

DISRUPTING THE RELATIONS AND FUNCTIONS OF SCHOOL MATHEMATICS

A Methodology for Reframing Mathematics through Culturally Responsive Pedagogy

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Overview of Research:

- Responds to calls to develop culturally appropriate curricula and to educate new teachers in these curricula, asking the question of how school mathematics and mathematics teacher education might be reframed through critical and culturally responsive pedagogies.
- The research challenges dominant school mathematics paradigms which (re)produce injustices with regard to participation in mathematics, proposing a new (*disruptive*) form of culturally responsive pedagogy (CRdP).
- Explores a methodological innovation involved in operationalizing a form of discourse analysis which draws on Nancy Fraser's three-dimensional framework for social justice and the concept of *participatory parity*, along with conceptual tools of Pierre Bourdieu.
- Reframing school mathematics through CRdP is to disrupt the relations and functions of school mathematics.

Presentation Outline:

- Background and context for research interests in CRP: A course in CRP (the *small study*)
- Defining terms: reframing, disruptive pedagogy, participatory parity...
- A pedagogical, theoretical and methodological 'vision' for CRP
- Research program: Phases of Conceptualization and Contextualization (the *BIG study*)
- Theory - Nancy Fraser in general, in education, in mathematics education
- Methodology - An approach to consider

Background & Context for Research

- In Canada, the research responds to calls to action emerging from the Truth and Reconciliation Commission (TRC) of Canada (2015), including
 - the principle of “[d]eveloping culturally appropriate curricula” (p. 2)
 - as well as the call for “[b]uilding student capacity for intercultural understanding, empathy, and mutual respect” (p. 7)
 - and “identifying teacher-training needs relating to [building student capacity]” (p. 7).
- Other research echoes these calls (Aguirre & Zavala, 2013; Mukhopadhyay & Roth, 2012; Nolan & Keazer, *in press*; Parker, Bartell, & Novak, 2017)
- A TESM course in *Culturally Responsive Pedagogy (CRP) in the Mathematics Classroom* (EMTH 425), first offered in July 2017
- Students were mostly practicing elementary school teachers, and a few prospective (pre-service) teachers
- Course design reflected the many intersecting fields of research that (I think) shape CRP:
 - **Ethnomathematics [EM]**
 - **Critical Mathematics [CM]**
 - **Indigenous Education [IE]**
 - **Language Diversity [LD]**
 - **Equity-based [E-b] research**

ETHNOMATHEMATICS

Generally defined as “*mathematics of cultural practices.*” (Presmeg)

CRITICAL MATHEMATICS

An expression of some broader concerns about mathematics education... including attempts to consider mathematics in its social, cultural and political complexities. (Skovsmose)

INDIGENOUS EDUCATION

A deep understanding of Indigenous knowledges... to integrate Indigenous knowledges and mathematics curricula in respectful and appropriate ways. (Stereberg)

Addresses relation between language and mathematics learning... that combines perspectives of mathematics learning with perspectives of language, bilingualism, and classroom discourse. (Moschkovich)

LANGUAGE DIVERSITY

Considers students' linguistic, ethnic, racial, gender, and socioeconomic backgrounds in learning mathematics [and] challenging the hegemony of mainstream knowledge and the reproduction of inequality. (Meaney)

EQUITY-based research

CRP...

Culturally responsive pedagogy “encompasses curriculum content, learning context, classroom climate, student–teacher relationships, instructional techniques, classroom management, and performance assessment” (Gay, 2010).

Course-based research (the small study)

- Research conducted using one of the course assignments: A reflective blog
- Students assigned one specific area to read about and provide seminars to class
- Aim:
 - **to understand more about how teachers interpreted the social, cultural and political challenges of teaching through CRP,**
 - **when the CRP is being introduced/taught through the lenses of these different areas/fields (EM, CM, IE, LD, E-b)**

- The Reflective blog

Stories of growth and success, but also stories of resistance...

