Aboriginal Perspectives and/in Mathematics: A Case Study of Three Grade 6 Teachers

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Abstract

The marriage of Aboriginal perspectives and mathematics is complex and comes with multiple interpretations. Through the research presented in this paper, we propose that one possibility for a lasting relationship between Aboriginal perspectives and mathematics lies in understanding more about teachers' experiences and stories from their own mathematics classrooms, with their own students. The purpose of this paper, and of the research project informing this paper, is to understand how Grade 6 teachers in one particular Canadian province (Saskatchewan) are addressing Aboriginal-focused curriculum goals/outcomes and to listen to teachers' perspectives on teaching mathematics with a distinctly Aboriginal focus. Data collection consisted of focus group discussions, individual interviews, and classroom observations with three case study teachers (Chris, Joe, and Lindsay). In this paper, we present three brief vignettes constructed out of the data, which provide a glimpse into the uniqueness of each teacher, each classroom, and each interpretation of what it means to teach mathematics through a distinctly Aboriginal focus.

Keywords: Aboriginal education; mathematics curriculum; qualitative research; case study; Grade 6 teachers

Authors' Note

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The relationships between Aboriginal cultures and mathematics are being conceptualized and practiced in many different ways across many different contexts. Research in the field ranges from discussions of culturally relevant pedagogy (Abrams, Taylor, & Guo, 2012; Greer, Mukhopadhyay, Powell, & Nelson-Barber, 2009) and culturally relational education in mathematics (Donald, Glanfield, & Sterenberg, 2011; Mason, 2006) to critiques of attempts to assimilate, segregate, and represent Aboriginal learners as culturally or mathematically deficient (Donald, Glanfield, & Sterenberg, 2011; Sterenberg & Hogue, 2011). Some would declare that promoting a picture-perfect marriage between Aboriginal perspectives and mathematics, without understanding its complex interpretations and readings, is doomed for the same failure as that of past mathematical marriages─between mathematics and science, mathematics and technology, and even mathematics and social justice (Nolan, 2009). The issue certainly raises the question for us as authors, and as mathematician and mathematics educator, of whether the project of Aboriginal perspectives and/in mathematics is currently conceptualized and practiced as another "make-work" relationship, with its extended periods of silence and frequent power struggles. Through the research presented in this paper, we propose that, in fact, one possibility for a lasting relationship between the areas lies in understanding more about teachers' experiences and stories from their own mathematics classrooms, with their own students.

The purpose of this paper, and of the research project informing this paper, is to understand how Grade 6 teachers in one particular Canadian province (Saskatchewan) are addressing Aboriginal-focused curriculum goals/outcomes and to listen to teachers' perspectives on teaching mathematics with a distinctly Aboriginal focus.

Background and Context for the Study

Mathematics is often referred to as a "gatekeeper" (Stinson, 2004), a discipline of study that one either has an aptitude to understand and succeed in, or not. Disrupting what it means to know (in) mathematics, as well as the nature of mathematics itself, can be a challenging task. As Burton (2012) notes, "it might be acceptable to negotiate a curriculum or introduce a collaborative, language-rich environment within which to make the learning of mathematics more accessible, but the mathematics itself is considered non-negotiable" (p. 20). In many ways, the various marriages between mathematics and social justice, technology, science, and Aboriginal perspectives risk further reifying Burton's (2012) claim that the marriages make mathematics more *accessible*, but not actually *different* in any enduring manner. The critique follows that if changing the nature of mathematics itself is non-negotiable then all one is left with is a soft integration—an approach where curriculum, pedagogy, and assessment are adapted in an attempt to suit the needs of diverse learners, but the discipline itself (and what it means to do and know mathematics) remains intact. The soft approach to integration makes it truly challenging to view Aboriginal perspectives (and, for that matter, any additional perspectives or lenses) as anything but add-ons, which are only taken into consideration if teachers have the time and inclination to do so.

