Moving Achievement Together Holistically: The MATH Project

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https://bit.ly/3iQtZr6
Positioning Myself...

- Wabanaki Confederacy: Mi’kmaw, Wulastoyiqik, Passeméquoy, Penobsquis
- Mi’kma’ki – 7 districts that lie to the East of the Wulastuk river (now known as the St. John River)
- Evidence to show the Mi’kmaw lived here for over 20,000 years
- Acadians settled in NS in the late 1500s and early 1600s
- Black Loyalists arrived in NB and NS in the late 1780s; having fought alongside the British in the war of Independence, they were granted land and freedom in Mi’kma’ki.
“Be good or you’ll go to Shubie School”

WFNS Grade 7 1995
How can Math Teachers Address the Call to Action of the TRC? How can we Decolonize?

• Understanding the role of Settler Colonialism on Education, including math education
  
  • As Tuck and Yang (2012) have stated, "Settler colonialism is different from other forms of colonialism in that settlers come with the intention of making a new home on the land, a homemaking that insists on settler sovereignty over all things in their new domain. [...] In order for the settlers to make a place their home, they must destroy and disappear the Indigenous peoples that live there" (p. 5-6).

  • Cultural genocide is the destruction of those structures and practices that allow the group to continue as a group. States that engage in cultural genocide set out to destroy the political and social institutions of the targeted group. Land is seized, and populations are forcibly transferred and their movement is restricted. Languages are banned. Spiritual leaders are persecuted, spiritual practices are forbidden, and objects of spiritual value are confiscated and destroyed. And, most significantly to the issue at hand, families are disrupted to prevent the transmission of cultural values and identity from one generation to the next. (Truth and Reconciliation Commission, of Canada, 2015, p. 1)

• Recognizing the discourses that reinforce these ideologies

• Unlearning and Relearning
In our schools, whose math are we doing?

• “School mathematics curricula emphasizing terms like Pythagorean theorem and pi perpetuate a perception that mathematics was largely developed by the Greeks and other Europeans.” (Gutiérrez, 2017 p. 17)

• Joseph (2010) has argued that ideological beliefs about European superiority meant that “The contributions of the colonized peoples were ignored or devalued as part of the rationale for subjugation and dominance” (p. 4)

• Aikenhead (2017) has referred to this phenomenon as “mathematics myth blindness” (p.121) and pointed out that mathematics’ “privileged status rests on the myth that its Platonist content is acultural, universalist, value free, objective in its use, and nonideological” (p.121).

• Reconciliation and decolonization ask us to address this inequity in mathematics education. We need to tell different stories.
What textbook companies think reconciliation looks like...They’re wrong!

9. Talise folded 545 metal lids to make cones for jingle dresses for herself and her younger sister. Her dress had 185 more cones than her sister’s dress. How many cones are on each dress?

11. Louise purchased a Métis flag whose length was 90 cm longer than its width. The perimeter of the flag was 540 cm. What are the dimensions of the flag?
Redefining Equity

Identity

Equity

Access

Achievement

Power

Gutiérrez (2012)
The late Dianne Toney was a Mi’kmaw elder who made quill boxes like the one in the picture. She always made them by starting with a circle of bark for the top on which she made her pattern. She would always start at the centre of the circle to make her pattern. After that she would make the ring for the top from strips of wood. To ensure the ring was the right size, Dianne said she would measure three times across and add a thumb. She claimed this would make a perfect ring every time.

Does this always work?

https://teacher.desmos.com/activitybuilder/custom/563159e8adf491e06d63c4a
Show Me Your Math!

- Began in 2007
- Inviting Children to be the mathematics researchers
- Where is the math in your community?
- Local Math Fairs
- Annual Regional Math Fair
“I’m the last one who can do this...”