[Resistance to disrupting the mathematics we know so well]

Students (practicing teachers) expressed challenges to teaching through CRP:

- “... there are **a lot of different cultures** who’s [sic] mathematics you would need to include in the curriculum”
- “I feel as though many teachers would have **issues with parents** who believe that “the old way worked for me so why change it?”
- “I also feel that it would be extremely difficult to ensure that **every single lesson we ever made** was culturally responsive.”
- “... one certainly sees that building the groundwork for CRP is **labour intensive** and can potentially take a teacher out of his/her comfort zone”
- “I’m afraid that I could turn into a teacher that knows the materials and knows the [cultural] perspectives but doesn’t act because [s/he] is **afraid of offending**”
- “[with] the added dimensions of responsiveness to equality, social justice, ethnomathematics and linguistics... There is a lot to consider when building a culturally responsive program. Truthfully, these are **not really issues that I had ever considered could be discussed in mathematics.**”

Why such stories of resistance?

- **Even though**, efforts to reframe and decolonize mathematics (Meaney et al., 2016) have generated an extensive body of research on mathematics teaching & learning and on educating new mathematics teachers through these diverse areas/fields (CRP, EM, CM, IE, LD, E-b)
- ... **and** there are many overlaps and intersections between these theoretical/philosophical perspectives, especially with respect to their critiques of school mathematics,
- in some ways, **however**, the perspectives also remain separate and potentially serve to theoretically compete with each other and to confuse teachers as to what, pedagogically, *to do* in mathematics classrooms.
- Such ‘confusion’ enables, on a conscious level, rationalizing discourses (Nolan & Keazer, *in press*) for why it is not possible to teach through CRP (for example, there is a ‘real’ curriculum to cover and CRP serves merely as a side service) and, on a more unconscious level, to reify dominant forms of mathematics (the math we know so well)

- That which is often referred to as Euro-Western (E-W) mathematics (Bishop,1990) but that which also, according to Bishop (1990), serves “as one of the most powerful weapons in the imposition of western culture” (p. 51).
- That which has been called “near-universal, conventional (NUC)” (Barton, 2008)
- That which has a history of being “culturally defined as objective, value-free, logical, consistent and [a] powerful knowledge-based discipline which students must accept, understand and manipulate” (Burton, 1994, p. 207).
- That which is considered a universal language, rather than “thinking in terms of repertoires of languages, discourses and voices [which offer] an organized way to examine the range of sources of meaning influencing students’ learning of mathematics” (Barwell, 2018, p. 166)
- That which has served so long in the role of gatekeeper, and “maintaining the gatekeeper image of mathematics works to secure specific versions of the world of teaching and learning mathematics, while obscuring other possibilities” (Nolan & Graham, 2015, p. 835).

What do I mean by the “math we know so well”?

To clarify what I mean, I get help from...

Bishop
Barton
Burton
Barwell
Nolan & Graham

- The objectives of the research:
Focus on **reframing** schooling and school mathematics through **disruptive pedagogies** in teacher education
- **Reframing**, in this context, means rethinking and reconstructing the boundaries of school mathematics which currently (re)produce injustices with regard to participation in mathematics.
 - Lingard and Keddie (2013) suggest that pedagogies “are the aspect of teachers’ practices that make the most significant impact upon student learning” and that “the quality of pedagogies is a social justice issue” (p. 430).
 - Social justice “can only be achieved in the disruption of practices which contribute to the reproduction of educational inequalities” (Beighton, 2017, p. 113).

Enter my new research...

To disrupt the “relations and functions” of school mathematics... through a critique and reframing of school mathematics and mathematics teacher education... to create spaces for a critical and socially-just exploration of being and becoming a mathematics teacher

- A pedagogy is disruptive if it “requires students to challenge or change their epistemologies and participation in their learning” (Anderson & Justice, 2015, p. 400).
 - **Disruptive pedagogies** work to dismantle and replace dominant paradigms, in contrast to the more common “additive pedagogies” (Vratulis, Clarke, Hoban & Erickson, 2011) which are merely integrated to support existing pedagogies.
 - Battiste (2017) calls for “changes to existing educational philosophy, pedagogy and teacher education, not an add and stir approach but a systemic change” (p. xi).
- Thus, my new research program is motivated by pedagogical concerns, while focused on tracing the dialogue between theory/methodology and practice/pedagogy.