The critique is not only centred on the subject of mathematics. Research reports that schooling experiences in other subject areas are not well-aligned with the cultural values and traditions of Aboriginal students (Claypool & Preston, 2011; Deer, 2011; Higgins, 2011; Kanu, 2002). Several of these research studies explore possibilities for designing and implementing a

cross-cultural curriculum that is more reflective of local First Nations and Métis groups (Higgins, 2011; Kanu, 2011). Recently, there have been efforts to design mathematics curriculum that incorporate Aboriginal perspectives as a more seamless aspect of everyday lesson planning for teachers. For example, in the province of Saskatchewan and in line with the Western and Northern Canadian Protocol (WNCP, 2006), one of nine (9) critical characteristics of mathematics discussed in the Grade 6 Mathematics Curriculum (Saskatchewan Education, 2006), is *First Nations and Métis Learners and Mathematics*. This document states:

> A first step in actualization of mathematics from First Nations and Métis perspectives is to empower teachers to understand that mathematics is not acultural. As a result, teachers then realize that the traditional ways of teaching the mathematics are also culturally-biased[*sic*]. These understandings will support the teacher in developing First Nations and Métis students' personal mathematical understandings and mathematical self-confidence and ability through a more holistic and constructivist approach to learning. Teachers need to consider factors that impact the success of First Nations and Métis students in mathematics: cultural contexts and pedagogy. (p. 17)

In addition to this philosophical positioning, curriculum documents also include specific First Nations and Métis Aboriginal-focused outcomes throughout Grades K-12. For example, in the Number strand of the Grade 6 mathematics curriculum , one outcome asks students to "research and present how First Nations and Métis peoples, past and present, envision, represent, and use quantity in their lifestyles and worldviews" (Saskatchewan Education, 2006, p. 34).

In addition to First Nations and Métis specific initiatives, curriculum initiatives in Saskatchewan and elsewhere stipulate that, in mathematics classes, a “variety of teaching and assessment strategies is required to build upon the diverse knowledge, cultures, communication styles, skills, attitudes, experiences and learning styles of students” (WNCP, 2006, p. 3). While this same document advocates that the “strategies used must go beyond the incidental inclusion of topics and objects unique to a culture or region, and strive to achieve higher levels of multicultural education" (WNCP, 2006, p. 3), it does not go so far as to provide more specific information and ideas for how to attain this goal. Similarly, many additional resources in mathematics education call for more authentic approaches to the integration of multicultural content into the teaching and learning of mathematics (Greer, et al., 2009; National Council of Teachers of Mathematics (NCTM), 2002; Saskatchewan Curriculum, 2010; Van de Walle & Folk, 2005), but few seem to ground their ideas in concrete practices (Lunney Borden, 2013).

Although curriculum documents contain general statements and specific outcomes regarding incorporating Aboriginal perspectives, much remains to be learned in transitioning these documents to include Western and Indigenous perspectives. Higgins (2011) points out:

> In transforming a curriculum so that it better reflects the multiple worldviews inherently present in many Indigenous communities, we can use the points of resonance where Western science and Indigenous knowledges meet as a point of departure to ease the transitions between bodies of knowledge. (p. 19)

Current research on understanding and integrating Indigenous knowledges resists reifying Burton's (2012) claim above, making it apparent there is a glaring need to hold more conversations between Western and Indigenous perspectives, in the discipline of mathematics

and mathematics education (Doolittle & Glanfield, 2007) as well as in other school subject disciplines.

