# Identity-Making through Cree Mathematizing

Stavros Georgios Stavrou
*University of Saskatchewan*

M. Shaun Murphy
*University of Saskatchewan*

## Abstract

We describe mathematics classroom teaching practice in an urban Canadian prairie Cree-bilingual school using the term *Cree mathematizing*, which, to us, means (re)considering Euro-Western school mathematics from the perspectives of the Cree people engaging with the content. *Cree mathematizing* takes the form of classroom lessons in which mathematical terms are translated between English and Cree, shared through stories situated in time, place, and relationships, and contextualized by the experiences of the students and teachers. In terms of the narrative conception of identity-making, *Cree mathematizing* is a process of engaging in school mathematics that necessitates Cree educators and students to understand themselves as producing mathematics through their unique experiences and stories, making *Cree mathematizing* a

**Canadian Journal of Education / Revue canadienne de l'éducation 42:3 (2019)**

**www.cje-rce.ca**

partial representation of identity. We argue that *Cree mathematizing* is a subversive practice that challenges the ways Euro-Western school mathematics is taught as a culture-free, apolitical, and decontextualized endeavour that is devoid of human narratives of experience.

*Keywords:* Indigenous mathematics education, Indigenization, narrative inquiry, Aboriginal education

## Résumé

Le terme « mathématisation crie » est utilisé pour décrire les pratiques éducatives en classe de mathématiques d'une école bilingue crie située en région urbaine des Prairies canadiennes. Pour nous, cela signifie de (re)considérer les cours de mathématiques euro-occidentaux de la perspective des peuples cris qui s'impliquent dans leur contenu. Dans la classe, la « mathématisation crie » est enseignée sous forme de leçons dans lesquelles les termes mathématiques sont traduits de l'anglais au cri ; elles sont transmises par des histoires situées dans le temps et le lieu, caractérisées par des relations, et contextualisées par les expériences des étudiants et des enseignants. En ce qui concerne la conception narrative de l'identité personnelle, la « mathématisation crie » s'articule par un processus d'engagement dans les mathématiques qui demande des éducateurs et étudiants cris de se comprendre eux-mêmes en tant que producteurs de mathématiques influencés chacun par ses propres expériences et son histoire, faisant de celles-ci une représentation partielle de leur identité. Nous soutenons que la « mathématisation crie » est une pratique subversive remettant en question la manière euro-occidentale—sans référence culturelle, apolitique, décontextualisée et dépourvue de récits d'expériences humaines—d'enseigner les mathématiques.

*Mots-clés :* éducation autochtone en mathématiques, autochtonisation, recherche narrative, éducation des Autochtones

## Acknowledgements

The first author's research and work is supported by SSHRC (Social Sciences and Humanities Research Council) and PIMS (Pacific Institute for the Mathematical Sciences).

## Protocols of Place

*We acknowledge that we live and work in Treaty 6 Territory, traditional lands of First Nations and homeland of the Métis peoples.*

My name (first author) is Stavros Stavrou, and I have White-settler identity with Greek heritage on my father's side and French and Ukrainian heritage on my mother's. I was born and raised in Prince Albert, Saskatchewan. I have completed a BSc and MSc in mathematics, an MEd, and I am currently a PhD candidate. I work as a mathematician and educator in Saskatoon.

My name (second author) is Shaun Murphy. I have White-settler identity and was born on Treaty Six Territory in Alberta. I currently work on Treaty Six Territory in Saskatchewan, in teacher education.

To clarify the voice used throughout the article, plural personal pronouns (like we) are used to reflect both authors, while singular personal pronouns (like I) are used to represent the work and experience narrated by the first author, Stavros Stavrou.

The words *Indigenous* and *Aboriginal* represent complex relationships between the Canadian state and its original inhabitants, and so it is important to differentiate between these terms. According to Plains Cree and Saulteaux scholar Maggie Kovach (2010), the word *Indigenous* refers to the first peoples of a place and their cultures, and the term "Aboriginal when referring to a specific Canadian contest, such as reference to Aboriginal rights" (p. 20). Moreover, the word *Aboriginal* is a colonial term that was introduced in the Canadian Constitution since it represents an imposed name. For this reason, the teachers and students in this article refer to themselves as *Indigenous*, and nêhiyawak or Cree (although Cree is also reflective of an imposed name, it will be used alongside nêhiyawak since it is a self-identifying name used by these teachers and students). Since some of the literature we draw upon is written by people who refer to themselves as Aboriginal, we will switch between *Indigenous* and *Aboriginal* (and refer to specific cultures to disrupt pan-Indigenous/Aboriginal identity) to reflect and respect how people have chosen to identify.

# Introduction

We wish to centre identity-making in Euro-Western school mathematics as an important facet of Indigenous mathematics education. How do Indigenous, particularly Cree, educators and students see themselves as producing school mathematics through their unique experiences and stories? The Cree educators with whom we worked negotiate their Cree identities as they teach mathematics to their predominantly Cree students. These negotiations take place in the midst of government mandates for *Indigenization* in the form of incorporating Indigenous perspectives and ways of knowing into the Euro-Western school curriculum. We hope to elucidate the complexities surrounding how Cree educators and students include their perspectives in school mathematics through a process termed *Cree mathematizing*. We clarify how *Cree mathematizing* unfolds in the context of a particular Western Canadian prairie city, and how this process not only exemplifies narrative conceptions of identity-making, but also provides a subversive teaching practice that challenges the way mathematics is taught as a culture-free, apolitical, and decontextualized endeavour.