To disrupt the “relations and functions” of school mathematics... through a critique and reframing of school mathematics and mathematics teacher education... to create spaces for a critical and socially-just exploration of being and becoming a mathematics teacher

‘Vision’ for constructing a culturally responsive *disruptive* pedagogy (CRdP)

- CRdP is
 - *pedagogically* informed by research in the fields of CRP, EM, CM, IE, LD, and E-b;
 - *theoretically* informed by Nancy Fraser’s three-dimensional conceptualization of social justice and participatory parity; and
 - *methodologically* informed by critical discourse analysis.

Returning to abstract for a moment: A side note on Bourdieu

“This presentation explores a methodological innovation involved in operationalizing a form of discourse analysis which draws on Nancy Fraser’s three-dimensional framework for social justice and the concept of *participatory parity*, along with conceptual tools of Pierre Bourdieu.”

- Pierre Bourdieu and Nancy Fraser: A likely pairing?
- As proposed by Lovell (2007): both theorists have links to critical theory, critical realist sociology, agency and participatory parity, noting
 - **“Fraser holds the place... for participatory parity, dialogics and agency in normative social transformation. Bourdieu, on the other hand, holds the place for the powers that thwart these processes and that condition and shape agency” (p. 7).**
- The theoretical and methodological design of my research program reflects this relationship between Fraser and Bourdieu

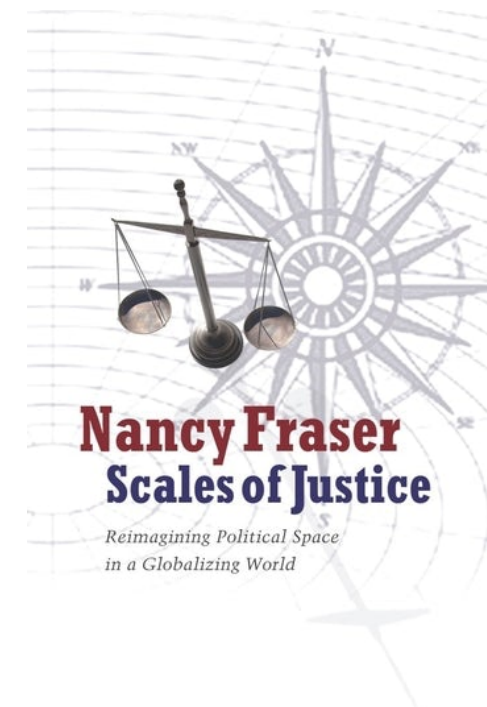
Two phases to my research program in terms of methodology/method: **Conceptualization** and **Contextualization**

- **Conceptualization**: I draw on Fraser's 3-dimensional theory of social justice to design CRdP in the goals of agency and participatory parity in school mathematics
- **Contextualization**: I draw on the tools of Bourdieu to study the network of relations and power that (attempt to) thwart this goal in the context of (the fields of) field experience (Nolan, 2016, 2018) to study the pedagogic actions of CRdP in the three intersecting spaces of teacher education: school practicum classrooms (F1), university classrooms (F2), and internship professional learning communities (F3).
- In other words, key socio-economic, cultural and political questions stemming from Fraser's theory drive this research program forward by reframing school mathematics through a social justice lens in the 3 Bourdieuan fields (F1, F2, F3).
- This presentation focuses on the **conceptualization phase** of my research, namely: Conceptualizing CRdP by synthesizing perspectives offered by the theoretical collective of Ethnomathematics, Critical Mathematics, Indigenous Education, Language Diversity and Equity-based research.