Research into Indigenous knowledge and ways of knowing is becoming more widespread (Claypool & Preston, 2011; Higgins, 2011; Nichol & Robinson, 2000; Sterenberg, 2013) and, for the sake of brevity, is not reiterated here. While this body of research on Indigenous knowledge and ways of knowing has significantly informed our research project, it is important to note that our intent (in that research and in this paper) is not to conceptualize an Indigenous mathematics that "transcends" curriculum. Instead, our research aims to emphasize that "[s]chool curricula and textbooks...must include Aboriginal culture/ content/ issues/ topics/ perspectives, and teachers' pedagogies must integrate these perspectives on a consistent basis" (Kanu, 2011, p. 195). We agree that, in mathematics education, it is desirable to move beyond a "just add and stir" (Rosser, 1997) approach to indigenizing mathematics curriculum, but we are also fully aware that many teachers are only just beginning to consider alternative ways of teaching, learning and knowing mathematics. We claim that a reasonable starting point is one that would "provide teachers with easy access to Aboriginal resources that are ready for classroom use" (Kanu, 2011, p. 194). Research on Aboriginal perspectives and Indigenous mathematics, along with the experiences of our lesson design team and the explicit outcomes of school mathematics curriculum documents, have together shaped our research project and our overall work designing mathematics lessons on Aboriginal perspectives and/in mathematics.

Overview of Aboriginal Perspectives Project

In 2009, one of the authors (Weston) worked with students, mainly from the Saskatchewan Urban Native Teacher Education Program (SUNTEP), to develop mathematics activities with a distinctly Aboriginal focus. In 2010, we were approached by SUNTEP and the Saskatchewan Instructional Development and Research Unit (SIDRU) at the University of Regina to request an expansion of this initiative. The goal was to equip Saskatchewan teachers with ideas and activities for integrating an Aboriginal perspective into their mathematics lessons. To accomplish this, a SUNTEP student was hired for the summer of 2010 to develop lessons and associated kits of activities for a mathematics workshop for Grade 3/4 teachers based on eight Aboriginal themes. The intent of the workshop was to aid teachers in using the resources in their classrooms or in augmenting their own lessons to include some of the materials developed. The SUNTEP student delivered the workshop to Regina area teachers in November 2010 with a follow-up meeting taking place in April of 2011, at which point teachers were asked to share their experiences using the kit activities in their classrooms. While these sharing conversations with the teachers were informative, a more formalized research study was needed in order to understand better classroom practices and the value of the activity kits. In the summer of 2011, two SUNTEP students were hired to develop lessons and associated kits of activities for Grade 5/6 teachers. The students delivered a Grade 5/6 workshop to nine Regina area teachers. We invited these nine teachers to participate in a research study that sought to understand teachers' perceptions on the integration of Aboriginal perspectives into mathematics curriculum. Three teachers responded positively and this paper reports on a case study of these teachers.

Research Methodology and Methods

In our research study, we were interested in understanding teachers' perspectives on teaching mathematics through Aboriginal-focused content and themes, and thus we present our research

in the form of three narrative case studies. As a methodology, narrative gives life to the complexities of teaching, learning, and knowing. Ritchie and Wilson (2000) propose that "in forcing us to compose, articulate, and reinterpret our lives, [narrative] can move us toward action" (p. 21). Reinterpreting our lives in the form of stories is valuable from at least two perspectives: stories “tell of individual experiences, and they may shed light on the identities of individuals and how they see themselves” (Creswell, 2013, p. 71).

Organizing narrative methodology within a case study framework emphasizes the importance of listening to and documenting teachers' stories as well as the value of studying bounded single cases. Case study is considered an approach to research “in which the investigator explores a real-life, contemporary bounded system (a case)” (Creswell, 2013, p. 97). As previously mentioned, in our Aboriginal Perspectives project (lesson plan construction and workshops), we worked with a group of nine Grade 6 teachers but, for the purposes of the research component and data collection, three Grade 6 teachers volunteered to be participants. We studied each of these teachers by listening to their stories, through focus group discussions and individual interviews as well as through conversations based on classroom observations of a mathematics lesson being taught. Stake (2008) suggests that the value of case study can be "in refining theory, suggesting complexities for further investigation as well as helping to establish the limits of generalizability" (p. 141). We value each of the three teacher's stories for what they convey to us about the complexity of teachers' professional lives, without attempting to compare and generalize the research learnings across all three cases or, for that matter, to other teachers.

