



# A Narrative Inquiry Into Indigenizing School Mathematics Through Miyō-pimōhtēwin and Kamskénow

Stavros Georgios Stavrou \*

Department of Educational Foundations, College of Education, University of Saskatchewan, Saskatoon, SK, Canada

In Canadian mathematics education, dominant colonial narratives highlight an achievement disparity between Indigenous and non-Indigenous students in a way that often re-inscribes perceived deficits of Indigenous students, ignores the educational aspirations of Indigenous peoples, and sidelines Indigenous cultural and linguistic representations of knowledge in the classroom. Intentions of Indigenizing curriculum include challenging and reversing racist and colonial ideologies that hinder Indigenous education, providing meaningful alternatives within school cultures that foreground essential aspects of Indigenous education, and supporting the dynamic learning of Indigenous students. In my research described in this article, I used a narrative inquiry to describe how two Cree elementary school teachers shared promising practices of holistic assessments in school mathematics that centered their Cree language, *miyō-pimōhtēwin*, and *kamskénow*.

**Keywords:** indigenization, school mathematics, narrative inquiry, cree, assessments, miyō- pimōhtēwin, kamskénow

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### \*Correspondence:

Stavros Georgios Stavrou  
stavros.stavrou@usask.ca

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## INTRODUCTION

My name is Stavros Georgios Stavrou. I was born and raised in a western prairie province in Canada, located on the ancestral and traditional land called Treaty 6 territory. I have Greek heritage on my father's side (he was a Cypriot immigrant), and French and Ukrainian heritage on my mother's side (she was born in the prairies). I acknowledge my colonial ties to Canada that have benefited me at the expense of Indigenous peoples. I have chosen to work alongside Cree educators to support the education equity of Indigenous students.

I work at the University of Saskatchewan as a mathematics lecturer in the College of Arts and Science, as well as a teacher educator in the College of Education. My research in the prairies relevant to this article included co-teaching Grade 6 school mathematics with Cree elementary school educators. The Saskatchewan Curriculum (2009) included outcome indicators that measured students' abilities to describe the ways Indigenous peoples (past and present) represent(ed) topics pertaining to numbers, shape and space, patterns and relations, and statistics and probability. However, outcome indicators that involve drawing on Indigenous experiences, languages, and knowledges are seldom included in formal assessments. Speaking from my experiences, these indicators are omitted due to a lack of resources to guide this process, as well as a level of uncertainty to assess these topics in a meaningful and authentic way. In a few instances, I witnessed teachers including questions on tests that asked students to draw examples of shapes and solids from Indigenous cultures. The expected answers were that medicine wheels are circles, tipis are cones, and drums are cylinders.

Shallow examples of material representations of culture (or exclusion altogether) do not foster youth's educative and healthy life-making across familial, community, institutional, cultural, and linguistic contexts. In this article, I shared experiences in which school mathematics assessments were conducted in relationally-ethical ways by *kamskénow* (discovering) and *miyō-pimōhtēwin* (walking in a good way), achieved through Cree *kohtawān* (spiritual being) principles. This holistic Cree framework was attentive to Indigenous ways of being by drawing on Cree to demonstrate promising practices for philosophically grounding assessment-making through understandings of *kotowān* principles and processes of discovering using mathematics.

Activating school assessments in the mathematics classroom that involved cultural and linguistic acquisition in the context of family, community, land, and place opened up assessment-making potential that taught to the lives of the students. Indeed, rather than assessments shaping the lives of students, the experiences of the teachers and students shaped the assessments and offered new understandings of Indigenizing school mathematics.

## WHAT IS INDIGENIZATION AND WHY DO WE NEED IT?

Mathematics is a subject shaped by invalid Eurocentric notions that it is acultural, apolitical, value-free, and universal (Bishop, 1994; Ernest, 1994; Gerdes, 1996). In educational institutions, school and university mathematics are used to regulate access to learning and employment, and provoke fear and anxiety amongst students and teachers (Iseke-Barnes, 2000; Popkewitz, 2004; Stinson, 2004; Macmillan et al., 2005). School and university mathematics assessments also operate as a barrier to Indigenous and minoritized students' ways of knowing mathematics, their mobility within educational contexts, and are used to racially justify the achievement gap through cultural-deficit discourses (Iseke-Barnes, 2000; Aitken and Head, 2008; Battey, 2013; Stavrou and Miller, 2017; Stavrou, 2020).