On Nancy Fraser...

- “The most general meaning of justice is parity of participation” (Fraser, 2005, p. 73)
- “... justice requires social arrangements that permit all to participate as peers in social life” (Fraser, 2005, p. 73)
- Three kinds of obstacles to participatory parity (i.e. three dimensions of injustice): economic (distribution), cultural (recognition), and political (representation)
- Draw on Cazden (2012); Lingard & Keddie (2013); Power & Taylor (2013) for Fraser in educational contexts:
 - **When resources are denied to some schools/classrooms (economic injustice)**
 - **When certain histories, cultures and knowledges are excluded from curriculum and texts (cultural injustice)**
 - **When certain individuals or groups are denied a voice in educational decision-making processes (political injustice)**

Introducing
Nancy
Fraser’s
framework
for social
justice



On Nancy Fraser in my research...

- CRP as a disruptive pedagogy (CRdP) is being created by drawing on the 3 dimensions of Fraser's theory of social justice
- The approach offers an understanding and a critique of school mathematics through key questions of
 - **who has access/resources (socio-economic dimension / politics of distribution),**
 - **whose knowledge is valued (cultural dimension / politics of recognition), and**
 - **who has a voice (political dimension / politics of representation).**
- **For example**, viewing school mathematics through the lens of recognition, or the cultural dimension, would see beyond school/ E-W/NUC mathematics as the *only* mathematics but, instead, see it as one thread (or "fibre" (Barton, 2008)) in the expansive cultural fabric of mathematics and what counts as mathematical knowledge.
- Methodologically, I apply a Fraser-framed discourse analysis to the identified literature in the EM-CM-IE-LD-E-b research collective, analyzing the research texts through questions about researcher aims, theory, methodology, and pedagogy, with the culminating question of analysis focused on viewing the text through Fraser's 3-dimensions

AREA/FIELD OF RESEARCH	Scholarly Research Texts
Culturally Responsive Pedagogy [CRP]	Aguirre & Zavala, 2013; Aronson & Laughter, 2016; Civil, 2006; Donald, Glanfield, & Sterenberg, 2011; Ladson-Billings, 1995; Nicol, Archibald, & Baker, 2013; Turner, et al, 2011; Ukpokodu, 2011; Wiest, 2006; ...
Ethnomathematics [EM]	Cimen, 2014; D'Ambrosio, 1985, 2006; Furuto, 2018; Knijnik, 2012; Mukhopadhyay, 2009; Powell & Frankenstein, 1997; Presmeg, 1998; Rosa & Orey, 2011; Wagner & Lunney Borden, 2015; ...
Critical Mathematics [CM]	Brantlinger, 2014; Bullock, 2018; de Freitas, 2008; Ernest, Sriraman, & Ernest, 2016; Nasir, 2016; Skovsmose, 2000; ...
Indigenous (Mathematics) Education [IE]	Aikenhead, 2017; Doolittle, 2006; Lunney Borden, 2011; Lunney Borden & Wiseman, 2016; Owens, 2015; Russell & Chernoff, 2013; Stavrou & Miller, 2017; Sterenberg, 2013; Edmonds-Wathen (2019); ...
Language Diversity [LD]	Barwell, 2016, 2018; Botes & Mji, 2010; Chronaki & Planas, 2018; Essien, Chitera, & Planas, 2016; Jorgensen, 2015; Moschkovich, 2002; Setati & Moschkovich, 2013; ...
Equity-based research [E-b]	Frankenstein, 1995, 1998; Gutiérrez, 2009, 2012; Herbel-Eisenmann et al., 2012; Meaney, Trinick, & Fairhall, 2013; Rubel, 2017; Tate & D'Ambrosio, 1997; ...

