arguments for cancelling the agreement and are also anxious to make use of the technology provided by First Nation Help Desk to ensure its continued funding. Positive publicity is in the communities' best interests. Second, many participant students have displayed their work at regional mathematics fairs, but most have not been able to attend. The internet provides a venue for all participants to share their discoveries with each other. Third, using internet posting aligns the contest with the other contests on which the SMYM contest is modeled, connecting it to the established storyline of community sharing.

In addition to the good reasons for publishing student projects in this way, however, there are concerns to consider. In our reporting on this research, the positioning theory lens helps identify some of these concerns. We have experienced enthusiastic audiences in our reporting, but we have sometimes worried about the storylines that might be enacted by our audiences. We have become aware of these storylines from the questions and feedback received by scholarly peers. For example, a colleague within the larger research project with which this research is associated wanted to use some of the students' ethnomathematical work to compose some problems for a textual resource he has been developing. From this, we were reminded that the students' ethnomathematical work could be used as a rich resource for people wanting to make connections between school mathematics and Aboriginal practices, and we also became aware of the lack of control the authors of the projects (the students) would have over how this material is used.

There are significant concerns to consider in representing Aboriginal community practices outside their communities. First, and most important (because our ethical responsibilities trump all other concerns in the research), we know that Aboriginal people in Canada are very concerned with the way they are represented outside their communities. Second, we share their concern ourselves and identify real dangers their communities face related to the images that feed stereotypes. There is the danger of essentialization. People reading a question taken from student ethnomathematical work may take it as representative of all Aboriginal communities, or of all Aboriginal responses to the particular situation addressed. Aboriginal people, much to their detriment, have had and continue to have storylines attributed to their lives by outsiders in this way. In his Massey Lecture series, King (2003) has explained well (and satirized) the construction of the "mythologized Indian" and some of the challenges such stereotyping presents for Aboriginal people.

Ironically, this problem of representation can be exacerbated by an emerging ethic of inclusion. School textbook publishers, clearly with good intentions, set standards for their books to include minimum percentages of representation of Aboriginal people in their images and word problems. The reality for authors and visual editors is that to meet these quotas they need to choose images and examples that are recognizably Aboriginal, which means using images and names that outsiders will connect with their knowledge of Aboriginal things, which inevitably includes stereotypes.

We looked through authorized mathematics textbooks for the Atlantic Provinces, which relate to the curriculum followed in the Mi'kmaw and Wolastoq[2] schools involved in the SMYM contest to get a sense of the current depiction of Aboriginal cultures in mathematics learning materials. We take all our examples from one book—*Mathematical Modeling—Book 1* (Barry et al., 2000), though we looked more widely. Our first observation was that there is very little in the

[2] Wolastoq communities are often referred to as Maliseet. Wolastoqiyik and Mi'kmaq people are neighbours geographically.

books that situates the mathematics in any culture, and plenty of missed opportunities. For example, with the question "What is the capacity of a pyramid-shaped box that is 20 cm tall and has a regular hexagonal base with side lengths of 15 cm?" (p. 269) the material for the box is dimensionless and students may wonder why someone would want a pyramid-shaped box. There are plenty of interesting-shaped containers in Aboriginal communities, and, for that matter, in non-Aboriginal communities, which have their own cultural distinctions worth including. There are in this book some references to particular cultures, but they do not seem to honour the people of the culture. For example, marginalized in a box beside the main text (or perhaps emphasized, but nevertheless positioned separately from the main text) we found "Did you know? One of the most famous pyramids in Mexico is the Kukulcán located in Chichen Itza. The steps going up the pyramid are very steep" (p. 240) and a question in the regular text on the same page describing normal stairs: "For safety reasons, a 'normal' set of stairs can only have a rise of 72 cm for every 1 m of run. What is the tangent of the base angle B?" (p. 240). This combination positions the people of the Aboriginal culture as not normal and overlooks the significant design that went into constructing this pyramid by asking about a measurement that is relatively meaningless for someone building a pyramid. Why not ask questions that invite students to imagine themselves building such a pyramid and perhaps calculating how much stone they would need?

Gerofsky (2000) described the apparent arbitrariness of contextual and linguistic structure of word problems that implies an "'understanding' between writer and reader that these supposed situations do not have truth value, and that the writers' intentions and the readers' task are something other than to communicate and solve true problems" (p. 46). This apparent arbitrariness (and even disposability) of context may be particularly disturbing to cultures, such as Mi'kmaw culture, in which context is indispensible. Nevertheless, Gerofsky's discussions with mathematics students prompted her to note that word problems can give them a "point of entry, a place to insert oneself actively into the story" (p. 132). The point of entry could welcome the student's cultural knowledge. Alternatively, as seems to be the case with the positioning of Chichen Itza as not normal, the point of entry may engage students with antagonism by marginalzing non-European cultural traditions and thus alienate an Aboriginal student.

In mathematics resources, we would hope to see students being directed to imagine themselves in the shoes of someone doing mathematics to address their needs — an active point of entry. For this to happen attention would need to be drawn to the questions one faces in design, instead of questions that one might ask about the finished product of the design. This distinction appeared in student contributions to the SMYM contest. It was clear that many of them positioned themselves alongside the designers in their community addressing personal and communal needs, as they identified explanations for how to make a *wi'kwam* (wigwam), a flat bread, or a drum. Others, however, positioned themselves as an outsider using foreign mathematical tools to analyze a local product, by, for example, using 'the formula' for the circumference of a circle to mathematize the outside of a dreamcatcher.