Ministries of Education—jurisdictionally located within Canadian provinces—have been Indigenizing curriculum and school spaces in the K-12 and post-secondary levels as part of reconciliation, cultural inclusion, decolonization imperatives, and anti-racism (Gaudry and Lorenz, 2018; Goulet and Goulet, 2014; St. Denis, 2004, 2007; Stavrou, 2020). The multi-faceted and evolving conceptualizing of Indigenization includes: recognizing treaty rights, expanding Indigenous epistemologies and ontologies, working towards reconciliation, decolonizing Euro-Western education and the colonial processes that maintain it, destabilizing racism and oppression in education, land-based education, and meaningful inclusion of Indigenous languages and culture (Aikenhead, 2006; Battiste, 2013; Battiste and Henderson, 2009; Brake, 2019; Gaudry and Lorenz, 2018; Goulet and Goulet, 2014; Korteweg and Russell, 2012; Kovach 2010a, 2010b; Kuokkanen, 2008; Snively, 1990; St. Denis, 2011; Truth and Reconciliation Commission, 2015; Wildcat, 2001).

How these concepts and processes are operationalized in education is fluid across dynamic locational, familial,

institutional, experiential, linguistic, and cultural contexts. It is in the individualized experiences of people working in relation that provide meaningful mobilization of Indigenization (Stavrou, 2020). In my research described in this article, I used a narrative inquiry methodology to share my experiences co-teaching Grade 6 school mathematics alongside two Cree elementary educators. In the unique institutional, linguistic, and cultural context of my work and research, Indigenizing school mathematics became meaningful through the teachers' Cree language and ways of being. It was through our experiences that we shaped the teaching environment and assessment practices of school mathematics, thus creating new stories to live by that were attentive to the needs and aspirations of their Indigenous students.

## METHODOLOGY

Narrative inquiry as a research methodology was introduced by Connelly and Clandinin (1990) based on a Deweyan (1997) ontology that education and life are intertwined. As we interpret our storied lives—past, present, and the imagined future—narrative inquiry guides research in contexts such as studies of education, community, healthcare, history, and anthropology. Connelly and Clandinin (2006) explained that narrative inquiry is a way to think of experience as story, where story is “a portal through which a person enters the world and by which their experience of the world is interpreted and made personally meaningful” (p. 477).

Narrative inquirers attend to experiences through considerations of three dimensions—temporality, sociality, and place (Downey and Clandinin, 2010). *Temporality* means being attentive to people and events evolving through the past, present, and future. *Sociality* refers to the inquirer and participants' personal conditions of “feelings, hopes, desires, aesthetic reactions, and moral dispositions” (Connelly and Clandinin, 2006, p. 480), as well as the social conditions of the environment and people who shape contexts. *Place* means the location(s) where the inquiry and events under inquiry take place. *Thinking narratively* is the simultaneous exploration of all three dimensions, which is a requirement of any narrative inquiry (Clandinin and Connelly, 2000).

Based on the work of Clandinin and Connelly (2000), Kirkpatrick (2008) provided a visual representation that shows the interplay of the three narrative dimensions.

Image from Kirkpatrick (2008) provided in **Figure 1**.

Clandinin (2013) explained that an inquiry starts with *narrative beginnings*, which is a personal justification of the research wonder through an autobiographical introspection. After the researcher frames their inquiry, they negotiate entry into the inquiry site with their research participants. Attentive to the narrative commonplaces of temporality, sociality, and place, the researcher and participants co-compose *field texts* (data such as written or recorded observations, transcribed conversations, lesson plans, curriculum documents, etc.) Clandinin and Caine (2013) explained that field texts show temporality as they are co-composed over many interactions and include considerations of earlier life experiences. Sociality is shown during these outward events as researchers and

participants pay attention to their inward emotions, thoughts, and moral responses. Place is the physical backdrop where the inquiry and reflected experiences occur.