Overview of Research Contributing to Creation of CRdP

Introducing: Fraser-Framed Discourse Analysis

An approach that questions the research texts to understand:

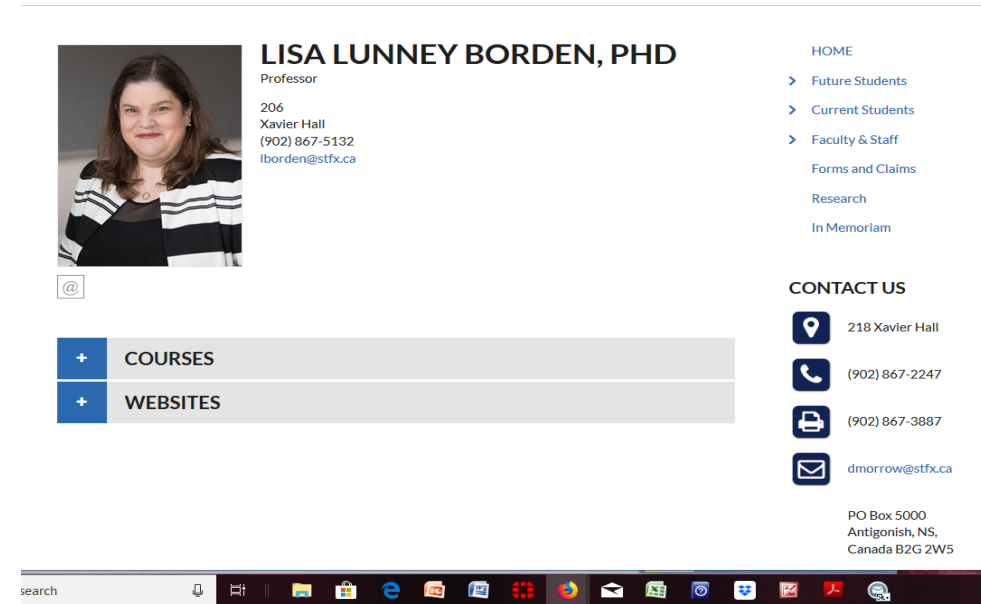
1. How the researcher defines and/or describes the **key aims** of (i) the area/field (if in fact the researcher even names their work using these area/field labels), and (ii) the specific research text (who and what the research is for)
2. The **theory/ies** (other scholarly research) that the researcher draws on to conceptualize/inform these aims
3. The researcher's description of research **methodology/ies** used
4. How/if the researcher grounds research in practice; that is **pedagogy/ies** and/or examples
5. What is noticed about the research text when viewed through the lens of Fraser's **3-dimensional social justice framework:**

- **Distribution (socio-economic)**
- **Recognition (cultural)**
- **Representation (political)**

Methodology based in discourse analysis, framed in Fraser's 3 dimensions of social justice

A “Part B” to this methodology

- Recognizing that a textual analysis is *not* the next best thing to conversation...
- I designed an ‘interview the researcher’ aspect to the methodology
- Much like the textual analysis questions, the conversation/interview seeks to understand how the researcher would position her/his work within the EM-CM-IE-LD-E-b collective as well as questions about the theoretical framing drawn on and to what end (desirable outcomes, key purpose for research)
- Researchers are also asked what they notice about the CRP field at this time... tensions? contradictions? etc
- So, in terms of my learning so far...
 - **for Part A: Lunney Borden (2011)**
 - **for Part B (my first interviewee): Dr. Lisa Lunney Borden**



The screenshot shows a faculty profile page for Lisa Lunney Borden, PhD. On the left is a portrait photo of a woman with dark hair wearing a black and white striped shirt. To the right of the photo, the text reads: "LISA LUNNEY BORDEN, PHD", "Professor", "206", "Xavier Hall", "(902) 867-5132", and "lborden@stfx.ca". Below the photo is a small '@' icon. Underneath are two menu items: "COURSES" and "WEBSITES", each with a plus sign icon. On the right side of the page, there is a "HOME" section with links: "Future Students", "Current Students", "Faculty & Staff", "Forms and Claims", "Research", and "In Memoriam". Below that is a "CONTACT US" section with icons for location, phone, fax, and email, followed by the address: "218 Xavier Hall", "(902) 867-2247", "(902) 867-3887", "dmorrow@stfx.ca", and "PO Box 5000", "Antigonish, NS,", "Canada B2G 2W5". At the bottom of the screenshot is a Windows taskbar with various application icons and a search bar.