As mentioned above, our data collection consisted of focus group discussions, individual interviews, and classroom observations with our three case study teachers (Chris, Joe, and Lindsay). In all, we conducted two focus group sessions (one held prior to the teachers being introduced to the Aboriginal Perspective lesson kit and the second one held at the end of the school year, once teachers had several months to use the lessons in their classrooms) and one classroom observation followed by an individual interview with each teacher. In this brief paper, it is not possible to elaborate extensively on the data gathered from each of the three teachers during the course of the research study. Instead, we present three brief vignettes constructed out of the data, which we believe, provide a glimpse into teachers' philosophies and approaches with regard to incorporating Aboriginal perspectives into mathematics classrooms.

Discussion of Data: Vignettes of our Case Study Teachers

Teacher Case Study 1: Chris

Chris (pseudonym), who teaches a Grade 5-6 split at a K-8 school in Regina, states that she is always looking for ways to develop her mathematics teaching ability because "kids hate it so much" (interview transcript, November 5, 2011). She thought that integrating Aboriginal content into mathematics would make mathematics more appealing to students, while also fulfilling one of her own professional development goals of integrating First Nations and Métis content into curriculum.

When asked about previous experience integrating Aboriginal content into schools and classrooms, Chris recalled:

> At my first school, we had a pancake breakfast and played aboriginal math games, like you just came and got your breakfast and you sat down at a table and

> you played these games... but it was just games. There was no teaching; there was no background. Like, I could not tell you the First Nations content behind the games but I could tell you how to play all of them and tell you that they came from First Nations history, but what it stands for or where it evolved from I don't know. (Chris, interview transcript, November 5, 2011)

After owning the Aboriginal Perspectives kit for a few months, Chris shared with us that she worked hard at trying to fit the activities into the mathematics units, instead of just saying to her class, "Hey, let's play some Aboriginal math games" (interview transcript, November 5, 2011). She provided specific examples of how one lesson (a beadwork activity) worked well in her fractions unit and another one (a polygon activity) had been used while teaching geometry. We asked Chris if she thought the Aboriginal content focus of the mathematics activities made a difference, or if the activities could have been more *acultural*. She responded that "it's a good and easy way to tie in the First Nations content."

During our final interview conversation with Chris, we asked her to share with us any other kit activities she had used in mathematics classes for the remainder of the school year. She responded that she used the activities in her Grade 6 mathematics class only a couple of more times, but that she used them in social studies and treaty lessons. She explained, "Yeah, cause I didn't even get through my math curriculum this year. But it's a nice way for them to not be bored with notes for treaty...I'm not a very good treaty teacher ‘cause I don't really know anything" (Chris, interview transcript, November 5, 2011). As the conversation progressed, it was clear that the combination of trying to teach a very full mathematics curriculum and her perceived lack of ability to engage students in treaty education resulted in Chris shifting how she used the activities—a shift from the mathematics classroom to the social studies classroom. In addition, she reported, the students did not even "see it as math because we did it in social"(Chris, interview transcript, November 5, 2011).

In addition to declaring limited knowledge about First Nations, Métis, and treaty education, Chris also questioned such an exclusive focus on First Nations and Métis cultures because she had recently been experiencing considerable diversity of cultures in her classroom. We asked if school administrators or parents put extra pressure on her with regard to the focus on First Nations and Métis content. She stated: "I think administrators are typically on board; I don't know if it's by choice or if it's enforced from higher powers in the school board... and I've never had problems with parents asking me about it though I do know a situation in our school." Apparently, in that situation, a parent who had recently immigrated to Canada wanted to know why her child was learning so much about First Nations and not about her own culture.

Overall, it seemed clear in each of our conversations that the integration of Aboriginal content sat quite uneasily with Chris. She expressed discomfort with her own knowledge, with the fact that she was asked to focus on First Nations and Métis cultures while neglecting to focus on, and learn about, the cultures of many other students in her classroom, and with the way in which parents were not really educated on the reasons for the focus. Chris stated "I would like to be able to justify [it] to parents... and as a teacher who's not completely sold on it, that's hard to do." She added, "So even me personally, I struggle with that, like I know province wide [there] is a higher shift towards First Nations but I think it could easily turn into a segregation of other cultures and that really bothers me. So I would like to see that addressed somehow" (Chris, interview transcript, February 15, 2012).