• Picture from: http://www.danielpaul.com/MargaretGrannyJohnson.html
Birch bark biting... “I remember Auntie Caroline doing that at the basket shop”
Maple Syrup Making...
Making a Drum...
Making a Canoe paddle... “It made me feel real Mi’kmaq making my own paddle.”
Wholeness

- Wholeness resists fragmentation, thus quality mathematics experiences require *cultural synthesis* bringing together cultures and values from mathematics and the community, *personal holism* including the child’s experiential, conceptual, and spiritual development, and *intergenerational interaction*. (Lunney Borden & Wagner, 2011)
Reconciliation

• Goal is to “restore what must be restored, repair what must be repaired, and return what must be returned” (Truth and Reconciliation Commission of Canada, 2015, p. 6).
“Within mathematics education, we have convinced ourselves that “equity” is a strong enough agenda when maybe revolution should be the goal.” Gutiérrez, 2017, p. 11

Often we believe ethnomathematical investigations alone are enough, but they are not. We must also consider ways in which we can teach math with and through Indigenous ways of knowing, being and doing – L'nui'ta'simk!
Learning from Language

A question of values

Meaningful personal connections to mathematics

Ways of learning

The importance of cultural connections

What is Mi’kmaw Mathematics?

Challenges and Complexities of Ethnomathematics

Show Me Your Math!

Hands-On

Visual-Spatial Learning

Apprenticeship and Mastery

Nominalisation and Verbification

What’s the word for…? Is there a word for…?

Using more Mi’kmaq

Enough is for survival, Number is for play

Spatial reasoning

Estimation and Fairness

Grounded in Necessity and Experience

Context and Connectedness

Lunney Borden 2010
Research Question:

• How can the implementation of the Mawikinutimatimk Framework (Lunney Borden, 2010) for transforming mathematics education in Mi’kmaw communities contribute to increased achievement in these schools across different school contexts serving Mi’kmaw children?
  • How does the professional learning support teacher development? How does the implementation vary across the different contexts?
  • What types of learning and assessment tasks help to improve student learning across these contexts?
  • How do students respond to this approach to learning mathematics in the varying contexts? Does this approach improve engagement and attitude toward learning mathematics?
  • How does the involvement of elders and community knowledge holders in professional learning and classroom teaching support teacher learning and student learning across these contexts?
Our Current Focus

• Working alongside teachers to help them develop an understanding of the model and consider the implications for teaching and learning

• Verbing and Spatializing Math Teaching and Learning
  • Designing tasks and noticing how students engage with those tasks

• Understanding students perceptions of mathematics

• Working with MK on developing a holistic assessment and learning tasks that support our overall goals (Currently just grade 1)
A Picture of Me Doing Math
162 + 72 = 882
5192 + 219 = 7384
ellen lisa kyle evan = math
A Picture of Me Doing Math

Shooting for the stars
A Picture of Me Doing Math

blocks
Bee-bots
iPad's
Findings

- Shared drawings with participating teachers to have them co-analyse with us;
- The emphasis on learning centres
  - Classes were collaborative
  - Children saw math as engaging in multiple modes of learning a concept in centres
- Teachers believe that centres are the best way to teach as it gives them freedom to work individually or in small groups with students
- Teachers couldn’t imagine any other way of teaching
Verbing

- Focus on change/motion
- How do I make it?
- What happens if...?
- How is it changing?
Spatializing

Linear

Set

Area

Hold it in your hand
Build \( \underline{5} \) sets of \( \underline{3} \).

Roll two dice to find the numbers for the blanks.

Record your results on the recording sheet.

\( \underline{5} \) sets of \( \underline{3} \) is \( \underline{15} \).
Build \( \underline{5} \) sets of \( \underline{6} \).

Roll two dice to find the numbers for the blanks.

Record your results on the recording sheet.
Take 2 jumps of 5.

Roll two dice to find the numbers for the blanks.

2 jumps of 5 is 10.

Record your results on the recording sheet.
Shade \( \underline{3} \) rows of \( \underline{6} \).

Roll two dice to find the numbers for the blanks.

\[ \underline{3} \text{ rows of } \underline{6} \text{ is } 18. \]
Findings from this series of tasks

• Using the “of” language with actions of building allowed students to engage with the tasks and allowed us to see strategies for working with multiplication concepts;

• Transferred building approach from sets of to story problems;

• Coming to know in their own ways, using their own descriptions
  • “I built it 4 times, I built this 3 times...wait, this is just times...You guys! This is just times!”

• When we figure it out we name it!

• Teacher designed similar tasks for introducing multiplication

• Centres allow for exposure to various strategies; Story problems allow for selection of preferred or efficient strategies & appropriate models to fit the story context
Can you organize it in two equal rows?

