“It’s like they’re speaking a different language …”

How research into second-language learning might be useful for improving mathematics teaching practice

The Context

- Halfway through a 7-year collaborative inquiry into “Changing the culture of mathematics teaching at the school level”
- Co-Researchers: Jo Towers, Olive Chapman, Sharon Friesen, Michelle Drefs
- Design-based research – a methodology in which participants attempt to understand the world by/while working to change it (Hoadley, 2004)
- Preliminary strategy (first 2.5 years): Infuse ideas into the system through a highly invested, self-selected core group
- Subsequent strategy: Reporting on that today.

Agenda

- Ecosystems of Analogy – how humans think, and why some ideas seem so much more compelling than others
- Educational Paradigms – some of the conflicting “languages” that are part of the current educational landscape
- Language Competencies – examples of how educators can speak very different languages … even when it sounds like they’re saying the same thing
- Changing Mindsets – how research into second-language learning might be useful for improving teaching practice.

WARM-UP EXERCISE 1: What’s teaching?

Identify a synonym for “teaching that really resonates with you.”
WARM-UP EXERCISE 1: 150 synonyms of teaching

In 2012, the Edmonton Public School Board suspended high school teacher Lynden Dorval for giving students zeros when they missed tests or didn’t hand in assignments.

1) Which side would you support? Justify your position in <4 words.

2) You’ve just been hired to defend the other side in court. Justify that position.

WARM-UP EXERCISE 2: Which side are you on?

Three points:
1. Such rationales/beliefs are based on metaphors/ analogies.
2. Specific metaphors are compelling and persistent because they exist in grander webs of association.
3. It’s can be VERY difficult to identify one’s metaphors, and even harder to get a sense of the grander web.
Where 300+ pre-service teachers landed

In the case of Dorval vs. EPSB ...

(Notably, 50+ of the pro-Dorvalians couldn’t identify their metaphor … … which matters because it means they can’t interrogate their convictions.)

Point 1: The rationales are based on metaphors/analogies

Humans are ANALOGICAL creatures who are capable of (but not very good at) LOGIC.

Human learning/knowing is most commonly defined in terms of logical & sequential processes. It is coming to be understood as mostly a matter of analogical and associative processes.

Humans are ANALOGICAL creatures who are capable of (but not very good at) LOGIC.

Point 2: Metaphors exist in grander webs of association

… ideas never stand alone. They come woven in a web of auxiliary ideas, consequential notions, supporting concepts, foundational assumptions, side effects, and logical consequences and a cascade of subsequent possibilities. Ideas fly in flocks. To hold one idea in mind means to hold a cloud of them. (Kevin Kelly, 2010)

Point 3: Identifying metaphors and their webs is difficult.

An historical example of what happens when we come to see what’s being taken for granted.

Re-emphasizing Point 2: These paradigms are/were compelling and resilient because they are part of grander (religious, political, philosophical, etc.) webs.
Point 3: Identifying metaphors and their webs is difficult.

William Irwin Thompson’s characterization of prevailing worldviews over the past 3000 years.

Re-Emphasizing Point 2: These paradigms are/were compelling and resilient because they are part of grander (religious, political, philosophical, etc.) webs.

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Some Paradigms in Western Formal Education

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These “languages” are internally consistent, but mutually incoherent.

(And each is also a subset of a grander cultural – philosophical, religious, political, pragmatic, mathematical, artistic, scientific, etc. – sensibility.)
How research into second-language learning might be useful for improving teaching practice

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**Agenda**

- How research into second-language learning might be useful for improving teaching practice

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<table>
<thead>
<tr>
<th>PARADIGM</th>
<th>STANDALIZED EDUCATION</th>
<th>AUTHENTIC EDUCATION</th>
<th>DEMOCRATIC CITIZENSHIP EDUCATION</th>
<th>SYSTEM SUSTAINABILITY EDUCATION</th>
</tr>
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<tbody>
<tr>
<td>START</td>
<td>1600s</td>
<td>early 1900s</td>
<td>1960s</td>
<td>1990s</td>
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<tr>
<td>ATTITUDE</td>
<td>Physical Sciences</td>
<td>Human Sciences</td>
<td>Social Sciences</td>
<td>Complexity Sciences</td>
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<tr>
<td>INFLUENCES</td>
<td>Physics &amp; Industry</td>
<td>Biology &amp; Structuralism</td>
<td>Sociology &amp; Economics</td>
<td>Ecology &amp; Systems Theory</td>
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<tr>
<td>ICONIC VISUAL METAPHOR</td>
<td>MECHANICAL; DIRECTIONAL</td>
<td>ORGANIC; BRANCHING</td>
<td>CONTRACTUAL; COLLABORATIVE</td>
<td>ECO SYSTEMIC; EMERGENT</td>
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<td>KNOWLEDGE CURRICULUM LEARNING</td>
<td>OBJECTIFIED FACTS</td>
<td>Personal interpretation</td>
<td>mean &amp; understanding</td>
<td>SOCIAL CONSTRUCTIONS</td>
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<tr>
<td>TEACHING</td>
<td>INSTRUCTING; DELIVERING; DIRECTING (EVALUATIVE LISTENING)</td>
<td>EVOLVING, SUFFICIENT AGENTS</td>
<td>EVOLVING, SUFFICIENT AGENTS</td>
<td>VIBRANT COMPLEX FORMS</td>
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<table>
<thead>
<tr>
<th>SOME SNIPPETS FROM STAN</th>
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<tbody>
<tr>
<td><strong>Metaphor</strong></td>
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**Observations:**

**Standardized Stan**
- unable to speak directly/explicitly to beliefs about learning and knowledge
- very limited lexicon for teaching

**Authentic Arthur**
- able to summon multiple, nuanced descriptions of knowledge, learning, and teaching

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**For both:**
Teaching that is highly consistent with their flocks of associations.