Responding to concerns about representation, we recognize that if we did not report the ethnomathematical work done by the students in scholarship or in facilitating the students publishing their own work on the internet, people outside the community would still be positioning the community in certain ways. With publishing more positive examples and communications, there is hope that some stereotypes will be diminished. Most powerfully, there is a clear message that the members of the communities are exercising agency because the website that displays the projects attributes them to the students' work directly, because the

diversity of the student projects suggests that they had significant liberty in their work, because the instructions are given by Mi'kmaw people in the video, and because this is all displayed on a site hosted by a first nations (Aboriginal) organization—The First Nations Help Desk (http://firstnationhelp.com/)

It is inevitable that there is reciprocity in the relationship between the people in a community and outsiders. The members of the Mi'kmaw communities engaged in the SMYM contest have been speaking into the world of outsiders, who in turn speak into the community in various ways. We argue that repressing contact is not in the best interests of the communities. Rather, mindful consideration of the implications of engagement with outsiders is warranted, and may draw attention to important mathematical values—for example, which is more valued, design or analysis? Nevertheless, when a community attends to the positioning at play within its relationships, as has been the case for participants in the SMYM contest and the people with whom they interacted, the view from the outside is more likely to be positive.

REFLECTION

As described above, our attention to interpersonal interaction illuminated aspects of our research activity. On reflection, trying to conceptualize the positioning with the maps given in Figures 1 through 3 illuminated even more. The map-making process and the maps themselves demonstrate to us that we have been seeing knowledge as a thing, as something that can be passed from one person to another. Such a conceptualization of knowledge can commodify knowledge, as it established metaphors for the exchange and distribution of knowledge. Interestingly, seeing knowledge as a thing relates to the dominance of nouns in English speech and writing, relative to the Mi'kmaw dominance of verbs. The elders explanation of how to talk about a circle in Mi'kmaq, which we described briefly above, is an example of this difference.

Perhaps the context of conversations in an Aboriginal community further invited the commodification of knowledge because of well-known storylines that relate to 'keeping traditions', 'loss of language', and 'elders passing on their knowledge', all of which use nouns to refer to knowledge and tradition in the context of Western influence and use metaphors of possession and transactions. However, such metaphors are pervasive outside of Aboriginal communities too, where people talk about 'course delivery,' 'acquisition of knowledge, attitudes and skills,' and the 'possession of essential graduation learnings,' among other images. We believe that the languages in the SMYM communities, Mi'kmaq and Wolastoqiyik, would not use these metaphors because the languages are far less noun-intensive than English. This chapter depicts our metaphors because the accounts of our research comprise our reflections, not our Mi`kmaq counterparts` reflections. We look forward to talking with elders about this distinction.

Nevertheless, the most important reflection for us relates to equity, which we would characterize as the fundamental value that has driven the research we describe here and the other research we have done. In the above analysis we analyzed the discourse in our research interaction as a means for addressing equity issues.

Gutierrez (2011) clarified the scope of the word 'equity' as it has been used in mathematics education, distinguishing among access, achievement, identity and power. In our analysis we have focused on identity and power, which Gutierrez characterized as the critical axis of equity. Access and achievement form the dominant access. She has described the critical axis as reflecting the mathematics that builds cultural identity around social and political issues, and notes that this kind of mathematics challenges static formalism (Gutierrez, 2007). Our focus on the discourse, which highlighted interpersonal interaction, draws attention to the critical

access. Nevertheless, we believe that such attention to power and identity in education relationships will have positive influences on achievement and access.

We understand that leaders in the Mi'kmaw communities do have an interest in access and achievement, and we think their interest in these aspects is not misplaced. In terms of access, they have articulated to us the need for people within their communities to be equipped to engage with external powers that greatly influence community concerns. For example, in the conversation in which the particulars of the contest were formed, community representatives` identification of modern community practices that should be highlighted in the ethnomathematics being done in the community comprised professions that would have immediate practical benefit for the community—plumbers, lawyers, lobbyists. It is recognized that for this kind of engagement mathematics is a key component. The shifts we made in our positioning as a result of paying attention to the discourse in our research relationships actually prompted school children to access community members who were engaged in professions that require mathematics. This access at a micro level is not what scholars usually mean when promoting or measuring access, but we think it is related. Students who have relationships that give them access to people in professional discourses end up making decisions that can give them access to these professions as participants.

It is inevitable that people position each other in their relationships. One way to avoid being positioned by others is to avoid relationships. We believe that there are greater dangers in isolation. We are suggesting that there is significant value for mathematics educators with an interest in equity to reflect on the discourses at play in their research. In particular, attention to interpersonal interactions was most fruitful in our experience as it led to the fundamental restructuring of our research relationships and the resultant effects on the community context.

Asking questions such as the following may be a good way to begin. These are questions that were central to our criticism of the conversations in our research and to our choices for restructuring these conversations. A teacher might ask:1) To whom are my students reporting their mathematics? 2) Whose problems/needs are my students addressing when they do the tasks I assign them? 3) How are people and communities represented in applications of mathematics I introduce? An education researcher might ask: 1) To whom am I responding when I do my research? 2) Whose problems/needs are addressed in the research and how are these problems /needs identified? 3) How are people and communities represented in the reporting of my research?

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