Part A: Fraser-Framed Discourse Analysis

Text selected:

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(3), 8-13.

1. **Key aim** of “supporting Aboriginal students in mathematics learning” and wanting “students to be successful learners of mathematics” while recognizing “conflicting worldviews” (p. 8)
 - This aim positions work in aims of IE
2. **Theory**: researcher draws on Smith; Gutierrez; Doolittle; Barton
3. **Methodology**: described by Mi’kmaq term of *mawikinutimatimk*, meaning “coming together to learn together”

4. **Pedagogy**: grounds research in discussion of geometry classroom episode; verbification of terms such as face, edge, etc.; “It goes like this...”
5. **The 3 Dimensions**:
 - **Distribution (Socio-economic)**: Access to mathematics is enhanced if Mi'kmaw language is drawn on to make connections and “value differences between Mi'kmaw concepts of mathematics and school-based mathematics” (p. 9); highlights issue of access and language as a resource
 - **Recognition (Cultural)**: the verbification (action) of mathematics has been silenced in favour of nominalisation (static; noun). This reflects a pattern of disadvantage in a culture where action-based language guides ways of learning and knowing.
 - **Representation (Political)**: cites Smith (2015): “The indigenist approach to research is ‘formed around the three principles of resistance, political integrity, and privileging indigenous voices’ (Smith, 2015, p. 89)” (p. 9) and also cites Denzin (2015) regarding “self-determination”; highlights indigenist voices in research process and in learning mathematics.

Part B: Interview the Researcher

- **When asked why (or if) Lunney Borden (2011) was a ‘good’ selection of research text:**
 - “So, I would say that I am much more certain now that verbing math is fundamentally a good idea not just for indigenous kids, but for all kids and you know... it’s 10 years now since I finished my PhD and that has really emerged as the piece of my work that I think is super important.”
 - “It’s really about thinking about the process and the concept and how these ideas even grew... if we’re thinking about western mathematics or a traditional Eurocentric mathematics. They all emerged out of this kind of active approach. But over time we have fixed and frozen them [such] that we’ve lost the origins of the ideas or the core of the ideas, right?”

When asked what is ‘noticed’ about the field of CRP at this time?

- “... when I talk about culturally responsive pedagogy with teachers, they think they have to respond to every individual child in their room and they have to address every individual culture in their room and that’s not really what I’m talking about in the sense of how I’m doing the work. My goal is really about... you know the system works for a lot of kids who are of the dominant culture. It’s the kids who are the least served that we need to think about culturally responsive pedagogy for so in that sense, my take on centering Indigenous knowledges is really about creating space for those kids who are least served by our public-school systems.”
- “But I know other people are not necessarily interested in that same thing, so I see the field has kind of many different paths,... and I’m not sure if they’re converging. I like the term decolonizing work because I think it addresses the horrors of colonialism that have impacted some communities in disproportionately negative ways. And I think if we talked more about decolonizing work, that might help us to find some convergence, but I’m not sure.”

(Other) Learning So Far...

- Early in process
- Theoretical and methodological work still to be done to focus and polish the Fraser social justice framework lens:
 - in questioning mathematics education research texts using Fraser-Framed discourse analysis
- Reflexive approach to questioning reductionist potential of CRdP: Will it 'strip' the EM-CM-IE-LD-E-b collective of the rich and diverse perspectives presently offered by each?

CLOSING THOUGHTS...

Could reframing school mathematics through CRdP be a step toward decolonizing it?

["d" for disruption AND decolonization?]

To be continued...

Thank you for your attention and for your questions!

[Copies of references available]