Teacher Case Study 2: Joe

Joe, who teaches mostly mathematics at a K-8 school in Regina, confessed that he didn't focus enough on Aboriginal involvement in his teaching of mathematics. In response to our request that the research participants comment on what it means to them to integrate Aboriginal content into mathematics teaching and learning, Joe responded:

> I'll be dead honest here. I probably wouldn't be involving Aboriginal content in my math if I wasn't supposed to. If it wasn't in the outcomes and indicators, I'd probably say well that's important [but]…I would still recognize the importance of it but I would say I'll get to that after graphing, after probabilities, after, after, after … (Joe, interview transcript, November 5, 2011)

Joe seemed somewhat apprehensive about introducing Aboriginal content into his mathematics classes and when asked about school administration and parent support he shared with us that, while he had not received concerns from parents; nevertheless, he commented "I might get a parent complain to me...and I'm not Aboriginal and the parent comes in and says you know you're not Aboriginal and you're teaching this what do you think you're doing, we'll just teach the way we're doing it" (Joe, interview transcript, November 5, 2011).

When we visited Joe's classroom for one mathematics class, he drew on two of the lessons in our activities kit, which were game-based, modifying one of them to more closely match the level of his Grade 4-5 class. In our interview after that mathematics class, Joe informed us that he might use the games in a "shoebox…something that is a math fun game to do after they've done their regular assignment" (Joe, interview transcript, May 10, 2012). Joe talked enthusiastically about the prospect of organizing an Aboriginal math day where there would be stations with Aboriginal games; the students would circulate and have an opportunity to experience the games. During our final interview with Joe, he confessed to us that he had only used our lessons on the day of our visit and that he had been unable to organize an Aboriginal math day after all, but that he hoped to accomplish this in the following school year.

The kits presented to the Grade 6 teachers contained background information on the cultural themes/issues around which the lessons were constructed. While this information was viewed by Joe as being important, it also presented a challenge for him. Joe believed that the background information would best be covered in a social studies class but, he informed us, he does not teach social studies. He shared with us: "I don't want to give two [math] classes where I give one class the background of the history of it but you know that's useful and that's important" (Joe, interview transcript, May 10, 2012).

Through our discussions with Joe, it became clear that in his practice he would continue to meet the curriculum outcomes as he had in the past and that the integration of materials with an Aboriginal perspective would be accomplished through additional activities such as shoebox games or through an Aboriginal math day.

Teacher Case Study 3: Lindsay

Lindsay, who teaches Grade 6 in a rural school not far from Regina, shared with us that she has a background in teaching about Aboriginal awareness and First Nations history in another province. When asked why she was interested in attending our workshop, she explained:

> I do have some, you know, background knowledge but I also don't necessarily know how to link that to math much more than what you said, like I know some cool games that you can bring out in math but as far as integrating it into every unit, I struggle with slotting it in everywhere. (Lindsay, interview transcript, November 5, 2011)

She was also concerned that her First Nation knowledge was not from the Saskatchewan area.

Lindsay has no First Nations students in her classroom and there are very few in her school but she experiences no difficulty in arousing an interest in First Nations culture in her students. She shared with us:

> So they all know that I have a background teaching First Nations and things and right now that's just a huge interest with them, I think because I talk about it so much and I have things in social studies. (Lindsay, interview transcript, April 18, 2012)

During our visit to Lindsay's classroom, she had her students work on a quillwork activity from the kit. Prior to teaching the lesson that day, she conducted her own research and expanded on the background provided in the kit by bringing in some books on Aboriginal art and by showing her students a video of a First Nations woman creating an artwork using quills. While her students were working on the activity and its mathematical component, she continually brought the discussion back to the Aboriginal aspects of the lesson. It was clear that she was quite comfortable with integrating the mathematical and Aboriginal components. In addition, Lindsay shared with us:

> I always end up linking it again back to ELA so we'll probably, this afternoon, do a quick write on what we thought about First Nations people and quill working and what they thought when they saw that video or they looked at those pictures or touched the porcupine things. (Lindsay, interview transcript, April 18, 2012)

We think this illustrates Lindsay's ease in integrating Aboriginal content across the curriculum.