## *Indigenization* and *Cree Mathematizing* in Euro-Western School Mathematics

It is through our experiences that we make sense of *Indigenization* in the context of our practices and educational landscapes. The Canadian education system, jurisdictionally situated in provincial Ministries of Education, has mandated initiatives of *Indigenizing* school subjects at all grade levels, and in some post-secondary spaces. There is no conceptual consensus about what *Indigenization* looks like in Euro-Western school curriculum, but Indigenous scholars have explained that it is a dynamic process of creating an educational philosophy and pedagogy that explores ways of knowing that have been actively repressed (Wildcat, 2001). *Indigenization* involves acknowledging treaty and traditional rights that recognize Indigenous peoples as stewards of the land (Korteweg & Russell, 2012), and positions Indigenous languages as essential to understanding traditional epistemology and ontology that cannot be adequately quantified or described by Euro-Western knowledge (Battiste, 2013; Kovach, 2010).

In this work we discuss nêhiyawak (Plains Cree) culture in Euro-Western school mathematics through the perspectives and experiences of Cree educators and students. This focus allows us to describe the ways school mathematics is situated in experiences, understood socially, across time, and in place by the participants.

We have adopted the term mathematize in the context of school mathematics to describe the processes by which students and teachers create mathematical meaning out of their daily lives, and this term takes into consideration social and historical contexts that are influenced by the culture, age, class, social groups, political motivation, and language of the people mathematizing (Beckmann, 2008; Wheeler, 1982). For example, Wager and Parks (2016) suggested mathematization to be a process of attaching mathematical language to experience by reflecting upon how mathematizing play is another way to understand how students make mathematical meaning of numbers. Restrepo (2013) used the term mathematization in chemistry to describe an iterative process of acting upon chemical knowledge in a mathematical way to produce new chemical statements. Thus, mathematizing is a framework for viewing the world through a mathematical perspective. This framework is dependent upon the unique perspectives of *who* is doing the mathematizing. *Cree mathematizing* Euro-Western school mathematics describes the ways the Cree teachers and children are engaging in Euro-Western classroom mathematics through their specific positioning as Cree peoples. Consequently, *Cree mathematizing* is not a consistent and generalizable activity—the process will unfold differently depending on *who* is doing the Cree *mathematizing*. Indeed, in this article we are illustrating *Cree mathematizing* through specific social, temporal, and spatial contexts.

Our experiences are situated in social relationships, time, and place. Thus, the ways the specific Cree teachers in this research *Cree mathematize* Euro-Western school mathematics shows their unique signature, and consequently influences the shaping and production of *Indigenization*. In the next section we look at the role of experience through the methodological framework of narrative inquiry—an analytical tool for inquiring into experiences as well as representing them.

## Narrative Inquiry

Clandinin and Connelly (2000) considered narrative inquiry as research into experience through a movement within a three-dimensional inquiry space in which *temporality*, *sociality*, and *place* represent each dimension. These narrative commonplaces are founded in Dewey's (1938/1997) epistemological and ontological terms of continuity, situation, and interaction. Continuity of experience informs the temporal considerations of past, present, and future. Interaction informs sociality—the personal and social contexts. Situation informs the narrative backdrop of place in which the experiences unfold (Clandinin & Connelly, 2000). Researchers also move inward to the internal conditions of "feelings, hopes, aesthetic reactions, and moral dispositions" (p. 50), outward toward the existential conditions of the environment and place, and backward and forward in time when attending to the continuum of experiences. Clandinin and Connelly (2000) stated that researching into an experience means analyzing the inward, outward, forward, and backward directions. This view of narrative inquiry as the study of experience over time and in contexts makes it both a way to view phenomena and a research methodology (Caine, Estefan, & Clandinin, 2013).

Narrative inquiry requires the simultaneous exploration of all three commonplaces and movement along these four directions (Connelly & Clandinin, 2006). Clandinin and Caine (2013) explained that all three dimensions must be attended to during the research process, and caution that "there may be times where one dimension foregrounds the inquiry, but all dimensions are attended to" (p. 173). It is the attention to these commonplaces that allow researchers to see the disruptions, fragmentations, or silences in our lives or the lives of the participants. Experience is lived in the midst, unfolds over time in diverse social contexts and places, and is co-composed in relationships (Caine, Estefan, & Clandinin, 2013).

Inquiring into experiences also involves attending to emotions and social relationships. Clandinin and Murphy (2009) explained that narrative inquiry involves the study of people in a research relationship who are studying the experiences of people in a research relationship. Relationships are integral to making sense of the temporal and spatial dimensions of narrative inquiry. Attending to relationships means simultaneously considering both the personal and social conditions—where the social condition refers to the circumstances in which experiences and events transpire, understood "in terms of

cultural, social, institutional, familial, and linguistic narratives" (Clandinin, 2013, p. 40), and the personal condition refers to the internal condition of emotions, hopes, and moral dispositions (Connelly & Clandinin, 2006). Clandinin and Rosiek (2007) explained that narrative inquiry focuses on both the individuals' experiences and the social, cultural, and institutional narratives that shape, express, and enable these experiences: "Narrative inquirers study the individual's experience in the world, an experience that is storied both in the living and telling and that can be studied by listening, observing, living alongside another, and writing, and interpreting texts" (p. 42).