Part of thinking narratively is using the data to co-compose *narrative threads* with participants. Clandinin and Connelly (2000) explained that *narrative threads* are plotlines woven over the commonplaces of time, place, and social interactions. Narrative threads are not compartmentalized themes. Rather, they are continuous plotlines that describe the intricacies of human experiences across contexts.

## Narrative Inquiry Site

My work and research as a narrative inquirer involves coming alongside Cree educators and students to co-teach school mathematics with attention to Indigenization. Attending to Indigenization involves describing the political, social, and cultural characteristics of school mathematics. One aspect that I wanted to address are the ways assessments are shaped by the varying contexts of Indigenization in school mathematics. This article builds on my research wonders of how practitioners take up Indigenizing school mathematics. My research and interest in this area aligns with the Canadian Truth and Reconciliation Commission's (2015) calls to action urging the support of Indigenous linguistic and cultural education in classrooms. Foregrounding equitable assessments *via* Indigenous ways of knowing and being in education are part of the ongoing need to decolonize pedagogies and school subjects—especially those that are produced as acultural and universal, such as mathematics and science (Battiste, 2013; Goulet and Goulet, 2014; Iseke-Barnes, 2000).

The inquiry site for this work were two classrooms in a Cree-bilingual school. The participants' chosen pseudonyms were Miss Moore and Miss Scribe. Both were fluent Cree speakers with ties to their nearby reserve communities. Both teachers travelled back to their family homes on weekends and holidays. Both teachers actively participated in community-held powwows, sweats, tipi raising, and sun dance ceremonies (some of these ceremonies were also part of the school's programming). The students in their classrooms were predominantly Cree, with varying levels of Cree language fluency. There are different linguistic dialects of Cree across Saskatchewan (including Plains, Woods, and Swampy). The dialect spoken by the teachers and students was Plains Cree. Indigenization is shaped by the linguistic and cultural diversity of Cree (and other Indigenous cultures). This is important to note because Indigenization is not monolithic.

My relationship with the teachers and students is through my employment as a teacher educator with the University of Saskatchewan. I met with the teachers once a week during their mathematics class. We co-taught mathematics to the students, and I made field texts using written observations. I interviewed the teachers individually after class and recorded our conversations. I presented our transcribed discussions at subsequent interviews. We negotiated how our conversations and my classroom observations would develop into this article. For example, we agreed on sharing the kohtawān principles lesson plan document, as well as what to include in the interim texts (partial texts that are open to changing as researchers and participants co-compose stories and interpretations).

Connelly and Clandinin (2006) explained that negotiating how the collection of field texts shape the interim and final texts is part of the methodological commitments of narrative inquiry. Our discussions evoked stories to live by—a narrative conception of identity-making (Connelly and Clandinin, 1999)—that showed a nuanced approach to Indigenization and cultural identity (Stavrou and Murphy, 2019) through holistic assessment-making that was grounded in Miss Moore and Miss Scribe's Cree language and ways of being. Specifically, I have come to see a facet of Indigenizing school mathematics to be about ways of being in relationship, rather than a focus on subject matter. I have also learned that the broad term *Indigenization* is made meaningful by contextualizing it to experiences shaped by the narrative commonplaces of temporality, sociality, and place. One intention of this paper is to provide one particular example of how we have conceptualized and operationalized Indigenization in Grade 6 school mathematics.

## NARRATIVE THREADS

Narrative threads are plotlines that represent experiences through the narrative commonplaces of temporality, sociality, and place (Clandinin and Connelly, 2000). In this article, I shared our stories to live by through two narrative threads that evolved during the inquiry. The first thread, which we named *miyō-pimōhtēwin* (walking in a good way), highlighted an alternative holistic assessment practice in which Miss Moore and Miss Scribe explained how they evaluated the relational space created by their students. This was achieved by assessing how Cree kohtawān principles guided students towards *miyō-pimōhtēwin*.

The second thread was named *kamskēnow* (discovering). This involved the teachers assessing how their students shared ideas and solved problems using school mathematics. This alternative assessment foregrounded processes of discovering that supported the cultural and linguistic knowledges and aspirations of the students and teachers, and served to provide more meaningful practices of Indigenization that was personalized to our educational contexts. *Kamskēnow* emphasized that learning school mathematics was an ongoing process of discovering another way of seeing and experiencing the world around us. The experiences shared focus on the teachers' implementation of these assessments, rather than the responses of the students.