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**We noticed a few monolingual Standardized Education Speakers**

And a few strongly inclined Authentic Education speakers.

But the vast majority of teachers we interview seem to be "between languages."

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**One common way to be between languages**

**Pidgin** – when two or more speakers who do not speak a common language form a distinct intermediate language

\[ \text{... which is kinda sorta comprehensible to all involved.} \]
1) Middlish isn’t sufficient to move sensibilities in ways that affect classroom practice in coherent and sustainable ways.
2) Middlish permits a sort of waffling that can feel progressive, but that may be regressive.

<table>
<thead>
<tr>
<th>LANGUAGE</th>
<th>TRADITIONALese</th>
<th>MIDDlish</th>
<th>REFORMese</th>
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<tbody>
<tr>
<td>“SPATIAL</td>
<td>“something more” (in any already packed curriculum)</td>
<td>“something in” (an integral aspect of mathematical doing)</td>
<td></td>
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<tr>
<td>REASONING”</td>
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<td>“GROUP”</td>
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<td>WORK”</td>
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<td>“APPLICATION</td>
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<td>OF SKILLS”</td>
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<tr>
<td>“PCK”</td>
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<tr>
<td>“I need to know more than they [the students] do.”</td>
<td>willingness to “muddle through” together</td>
<td>“being able to get inside concepts, and knowing how they hang together”</td>
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Ecosystems of Analogy – how humans think, and why some ideas seem so much more compelling than others.

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3) Middlish is an easy target for back-to-basics advocates, as it can be readily assumed by unilingual Traditionalese speakers (i.e. MOST people).

change.org
Back to Basics: Mastering the fundamentals of mathematics
(A petition to the Alberta Minister of Education)
Nhung Tran-Davies

“The Back to Basics: Mastering the Fundamentals of Mathematics petition was started in December 2013 in response to clear evidence that since the introduction of the “new math” (discovery math) curriculum in the past decade, not only are we seeing deteriorating math scores across Canada, as measured by the OECD, but also its detrimental effects on our children’s confidence, skills and future.”

Does your synonym for teaching fall in one of these columns?
Lessons from research into second language learning

- Dwell in an immersive setting – with, e.g.,
  - routines & regular demands – practice, practice, practice
  - unpredictable challenges
  - peer support – corrections, challenges, elaborations
- Develop metacognitive awareness – by, e.g.,
  - explicitly discussing vocabulary
  - being attentive to how the new language carries a different worldview
- Engage in the challenge of bringing others into the language
  - speak in a way that confronts them with the limitations of their fluency
  - i.e., avoid a middle language
- Time
  - 2 years to “conversational fluency” (likely already achieved)
  - 5 years to “academic fluency”

Our next DBR iteration …

- Designing an action research project within the DBR project
  - Mid-February – met with teaching leaders (a.k.a. administrators) to think through shared next steps
  - End of February (last week) – presented a scaled-down version of this talk to the math teachers in the school
  - Currently – doing a “what’s holding us back” assessment
  - Balance of this school year – co-imagining a project among teachers of creating “an immersive setting” for next year
  - Next year – involving students and parents in a collective “change the language” project
- Immediate points of agreed emphasis/need
  - Weekly provocation to interrogate assumptions – à la “Dorval vs. EPSB” (next topic: Should we have an honor roll?)
  - PCK support – “We need better math to do this.”
  - Using spatial reasoning as a focal element

Why spatial reasoning?

Spatial reasoning is a high-impact topic –
- strongly predicts interest in, appreciation of, and success in STEM domains and careers
- correlates to academic success across all school disciplines

Spatial reasoning comprises a high-yield skill set –
- strong transferability across skills and disciplines
- highly malleable; it can be learned

Spatial reasoning is under-used & under-developed –
- ignored in current grade-school curriculum and teaching
- … which may contribute to atrophy

Spatial reasoning has powerful disruptive possibilities for Standardese and Middlish speakers
- It rests on a body of (Standardese-ish) evidence
- It resides in a Reform-ese ecosystem of associations

Tag-onto-the-end thoughts

- The second-language-learning frame is proving a potent means remind ourselves of the complexity of educational change.
- Might it be a productive frame for construing/constructing/examining teacher education and professional development programs? (And might something like that already be happening somewhere?)
- And a dollop of reality:
  - PERHAPS more than any other profession, teaching happens in the vernacular.
  - No educational language can be better fitted than Standardized Education to the contemporary culture of objectification and commodification. To survive in this discursively hostile milieu, the language of Authentic Education must be deliberately distinct.