Clandinin (2013) explained that narrative inquirers cannot remove themselves from the inquiry relationship. The researcher and participant are intertwined as the process of inquiring shapes lives in the midst. The paths of researchers and participants are altered during narrative inquiry research so that "neither researchers nor participants walk away from the inquiry unchanged" (Clandinin & Caine, 2013, p. 170). Researchers and participants are entangled, and both will experience change as they engage in a research relationship. A commitment to relationships and attending to personal and social conditions means that there are social responsibilities throughout the inquiry process (Clandinin & Caine, 2013). As researchers and participants engage in the research, *relational responsibilities* as well as the *negotiation of relationships* are both touchstones of narrative inquiry that have an ethical imperative to acknowledge the researcher–participant relationship and the commitments involved as texts are co-composed.

Ethical commitments include protecting the stories told by participants. According to Kovach (2010), stories represent knowledge, and storytelling as a method of educating and healing is part of doing research with Indigenous peoples. The stories and storytellers must be protected and respected, so there is an ethical imperative to work in a good way, relationally, in a community context that upholds trust (Kovach, 2014). Narrative inquiry proceeds from a relational ontology that aligns and supports the relational work required in working alongside Indigenous peoples in research.

Narrative inquiry is a Western methodology, and we are non-Indigenous (White) scholars researching alongside Indigenous participants. It is expected that one might wonder why an Indigenous research methodology was not used, and so we attend to this matter by locating narrative inquiry in Indigenous research. To this end, it is important to first distinguish Indigenous research from an Indigenous research methodology. Kovach (2018) aptly differentiated between these, stating that *Indigenous research* is a broad

term in which Indigenous matters are studied and does not necessarily include directly researching with Indigenous peoples, nor does it require using Indigenous methodologies given by Indigenous researchers. She explained that Indigenous research can be found in many disciplinary contexts, such as "education, social work, law, sociology, health, and environmental studies" (p. 215), and includes "community-based, ethnographic, grounded theory, phenomenology, narrative inquiry, decolonizing, and Indigenous methodologies" (p. 215). That is to say, Indigenous research is interdisciplinary and is open to study by *Indigenous methodologies* (which are founded on Indigenous knowledge systems), as well as Western methodologies (such as, in our case, narrative inquiry).

## Situating the Inquiry

Stavros came into this research site through previous work he was doing with the current teacher participants. Stavros works for the Department of Mathematics and Statistics at the University of Saskatchewan, and part of his work involved doing mathematics classroom activities with local teachers and students. Stavros worked for several years at an elementary Cree bilingual school in a sixth grade classroom. Having a positive rapport with the teachers and students in this school made possible the transition to a research relationship with these same teachers. The research direction was then motivated by government curricular mandates to Indigenize school subjects, including mathematics lessons. Stavros' research was conducted in a sixth grade classroom with two Cree teacher participants. Stavros negotiated weekly visits to the classrooms during their mathematics lessons. He recorded field notes through observations. He also negotiated interviews with the teachers throughout the school year (approximately 10 one-hour-long interviews were conducted). Data collected from the interviews were developed into narratives of experience for this article.

Since the Cree teacher participants were fluent Cree speakers (who also taught the language to their students), the focus Stavros established for the school year was to have the teachers and students incorporate their Cree language in the mathematics classroom. Stavros highlighted language by beginning some of the lessons with asking the teachers questions such as "How do we say _____ in Cree?" or "How do we represent _____ in Cree?" The intent was to see how Euro-Western school mathematics is understood, developed, conveyed, and made significant through the linguistic and cultural perspectives

of these Cree teachers and students. The identity-making focus came from the teachers and students implicitly constructing themselves through *Cree mathematizing* while doing Euro-Western school mathematics.

Stavros was inspired to use a language-focused approach by Lunney Borden (2013), who asks "Is there a word for…?" (p. 5) to consider how mathematical concepts in the school curriculum can be understood through Mi'kmaw grammar, as represented by the Mi'kmaw students, teachers, and Elders in a specific Eastern Canadian maritime context.

Lunney Borden (2011, 2013) used a process called verbification (converting nouns to verbs) to translate mathematical nouns (in English) to verbs (in Mi'kmaw). Verbs were spoken in English but were consistent with grammar structures of Mi'kmaw so that static Euro-Western mathematical terms could be represented in ways that show motion. It is a limitation of the noun-based English language to adequately and accurately describe verb-based Indigenous languages, such as Mi'kmaw (Battiste, 2013), but we hope the following examples by Lunney Borden (2011) provide clarity. In Mi'kmaw, the word *pekaq* means *goes straight*, and *pektaqtek* describes anything that would *go straight*, such as a road. These nouns are characterized as being in a linear motion, rather than as static objects. As another example, the word *kiniskwikiaq* means *moves into a poin*t, which can be used to describe objects that are pointed, such as a pyramid. Lunney Borden also explained that tensions emerged for some community Elders in Mi'kmaw schools when the word *nesikk* was developed as the translation for the word *triangle* because the word did not convey the motion that is consistent with Mi'kmaw grammar.