## Miyō-pimōhtēwin

Miss Moore and Miss Scribe focused on relationships in the mathematics classroom through *miyō-pimōhtēwin*. *Miyō-pimōhtēwin* was an ongoing process guided by eight principles that supported kohtawān (our spiritual being). An image of these principles, provided in **Figure 2**, was part of their assessment documents. These principles (created and shared by Senapan Thunder) were provided to the teachers during professional development presentations. The pictorial representation of the kohtawān principles in the field note was the resource they brought back to their classroom, which was introduced to me later during one of my visits to the school.

When we practiced the kohtawān principles, we balanced the physical, mental, spiritual, and emotional parts of our whole being. Focusing on relationships—rather than traditional methods of mathematics assessments—changed the learning environment of the mathematics classroom.

In the Saskatchewan mathematics curriculum, teachers are expected to recognize that mathematics is not acultural, and Indigenous cultural contexts and pedagogy influence mathematical learning (Saskatchewan Curriculum, 2009). Miss Moore and Miss Scribe integrated assessments that helped students experience their mathematics classroom as a relational space, rather than a rigid time for doing decontextualized booklet work and memorizing facts by rote.

The teachers demonstrated that the starting place was not subject-matter, but rather how we treated ourselves and others while we learned together in the classroom. The following interim text was from a transcribed conversation (field note) in which Miss Moore explained how the kohtawān principles guided her classroom assessments. Bracketed words were added by me for clarification.

*Each student gets a laminated paper with the kohtawān principles written on it. They know the eight principles hold equal importance so that we are miyō-pimōhtēwin. Throughout the day, the students highlight the words with a Dry Erase marker. By the end of the day, all the principles should be highlighted. If any aren't, we pause individually or together to get our spirits on track. The next day, we erase the paper and repeat the process. Chuck and Dale [pseudonyms given by me] come to school every morning saying they started [the principles] at home with their parents, and they make an effort to explain to me and the class what activities they do at home [to feel better] when they are upset or stressed.*

*Students are motivated to highlight all the principles by the end of the day because it represents perfect balance. Math class is a frustrating place for some students and teachers. Sometimes, students had a principle highlighted that they had to erase during [math] class because they got upset. I can't just assess for content knowledge. I have to know that they are seeing the value in what they are doing and that they don't feel stupid if they don't understand.*

(Interim text, December 2019).

I witnessed the kohtawān principles in action during my visits to the teachers' classrooms. One notable experience involved an inquiry-based activity in which students had 1 wk to create and describe a pictorial model of a rectangular garden based on specific criteria (e.g. fixed perimeter, cost of supplies, maximizing planting area, quantity of dirt required, how to space seeds, etc.) Not surprisingly, students progressed at different rates throughout the week. A few students were stuck on the step of trying to determine the dimensions of the rectangular garden that would give the largest planting area. One of the students, Jill (pseudonym chosen by me), became angry 1 day. She was withdrawn, unmotivated to continue, and ignored her classmates out of frustration. Miss Moore used the principles *ākamēyimo* and *wīchiso* to remind Jill that we

must move frustration out of our bodies by finding new ways to help ourselves. This opened a conversation in which Jill expressed feeling stupid because she needed to go slower than most of her classmates. Miss Moore explained that when we are learning something new, *nākatēyimiso*—being aware of yourself and your strengths—was more important than being as fast as everyone else and getting the right answer. This alleviated Jill's frustrations and shifted her focus positively back to her work.

Miss Moore demonstrated that part of learning successfully involved feeling balanced. She wanted students to know that their sense of wellbeing was always the focus throughout the day. This Cree way of being made curriculum a process that foregrounded relationships through *miyō-pimōhtēwin*. Miss Moore's familial experiences (outside of classroom contexts) learning Cree (as a language and way of being in relationships with others), revealed her curriculum-making as she brought her knowledge into the classroom (Clandinin and Connelly, 1992). The kohtawān principles are not specific to mathematics—the teachers apply this in other subjects, but this application is not something I consider in this article.