<table>
<thead>
<tr>
<th>14</th>
<th>24</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>18</td>
<td>21</td>
<td>32</td>
</tr>
</tbody>
</table>

8 - Yes

9 - No
Proof and Conjecture
Multiplying Integers

- The Bucket of Zero
- Adding to or taking from zero
The bucket of zero

Taking away positives, leaves the bucket negative
The bucket of Zero

Say it in words: Take off 5 sets of -3

\((-5) \times (-3)\)
\((-5) \times (-3) = +15\)

Taking away negatives, leaves the bucket positive
Current work: Holistic Math Assessments
<table>
<thead>
<tr>
<th>Whole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part</td>
</tr>
<tr>
<td>Part</td>
</tr>
</tbody>
</table>
Making sets with 2 colours

I built 18 on my ten frame. I used 12 red and 6 yellow. What can you build?

Roll for a number!

Build it on the ten frame using yellow and red!

Record what you built!
When we figure it out, we name it...
HOW CAN THIS HELP US WITH OUR 7S FACTS?
NOW LET’S EXPLORE OUR 9S FACTS!
Choose the orange rod.

Find two rods that make the same length as the orange rod.

Record on grid paper.
Choose two rods.

Find two different rods that make the same length.

Record on grid paper.

Write the number sentence that describes the equal lengths.

Making Trains – Two Rods
Choose two rods

Combine them to make a long train.

Use the orange to find the total length.

Record on grid paper.

Making Trains – Helpful Orange

\[ 9 + 6 = 15 \]
Multiplying and Dividing

- $4 \times 5 = 2 \times 10 = 20$
- $19 \div 6 = 3 \text{ R } 1$
From rods to strip diagrams

\[ X + 11 = 36 \]

\[
\begin{array}{ccc}
36 \\
X & & 11 \\
\end{array}
\]

\[ 3x - 5 = 22 \]

\[
\begin{array}{ccc}
X & X & X \\
22 & & 5 \\
\end{array}
\]
Arrays and Areas

3 x 4 = 12
2 x 6 = 12
4 x 3 = 12
1 x 12 = 12
The Shape of a Number

Use square colour tiles to make rectangles with areas from 1 to 20. Record the dimensions of these rectangles on grid paper and complete a chart similar to the one below.

Note: When we talk about whether it make a rectangle in more than one way we will consider any rotation of a rectangle to be the same rectangle (i.e. a 2 by 1 and 1 by 2 will be considered as only one rectangle so 2 can be made in only one way).
<table>
<thead>
<tr>
<th>Number</th>
<th>Makes a rectangle</th>
<th>Makes a square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Only one way</td>
<td>More than one way</td>
</tr>
<tr>
<td>1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Explore...

• Look for patterns in the table. Do you notice anything about the numbers that can make a rectangle in only one way? Explain anything you notice about these numbers.

• Can you find numbers between 20 and 100 that can be made in only one way as well? What are they? How can you be sure their rectangles can be made in only one way?

• Look for patterns in the table. Do you notice anything about the numbers that can make a square? Explain anything you notice about these numbers.

• Can you find numbers between 20 and 100 that can a square as well? What are they? How can you be sure you have found all the square numbers up to 100? Explain.
Multi-Digit Calculations with Area
Area models

The area model can become a regional model to do 1 digit by 3 digit

\[
4 \times 326 = 1200 + 80 + 24 = 1304
\]
When I build 8 rows of 5 squares, I need 40 squares in all.

If I take off the 4 bottom rows and move them beside the 4 top rows, now I have 4 rows of 10, but it is still 40 squares in all.

Show $8 \times 5 = 4 \times 10$

$8 \times 5 = 4 \times 2 \times 5 = 4 \times 10$
If I make an area model that is 12 rows of 15 and then I cut it in half to make two rectangles that are each 6 rows of 15, I can rearrange the pieces to show this is 6 rows of 30 so 180 in all.
Multiplying Fractions with area...
$\sqrt{12} \approx 3.5$

$\sqrt{25} = 5$

Square Root
MODELING WITH ALGEBRA TILES

Algebra

4 \(x + 3\) = 4\(x + 12\)

\((x - 1)(x - 4) = x^2 - 5x + 4\)

\(x^2 + 5x + 6 = (x + 2)(x + 3)\)
A Time of Reconciliation

It will never happen again!
Questions?

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Showmeyourmath.ca