Primm and Wagner (2003) argued that verbification disrupts the standard practice of nominalization (converting verbs to nouns) which seems to be privileged in Euro-Western mathematical discourses. Turning mathematical processes into static nouns (Schleppegrell, 2007) creates tension for many learners who would be more naturally engaged through words that elicit action and movement. Furthermore, Battiste (2013) argued that the very nature of the verb-based, process-orientation of Indigenous languages offers an understanding of Indigenous worldviews and consciousness that cannot be adequately described in English.

In Stavros's work of *Cree mathematizing* with his Cree teacher participants, he has been taught translations that also animate static English mathematical terms. For example, *kakwayaskwak kikway* translates in English to *something that goes straight*. You

may wonder about the presence of the word *something*, which contradictorily indicates a noun, but this word is used to bridge the translation into a sentence that is consistent with English grammar. That is, *kakwayaskwak kikway* refers to the embodying of linear motion that indicates straightness. The phrase *kawawîyak kikway* is the embodying of roundness. The translation is *something round*—again, the word *something* is a bridging term that provides a noun for English grammar. Another example is *ka napakak*, which means *it goes flat* (*it* is a bridging noun). The word *ka* is short for *kēkā*, and is the word that means *goes to*, which explains that a change is occurring. For example, change is evident when counting: *mitātaht* means *ten* and *kēkāmitātaht* means *goes to ten* (i.e., nine).

It was not easy for Stavros to explain how these terms are verb-based and would elicit motion, because he is limited to how these words translate into the noun-based English language. This is something he hopes to learn more about as he continues this relational research with Cree teachers. The dissonance occurs because the translations require the nominalization of Indigenous languages.

Language-based activities and lessons that are composed in specific places exemplify Indigenous mathematics as steeped in local languages, cultures, and physical contexts, and disrupts the pan-Indigenous/Aboriginal identity that is over-emphasized in how *Indigenization* work often gets taken up (Stavrou & Miller, 2017). One of the misconceptions of *Indigenizing* the curriculum is that there is a singular Indigenous identity and knowledge, and so practitioners must be mindful of the multiplicity of Indigenous knowledges that are not uniform across Indigenous cultures (Battiste & Henderson, 2009; Kovach, 2010). It does not make sense to think of the diversity across Canada in a singular way. The global consideration of Indigenous mathematics education reduces experience because it is a form of generalization across Canada. *Cree mathematizing* is attentive to the experiences of people in the way narrative inquiry is attentive to the individual and their experiences socially, across time, and in place.

## "*I'm stupid!*"

As in every classroom, students have a range of capability, interests, and feelings toward mathematics. Students fall across a spectrum of being "great" and "bad" at it, and "loving" and "hating" it, and their experiences offer a way to see how their identities are

being constructed as they do mathematics in the classroom. A common narrative of mathematics learning is exemplified through a discussion between Stavros and Miss Moore (pseudonym), one of the Cree classroom teachers in his narrative research. Stavros composed the following field note after an experience he had with a sixth-grade student prior to Stavros's *Cree mathematizing* classroom approach:

> One day after math class ended and the students left for lunch, Miss Moore spoke to me privately about one particular student who was acting withdrawn from the class by hiding his face in his sleeve and not participating in the activity we did with the students. Miss Moore said when this student withdraws, she leaves him alone because he gets upset and calls himself stupid when she prompts him. She said this is a common occurrence for him when he does not understand the topic, and she notices that he will quietly cry to himself and repeatedly say "I'm stupid! I won't ever be able to learn math." (Field note, February 2017)

Tensions emerged for Stavros when he learned of the student's self-deprecation during math class. Most distressing was Stavros's realization that as they did mathematics together, the student was constructing himself as "stupid." His story is a common experience of many whose identity-construction includes feelings of incapability, stupidity, angst, and dissonance. The takeaway of the discussion with Miss Moore is that what Stavros had been doing was not serving this student to move forward in educative ways (Dewey, 1938/1997). This is where the beginnings of *Cree mathematizing* came into play. With the success of Lunney Borden's (2011, 2013) work in mind, Stavros was interested in learning mathematics terms in Cree from the teachers and students. Miss Moore always spoke in a mix of English and Cree to her students, but did less of this during math class when he was present. When she did speak Cree, it was to instruct the students to settle down, get in their seats, and pay attention. Stavros saw a poster hanging on Miss Moore's wall that had shapes translated into Cree, so he was curious to see what words her students might already know. He asked the class if they could teach him to count in Cree. The following field note recounts the conversation Stavros had with Miss Moore after the lesson:

> I was so impressed by Nigel (pseudonym of the student who called himself stupid)—he can say and spell the numbers in Cree and knows where to put the

> diacritical marks. It was wonderful to see him excited to participate and teach me Cree. Miss Moore told me he lives with his grandma, who is a Cree speaker. She said he catches on to Cree easily and probably knows the most Cree out of all of her students. I looked at the chalkboard where I wrote the numbers one through twenty in Cree: *pēyak*, *nīso*, *nisto*, … *nīstanaw*. Miss Moore giggled as she recalled the students correcting my pronunciation while cheering me on to repeat after Nigel as he named and spelled the numbers for me. (Field note, February 2017)

Following the success of the Cree counting lesson, Stavros was inspired to co-create activities and lessons with Miss Moore that included more Cree translations of mathematical terms for the purpose of animating Euro-Western school mathematics in ways that supported the experiences of the students and teachers. The ways they taught mathematics together in the classroom, sharing and exploring the Cree language, and making space for the cultural and linguistic knowledge that students have to offer, disrupts the conventional practice of teaching school mathematics as a subject devoid of experience and context. Like Lunney Borden (2013) in her work, Stavros was inspired to ask "How do you say ____ in Cree?"