## Kamskénow

At the end of the week, the students were putting the final touches on their projects. The teachers and I arranged to have the students share their ideas within small groups as we assessed their work. Many students were fixated on their final answers, and whether or not they were correct. This drew me backwards in time to the feelings, hopes, tensions, and desires (Connelly and Clandinin, 2006) of my own schooling experiences in which I was anxious and self-conscious about my answers during math class. This all-too-familiar concern we have all likely shared resulted in some students (including Jill) being too doubtful and insecure to share their work. Miss Moore and Miss Scribe subverted these issues by reminding their students that projects in math class are part of *kamskénow*—ongoing processes of discovering the world around us.

The teachers explained in Cree that the project was not about having a perfect model, but rather about discovering and describing some of the necessary things required for creating their rectangular gardens. They said mathematics was one of the many tools used in *kamskénow* because it allowed students to describe and model their project through measurements and quantities. Students were asked to share what ideas they needed to design their model, rather than describe the end result. Students were also encouraged to explain things they struggled with, and how they relied on their peers and teachers for guidance. As the inquirer, I observed the ways social, cultural, and institutional narratives shaped the teachers and students' experiences, as well as my own (Clandinin and Rosiek, 2007). For example, I realized the ways my understanding of Indigenization was shaped by these experiences and discussions in the classroom.

The following interim text was from a transcribed conversation (field note) in which Miss Scribe explained how she connected the concept of *kamskénow* with assessments. Bracketed words were added by me for clarification.

*The problem with the status quo of assessments is that we need to teach students a lot of concepts in a short time, and*

then give them a written test. This is such an unnatural way to learn. We have oral traditions that dictate how and when we share our knowledge, and this knowledge transfer happens by doing. By seeing [how we do things] we can make sense of what we know and don't know. I can't just look at a piece of paper with some equations and numbers on it to see if my students get it. I can't just give them a grade on their final answer and not expect they won't feel stupid if they don't get a perfect score. Lots of students won't come to school when there's a test.

Students need to learn about area, perimeter, the environment, money, and finding the best way to measure all that stuff [optimization]. I don't always care about the final answer though. I care about if the students can think about these concepts in their life. I want them to embrace that they will always make mistakes along the way. I don't give them a mark, I ask them what they have thought about, what is missing, who they can ask for help if they get stuck, and things like that. This is what it means to discover as a Cree person. This is kamskénow.

(Interim text, December 2019).

By emphasizing kamskénow, Miss Moore and Miss Scribe established a culturally-relevant and meaningful curriculum that allowed them to pass on traditional knowledge. They created resources and assessments by centring their language and stories of experience, which exemplified ways teachers are curriculum-makers (Campbell and Caswell, 1935). These assessments did not replace Eurocentric forms of assessment, rather they provided a shift in the focus of what gets assessed.

### CONCLUDING REMARKS

The stories I shared of our classroom experiences showed the power and potential of Cree in providing holistic assessments that foreground languages, knowledges, and ways of being in relationships in the mathematics classroom. This potential is sought in broader contexts. As Goulet and Goulet (2014) explained:

The rich, dynamic complexities of Indigenous languages need revitalization and full integration with linguistics, language teaching, education, neuroscience, and other disciplines. Language is not a simple reflective mirror or medium of experience; it is part of the complex cognitive neuro-scientific framework that governs our thinking and actions. (p. 56).

Miss Moore, Miss Scribe, and their students represented an aspect of Indigenization as being uniquely experiential and located in our languages. Combining miyō-pimōhtēwin and kamskénow in the mathematics classroom emphasized that we must begin and end in relationships, while attending to the processes of discovering in ways that support our mental, physical, spiritual, and emotional wellbeing. Attending to the teacher-student relationships—as well as my relationship with the teachers and students—was part of my relational responsibility as