During our final interview with Lindsay, we asked if she experienced any resistance from school administration or parents with regard to this focus on First Nations and Aboriginal culture. She responded that the school administration was very supportive and that she had not received any concern from parents. With regard to such an exclusive focus on First Nations and Métis cultures, she responded:

> You know, in Canada, we're meant to make sure we touch on those kinds of things, but it's not saying that you can't touch on all the other things, like you know this year even in our social studies class, we've learned about tons of other cultures and brought that in to show different curriculum outcomes, like power and authority. (Lindsay, interview transcript, April 18, 2012)

Lindsay seems able to weave seamlessly First Nations content into her lessons and she clearly has a passion for this aspect of her teaching. She stated, "You know, I love bringing First Nations things in." It is also clear that Lindsay's students thrive on her enthusiasm, evident when she stated: "I guarantee someone will come in tomorrow morning and say 'I went on You Tube and I

watched that quill working video and I saw this other one'…" (Lindsay, interview transcript, April 18, 2012).

Interpretations and Closing Thoughts

It is important for us, as researchers, to admit that our original goals and intended outcomes of this project were to 'help' teachers realize that one can seamlessly integrate a distinctly Aboriginal focus into mathematics classrooms without doing so in a contrived, inauthentic manner that 'sacrifices' content. We intentionally made links in our activities to a range of curriculum outcomes so that teachers would begin to see the Aboriginal focus as one possible context for the mathematics being studied. We were hoping this might lead to a deconstruction of a common approach of separating mathematics from its contexts—an approach that often results in first teaching the 'real' mathematical content and then pointing out a few examples from Aboriginal (or other) cultures in order to make a few obligatory connections. Admittedly, as researchers and mathematics educators, we hoped that all teachers could eventually become like Lindsay, who neatly supported our project intentions.

Through this study, however, our eyes have been opened to the uniqueness of each teacher, each classroom, and each interpretation of what it means to teach mathematics through a distinctly Aboriginal focus. We now question the idea that school divisions or ministries of education could possibly mandate particular ways of incorporating Aboriginal perspectives into the teaching of mathematics. Mandating how/when/why teachers teach mathematics through Aboriginal perspectives would suggest that there could be a consensus on a "best practice"—an idea that is challenged through the stories and individual approaches of these three teachers. Each teacher is a different individual with a distinct teaching identity and, as evidenced in this paper, our efforts to provide fully developed lesson for them to integrate into their ordinary teaching day produced mixed outcomes. One teacher viewed the lessons as not being connected explicitly enough to the mathematics content and curriculum that she must cover, but acknowledged its fit within the content of her social studies class (Chris); another teacher preferred to enact his integration attempts by addressing traditional mathematics curriculum outcomes separately and then connecting to the activities on Aboriginal perspectives when there is time, on a special "events" day (Joe); and the third teacher (Lindsay), had one eye on mathematics outcomes and the other eye on connections (to student interests, to Aboriginal perspectives, etc.) and did not need nor desire that they be kept separate; for her, the marriage of mathematics and Aboriginal perspectives works on a number of levels.

As researchers and educators, we do humbly confess that we feel strongly about which approach we think is the best approach—and which teacher "got it right!" We are thus returned to the issues raised in our introduction, and we admit to having many more questions now than when we started this research project. Are we at risk of establishing inflexible ways of living out this marriage of mathematics and Aboriginal perspectives? Are we working to build a robust marriage or one doomed for divorce due to "simplified consensus practices and misunderstood communication" (Nolan, 2009, p. 214)?

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