On subsequent classroom visits, as soon as Stavros entered the room, Nigel approached him to teach him more Cree. Stavros dubbed Nigel the *Cree Language Expert*, and this seemed to have the effect of driving Nigel to want to learn mathematics and teach Stavros, Miss Moore, and his classmates more translations of mathematical terms in Cree. The validation Nigel received from his teachers and peers energized him to participate in activities that he would normally shy away from.

Centring Cree language learning has a larger social imperative to support, protect, revitalize, and share the gift of Cree, as Indigenous languages and cultures are in a precarious position due to Canada's historical and ongoing colonialism (Battiste, 2013). The Truth and Reconciliation Commission (2015) published 94 Calls to Action imploring all levels of government to work at rectifying the harm caused by the legacy of residential schools and other colonial policies that marginalized Indigenous peoples by separating them from their languages and cultural identities. Recently, the Government of Canada has proposed a bill called Bill C-91 Indigenous Languages Act, which is intended to create long-term sustainable funding of Indigenous languages, establish an Office of the

Commissioner of Indigenous Languages, and promote collaboration between federal, provincial, and Indigenous governments to deliver supports for Indigenous languages (Brake, 2019).

## *Cree Mathematizing* Without Euro-Western School Mathematics

As we stated, *Cree mathematizing* depends on *who* is doing the mathematizing. In the context of our work, we described *Cree mathematizing* of Euro-Western school mathematics to be a process in which Cree students and teachers begin with school mathematics and then look at creating the meaning of the content through their unique linguistic and cultural perspectives. In a chicken and egg analogy of what came first, school mathematics was the starting point, and *Cree mathematizing* was a framework for animating the static nouns of school mathematics by considering their translations in the verb-based Cree language. In this way, Euro-Western school mathematics is at the forefront, and the *Cree mathematizing* taking place is determined by a way to understand and represent the content through perspectives that reflect linguistic experiences. This representation of *Cree mathematizing* has many complexities that need acknowledgement. To start, it is colonially driven by the pursuit of learning and understanding Euro-Western school mathematics. Furthermore, in the context of sharing Indigenous languages, without the relational aspect being established first there is a risk of Indigenous peoples being made to feel inferior if they cannot share their languages (St. Denis, 2004). There is also the often overlooked issue that translations between English and Cree (or any other Indigenous language) may not exist when considering Euro-Western mathematical terms, and so care must be taken to establish this type of work in relational ways in order to identify, discuss, and navigate the complexities surrounding how *Cree mathematizing* is situated. We argue that the relational facet of narrative inquiry enabled such productive and meaningful conversations during the research process.

We then wondered, how do we position *Cree mathematizing* strictly in our experiences so that the process unfolds independent of prompting by Euro-Western school mathematics? In other words, how would *Cree mathematizing* look if we removed the motivations by Euro-Western school mathematics from the equation? We illustrate one way of moving in this direction in the following field note collected and recounted by Stavros after one of his classroom visits:

> Miss Moore's classroom is located upstairs and there are two stairwells on opposite sides of the school that can be used to get there. I normally take the north stairwell but today I was running behind so I decided to take the south stairwell in hopes that it might be faster. I got briefly mixed-up as I was trying to find the classroom. When I arrived, Miss Moore and her students were ready to go and they jokingly said "You're late Mr. Stavrou!" and Miss Moore said something in Cree that she said translated to "Did you get lost?" I explained that I did, and then I asked, "How do you describe directions in Cree? Left, right, up, down?" Miss Moore walked to the whiteboard and began writing the translations *nīkan* (up), *nāwey* (down), *sahkastinohk* (east), and *pahksimonohk* (west).
>
> "We don't say left or right because there is no word for it," she explained. As I repeated after her, the students who already knew the words giggled at my pronunciation—which I am very used to! I pulled up a picture of a map with gridlines off Google and asked, "How would I describe moving from this spot to this spot?"
>
> Miss Moore looked at my starting and ending points and said, "So you are moving two spots up? *Itohti niso nīkan*—move two up."
>
> I recognized that the word *niso* means *two* from when Nigel taught me to count so it was clear the word *itohti* means *move*. I responded, "Cool! How would we indicate moving three down and one west?"
>
> Miss Moore watched my hand move down three gridlines then left by one gridline. "Why would I travel like that? I would just go straight from here to here. *Kaskam*—straight across. It's faster."
>
> I laughed at her logical answer. "Fine, let's pretend there is a river we cannot swim across so we must travel this way. How would we say it?"
>
> We both looked at the class as they started offering answers. Very quickly we concluded that "*Itohti nisto nāwey ekwa peyak pahkimonohk*" is how we move three down and one west. (Field Note, March 2017)

Reflecting on the experience in this field note, Stavros saw new ways to imagine *Cree mathematizing* by beginning without problems situated in Euro-Western school

mathematics. In this case, Miss Moore and her students made meaning of spatial movements and drew on their linguistic experiences to convey that meaning.