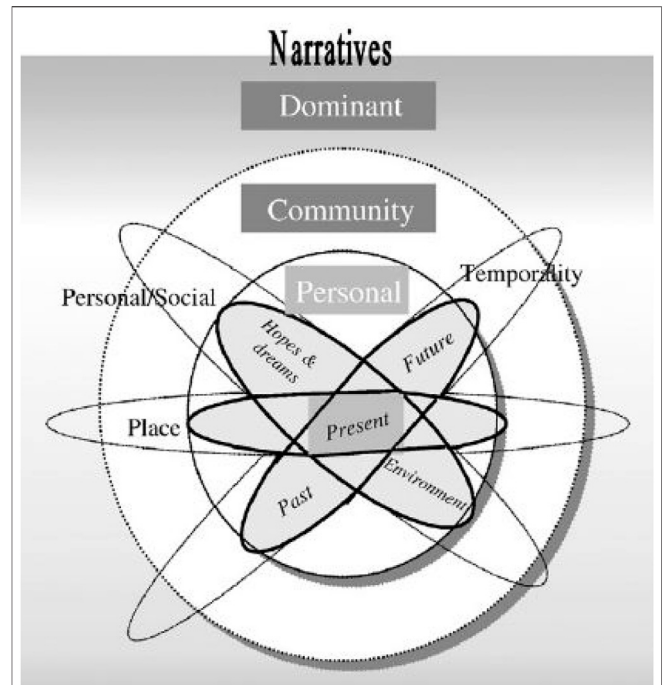


FIGURE 1 | Dimensions of a Narrative Inquiry.

a narrative inquirer (Clandinin and Caine, 2013). Attending to curriculum in ways that centered relationships, miyō-pimōhtēwin, and kamskénow was how Miss Moore and Miss Scribe provided alternatives to assessment and teaching that were more meaningful to their students' learning.

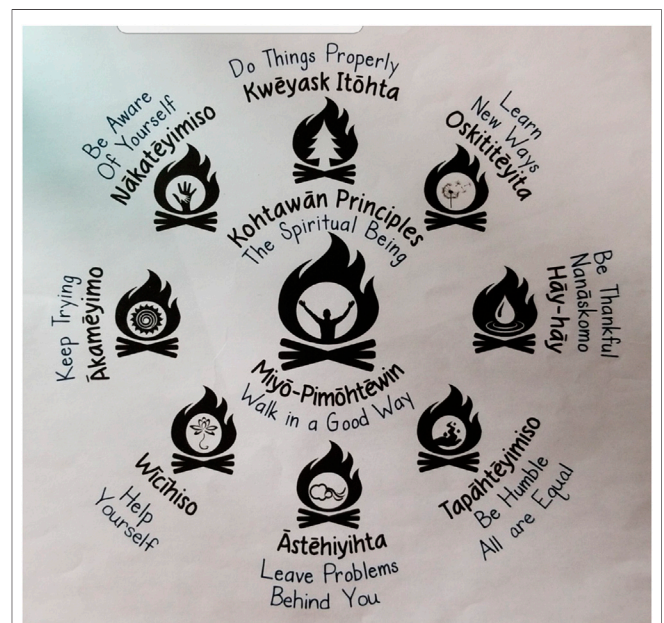


FIGURE 2 | Kohtawān principles.

The broader implications and results of these assessments in other classrooms, schools, and subject matter is not something the teachers and I attended to because we cannot speak to how a teacher's practice might shift. My ethical responsibility is in sharing our work, but I cannot necessarily say what the results will be. The possibilities of how teachers might factor these Indigenized assessments into grades is an area of future research and inquiry. As a narrative inquirer, I can *describe* some successes of our classroom experiences but I cannot *prescribe* how miyō-pimōhtēwin and kamskēnow could be used in other classrooms, since the conceptualization and actualization of these assessment frameworks depended on the uniquely-determined classroom conditions and behaviors driven by Miss Moore and Miss Scribe. I wonder how our experiences will inspire others.

While our time together was abruptly halted due to the pandemic, I remained in a research relationship with Miss Moore and Miss Scribe through virtual means. We are finding other ways to be in relationships so that we can continue to shape our work and practice. I want to acknowledge these teachers (and all educators) for their tireless efforts during the pandemic to weather the storm. As the teachers transitioned back and forth between virtual and face-to-face teaching, miyō-pimōhtēwin and kamskēnow remained integral to their teaching.

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## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the author, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Saskatchewan. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## AUTHOR CONTRIBUTIONS

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**Conflict of Interest:** The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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