## Identity-Making Alongside *Cree Mathematizing*

In the beginning, Nigel's translation of numbers to Cree provided Stavros an understanding of the value in peoples' linguistic and cultural experiences being represented in their mathematical learning. This motivated lessons in which students continued to describe Euro-Western school mathematics in Cree. While this was initially interpreted as a form of *Cree mathematizing*, we want to emphasize that school mathematics is situated within particular contexts. In the field notes above, we can imagine alternative scenarios for such contexts—situating experiences through *Cree mathematizing*—by illustrating how *Cree mathematizing* is a process that can occur independently of Euro-Western school mathematics. This reaffirms the importance of letting school subjects like mathematics emerge from community context by beginning with community context (Lunney Borden & Wiseman, 2016).

Miss Moore shared her coming-to-know of specific Cree phrases (from her family, community, Elders, friends, books, the Internet, and so on) and how these phrases describe mathematical experiences that are meaningful to her. The identity-making from *Cree mathematizing* comes from a linguistic description of a phenomena from the perspective of the person doing the mathematizing. Rather than the conventional practice of imposing decontextualized mathematical rules, formulas, and processes on students, *Cree mathematizing* offers an approach in which a person's specific linguistic and cultural experiences support their mathematics education. It is well-known that mathematics is paradoxically produced as a culturally-neutral and apolitical subject, devoid of human context, and so we argue that *Cree mathematizing* is a subversive practice because it foregrounds experience, rather than side-lining it. Experience is the signature of those engaging with mathematics.

### Tensions When Identity Is Not Evident

Miss Moore has also described feeling conflicted when it came to using class time to emphasize language in mathematics. During one of Stavros's classroom visits, Miss

Moore and he were trying to decide what to teach before class began. Below is a field note recounting their discussion:

> *Stavros*: What would you like to cover today?
>
> *Miss Moore*: We can cover converting between mixed fractions and improper fractions. The students need this for the CMA (Common Math Assessment). Whatever lesson you have in mind that would help would be great.
>
> *Stavros*: Yes, I have an interactive game we could play online. Can we look at Cree translations, too?
>
> *Miss Moore*: Maybe. We are behind and I still need to show them a few more things to get them ready for this damn assessment. Everything is rushed and there is no time for the students to understand the material before I have to move on. (Field Note, March 2017)

This field note speaks to the tensions educators face when they negotiate class time to do activities that are not being formally evaluated through local, provincial, or federal assessments. While there are government directives of *Indigenization*, the current curriculum is rigid in the content that must be covered and assessed. *Indigenization* does not make its way into mandatory government assessments, making it difficult for teachers like Miss Moore to spend even a limited amount of time exploring Cree ways of knowing. This results in the curriculum overriding identity-making possibilities for students and teachers, and de-emphasizes the ethical responsibility to teach to the life of a child.

Tensions arose for the students in lessons following the one described in the field note above when they were asked to do practice exams for the Common Math Assessment. Many students were no longer interactive or engaged as they trudged through workbooks. Two students refused to work on the workbooks at all and either avoided class by hiding in the bathroom or hid their faces in their sleeves with their heads resting on their desks.

## The Role of Experience

In a context of *Cree mathematizing*, where math is animated through the act of verbification, experience is necessary in understanding mathematical terms. As we can see in the

work of Miss Moore, mathematizing is an embodied act, and therefore in order to take typically static mathematical terms and situate them in action entails a body's sense of movement. So the act of naming *kakwayaskwak kikway*, meaning *something that goes straight*, entails that we have to have a sense of how to go in a straight line, and *mitātaht* (meaning *ten*) and *kēkāmitātaht* (meaning *goes to ten*, i.e., nine), suggests that we have *experience* with such actions. Such a shift in school mathematics teaching suggests that mathematics arises from the body and must return to an embodied experience in order for it to make sense.

The act of understanding mathematics as an embodied subject matter interrupts the idea of mathematics as an abstract language communicated in static classrooms, and encourages teachers to consider the actions of mathematics. Furthermore, this thinking understands the body as a mathematical manipulative, in that the body needs to understand *going straight* in order for the body to be able to move an object in a straight line and eventually move a writing implement in a straight line to create a straight line.

It is the same for the act of counting, which is certainly about understanding that a starting point number *goes to* a larger or smaller number. Understanding the idea of *goes to* is foundational to adding or subtracting, and especially in relation to counting as we move to larger or smaller numbers and amounts. In work with young children, good mathematics teaching involves the doing of mathematics (Fosnot & Dolk, 2001; Van de Walle & Folk, 2005; Wheatley, 1990). By introducing verbification and mathematizing, the doing becomes clearly reflected through both language and action.

Stavros's work occurred in an elementary mathematics classroom, and we consider that the act of understanding foundational school mathematics is important as we move into more abstract notions of numbers and elements, while still giving an experiential sense of why something exists and how it has certain properties.

## *Cree Mathematizing* in Euro-Western Mathematics Curriculum Guides

Curriculum guides are one aspect of curriculum making in a classroom between teacher and children. Curriculum making is a term developed by Clandinin and Connelly (1992) to describe how "an account of teachers' and students' lives over time is the curriculum, although intentionality, objectives and curriculum do play a part in it" (p. 365). This

understanding of curriculum considers how teachers and students live out the curriculum as opposed to a typical understanding where it is delivered and received.

In earlier work, Connelly and Clandinin (1988) described curriculum as a course of life. This is a more complex understanding of curriculum beyond typical references to subject matter guides. In this conceptualization, the idea of identity-making becomes central to the act of being in curriculum-making contexts. This was evident in the earlier section about Miss Moore's experience alongside Nigel, in Miss Moore's work with Stavros, and in Stavros's own experience of coming to know a different way of mathematics education.

## Concluding Remarks and Considering Ways of Moving Forward

We proposed *Cree mathematizing* as a process in which the Cree teachers and students with whom we work create and make meaning out of school mathematics through their diverse linguistic and cultural experiences. We contrasted ways this process unfolded in situations where students are centring Euro-Western school mathematics, as well as situations in which *Cree mathematizing* worked independently of the presence and prompting of school mathematics. Either way, we centred identity-making in school mathematics as an important facet of *Indigenization* in mathematics education in hopes of providing a more nuanced understanding of how this process could be imagined.

Our findings are rooted in a narrative understanding of experience. It is clear from the previous sections that the role of temporality has played a part in the lives and experiences of the various participants. Their identity as students and teachers has been shaped over time in relationship with particular people like other teachers, Stavros himself, and different community and family members. All experience happens in a place, and these places have provided a variety of contexts. This is evident for both the participants and the researchers themselves. As we worked with the field texts (data) we simultaneously attended to their experiences and ours. In this way we attended to the four directions of narrative inquiry as we considered our experience as the researchers. As we noted in earlier writing in this article, Clandinin and Connelly (2000) stated that researching into an experience means analyzing the inward, outward, forward, and backward directions. This

was true for us as we considered the experience of the research. We were shifted because of the research.

Miss Moore shared her coming-to-know of Cree, and her linguistic experiences directed the classroom lessons to take shape in ways that supported language learning. Nigel came to see himself as a contributing member of the mathematics classroom by way of his knowledge of Cree. These experiences exemplify conceptions of *Indigenization* through the foregrounding of Cree language and cultural experiences that promote positive identity-making. This subversive teaching practice challenges Euro-Western methods of presenting mathematics as a culture-free, apolitical, experience-devoid, and decontextualized endeavour.

We noted tensions in Miss Moore as she was negotiating classroom time needed to prepare students for provincial exams while trying to fulfill government mandates of *Indigenization* that are not included on provincial assessments. The tensions were apparent in the students as they became detached from lessons in which they were forced to prepare for these stressful assessments.

Importantly, this research highlights the way *Cree mathematizing* contributes to identity. In the field notes regarding Nigel, we see how using his language shifted his way of being in mathematics, and we believe this would happen in any subject matter that took up the work of *Indigenization* specific to any group of people. In this article, we highlighted *Cree mathematizing* through language. Further research could uncover the role of conceptual understandings of school mathematics in relation to Cree ways of knowing. Further, we note that standardized testing seldom leaves room for government mandates such as *Indigenization*, and making a space for this is essential in moving forward with initiatives related to *Indigenization*.

## References

Battiste, M. (2013). *Decolonizing education: Nourishing the learning spirit*. Vancouver, BC: UBC Press.

Battiste, M., & Henderson, J. Y. (2009). Naturalizing Indigenous knowledge in Eurocentric Education. *Canadian Journal of Native Education*, *32*(1), 5–18.

Beckmann, A. (2008). Mathematical literacy through scientific themes and methods. In B. Sriraman, C. Michelsen, A. Beckmann, & V. Freiman (Eds.), *Proceedings of the 2nd international symposium on mathematics and its connections to the arts and sciences (MACAS2)*, *Odense* (pp. 187–196). Odense, Denmark: University of Southern Denmark.

Brake, J. (2019, February). Canada unveils Indigenous languages bill to fanfare, criticism. Retrieved from https://aptnnews.ca/2019/02/05/canada-unveils-indigenous-languages-bill-to-fanfare-criticism/

Caine, V., Estefan, A., & Clandinin, D. J. (2013). A return to methodological commitment: Reflections on narrative inquiry. *Scandinavian Journal of Educational Research*, *57*(6), 574–586. https://doi-org.cyber.usask.ca/10.1080/00313831.2013.798833

Clandinin, D. J. (2013). *Engaging in narrative inquiry*. Walnut Creek, CA: Left Coast Press.

Clandinin, D. J., & Caine, V. (2013). Narrative inquiry. In A. Trainor & E. Graue (Eds.), *Reviewing qualitative research in the social sciences* (pp. 166–179). New York, NY: Routledge.

Clandinin, D. J., & Connelly, F. M. (1992). Teacher as curriculum maker. In P. W. Jackson (Ed.), *Handbook of research on curriculum* (pp. 363–401). New York, NY: Macmillan.

Clandinin, D. J., & Connelly, F. M. (2000). *Narrative inquiry: Experience and story in qualitative research*. San Francisco, CA: Jossey-Bass.

Clandinin, D. J., & Rosiek, J. (2007). Mapping a landscape of narrative inquiry: Borderland spaces and tensions. In D. J. Clandinin (Ed.), *Handbook of narrative inquiry: Mapping a methodology* (pp. 35–75). Thousand Oaks, CA: Sage Publications.

Clandinin, D. J., & Murphy, M. S. (2009). Relational ontological commitments in narrative research. *Educational Researcher*, *38*(8), 598–602.

Connelly, F. M., & Clandinin, D. J. (1988). *Teachers as curriculum planners: Narratives of experience*. New York, NY: Teachers College Press.

Connelly, F. M., & Clandinin, D. J. (2006). Narrative inquiry. In J. Green, G. Camilli, & P. Elmore (Eds.), *Handbook of complimentary methods in education research* (3rd ed., pp. 477–487). Mahwah, NJ: Lawrence Erlbaum.

Dewey, J. (1997). *Experience and education*. New York, NY: Touchstone. (Original work published 1938)

Fosnot, C. T., & Dolk, M. (2001). *Young mathematicians at work: Constructing number sense, addition, and subtraction*. Portsmouth, NH: Heinemann.

Korteweg, L., & Russell, C. (2012). Decolonizing + Indigenizing = Moving environmental education towards reconcilliation. *Canadian Journal of Environmental Education*, *17*, 5–14.

Kovach, M. E. (2010). *Indigenous methodologies: Characteristics, conversations, and contexts*. Toronto, ON: University of Toronto Press.

Kovach, M. (2014). Thinking through theory: Contemplating Indigenous situated research and policy. In K. Denzin & M. D. Giardina (Eds.), *Qualitative inquiry outside the academy* (pp. 92–106). Walnut Creek, CA: Left Coast Press.

Kovach, M. (2018). Doing Indigenous methodologies: A letter to a research class. In N. K. Denzin & S. L. Yvonna (Eds.), *The SAGE handbook of qualitative research* (5th ed., pp. 214–234). Los Angeles, CA: SAGE.

Lunney Borden, L. (2011). The "verbification" of mathematics: Using the grammatical structures of Mi'kmaq to support student learning. *For the Learning of Mathematics*, *31*(1), 8–13. Retrieved from http://www.jstor.org.cyber.usask.ca/stable/41319601

Lunney Borden, L. (2013). What's the word for…? Is there a word for…? How understanding Mi'kmaw language can help support Mi'kmaw learners in mathematics. *Mathematics Education Research Journal*, *25*(1), 5–22. doi: 10.1007/s13394-012-0042-7

Lunney Borden, L., & Wiseman, D. (2016). Considerations from places where Indigenous and Western ways of knowing, being, and doing circulate together: STEM as artifacts of teaching and learning. *Canadian Journal of Science, Mathematics and Technology Education*, *16*(2), 140–152.

Primm, D., & Wagner, D. (2003). Investigation, mathematics education and genre: An essay review of Candia Morgan's writing mathematically: The discourse of investigation. *Educational Studies in Mathematics*, *53*(2), 159–178. Retrieved from http://www.jstor.org.cyber.usask.ca/stable/3483293

Restrepo, G. (2013). To mathematize, or not to mathematize chemistry. *Foundations of Chemistry*, *15*(2), 185–197.

Schleppegrell, M. J. (2007). The linguistic challenges of mathematics teaching and learning: A research review. *Reading & Writing Quarterly*, *23*(2), 139–159. doi: 10.1080/10573560601158461

St. Denis, V. S. (2004). Real Indians: Cultural revitalization and fundamentalism in Aboriginal education. In C. Schick, J. Jaffe, & A. M. Watkinson (Eds.), *Contesting fundamentalisms* (pp. 35–47). Black Point, NS: Fernwood.

Stavrou, S. G., & Miller, D. (2017). Miscalculations: Decolonizing and anti-oppressive discourses in indigenous mathematics education. *Canadian Journal of Education*, *40*(3), 92–122. Retrieved from http://cyber.usask.ca/login?url=https://search.proquest.com/docview/1952361626?accountid=14739

Truth and Reconciliation Commission. (2015). Honouring the truth, reconciling for the future: Summary of the final report of the Truth and Reconciliation Commission of Canada. Ottawa, ON: Library and Archives Canada. Retrieved from http://www.trc.ca/assets/pdf/Honouring_the_Truth_Reconciling_for_the_Future_July_23_2015.pdf

Van de Walle, J. A., & Folk, S. (2005). *Elementary and middle school mathematics: Teaching developmentally*. Boston, MA: Pearson Allyn and Bacon.

Wager, A. A., & Parks, A. N. (2016). Assessing early number learning in play. *The International Journal on Mathematics Education*, *48*(7), 991–1002.

Wheatley, G. H. (1990). Spatial sense and mathematics learning. *The Arithmetic Teacher*, *37*(6), 10–11. Retrieved from https://www.jstor.org/stable/41193836

Wheeler, D. (1982). Mathematizing matters. *For the Learning of Mathematics*, *3*(1), 45–47. Retrieved from https://flm-journal.org/Articles/710C1E323C3DBE0C9B8579E0A526C4.pdf

Wildcat, D. R. (2001). Prelude to a dialogue. In V. Deloria & D. R. Wildcat (Eds.), *Power and place: Indian education in America* (p. vii). Golden, CO: Fulcrum Resources.