# Public Perceptions of the (Not) New Mathematics

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## Perspectives for the Research

The "Canadian Math Wars" (see Chernoff, n.d.) have been in full force since the release of the 2012 Programme for International Student Achievement (PISA) (Brochu et al., 2013; OECD, 2013). Canadian students ranked thirteenth in the world in mathematics, but media focused on Canada dropping out of the top ten (e.g., Alphonso, 2013). Media frequently targeted the "discovery learning" emphasis in curriculum as the direct cause (e.g., Hopper, 2014). Public outcry has been unprecedented. Petitions launched in three provinces demanded a "back to the basics" approach (Houle, 2013; Murray, 2013; Tran-Davies, 2013) claiming that "the system has clearly failed the first wave of children subjected to their grand experiment" (Tran-Davies, 2013 from petition letter).

While much has been written on Math Wars in North America (e.g., Herrera & Owens, 2001; Klein, 2007; Schoenfeld, 2004; Wright, 2012), current efforts to strike a "balance" continue to place educators and parents in opposition. Attempts to communicate the advantages of today's mathematics curricula to an influential and vocal minority have largely failed. Despite the ongoing debate, there is limited research investigating perceptions of reform (e.g., Bartlo & Sitomer, 2008; Civil & Bernier, 2006; Gellert, 2005; Remillard & Jackson, 2006), particularly from parents and stakeholders willing to actively speak against curriculum.

Using phenomenography, we investigated public perceptions of the (not) new mathematics as expressed in their responses to media coverage. We asked: What is the public's perceptions of curriculum change in mathematics? More specifically, what is the nature of their concerns? This is the first phase in a project aimed at learning how to communicate curriculum reforms to parents.

## Mode of Inquiry

We selected a phenomenographic methodology to address our inquiry. Phenomenography (Marton, 1981, 1986; Marton & Booth, 1997) "investigates the qualitatively different ways in which people experience or think about various phenomena" (Marton, 1986, p. 31). This methodology has been used successfully in mathematics education to understand individuals' conceptualizations of teaching and learning (e.g., Bolden, Harries, & Newton, 2010; Yang, 2014). Grounded in a nondualist ontology, phenomenography is a second-order approach that relies on participants' expressions of and reflections on experience (Ashworth & Lucas, 1998). "Selected quotes are grouped and regrouped according to perceived similarities and differences along varying criteria" to map variation in the ways people experience a phenomena (Akerlind, 2012, p. 118). *Categories of description* of collective experiences are generated and further substantiated through rich description of data excerpts.

Phenomenography allowed us to develop an understanding of the public's perception of what is taking place in elementary school mathematics classrooms amid the cacophony of voices straining to be heard. A premise of phenomenography is that there is a limited number of ways of experiencing a phenomenon which is, in this case, mathematics curriculum change. Therefore, the results of the study are useful in framing mathematics educators' responses to the public's concerns in an effort to engage parents in conversation, rather than debate.

**Data Sources**

The debate on mathematics learning has been shaped by media coverage and the public's reaction to international testing results and curriculum change. Our data consisted of online comments posted by readers to articles in national newspapers in Canada from June 2013 to June 2014. The 62 articles published, with more than 5000 reader comments, addressed issues related to mathematics education in schools, discovery methods of learning, curriculum change, provincial standards testing results, and/or the PISA results. A sample of 15 articles were selected using the following criteria: content that emphasized national interests, parents' perspectives, and learning mathematics in school. A total of 2442 online reader comments comprised the data pool.

**Data Analysis**

Each post was treated as a unit of analysis and typically included one claim with a supporting example or reason as evidence for the perspective. Initially, we sorted subsets of the data set independently by noting qualitatively different concerns expressed. We then compared our sorting processes, noted commonalities, and resolved differences in categories generated through illustrative responses. A second sorting process ensued to exhaust the range of different perspectives expressed by readers. Through our joint comparative analysis, two categories of description, with five and three subcategories respectively, were generated and are reported below.

## Results

Our results describe what we see as *mutual collective concerns* held by parents, educators, and stakeholders with regard to teaching and learning mathematics.

| **Categories of Description** | **Subcategories:** *Reframing Criticism into Mutual Concerns* |
|---|---|
| Students need the opportunity to reach **expected goals** of mathematics learning. | 1. *Need to master basic computational skills.*<br>2. *Need to be able to problem solve.*<br>3. *Need to be functionally numerate citizens.*<br>4. *Need to understand mathematical principles.*<br>5. *Need to develop discipline and intellectually through mathematics.* |

| | |
|---|---|
| **Essential supports** must be in place for students to reach goals of mathematics learning. | *6. Need teachers who can teach according to curriculum expectations.*<br>*7. Need teaching resources that are clear to parents and teachers.*<br>*8. Need to ensure success without substantial extracurricular support.* |

**Expected Goals of Learning Mathematics**

The public's perception of learning mathematics included expected goals that students were believed to not be reaching or were assumed to be removed from curriculum.

*1. Need to master basic computational skills.*

Many readers noted a de-emphasis in schools on rote learning to master computational skills:

> Math is entirely a ROTE learning thing. First is adding and subtracting, then multiplying and dividing. After that comes formulas for the order of operations for equations. You cannot survive in math without memorization. (i.r.t. Alphonso, 2014, Mar. 25)[1]
>
> I learned things by rote in grade school and then later on in high school I learned how to do abstract problem solving in topics like algebra. From what I understand, the system is unnecessarily complicating kids' minds by saying they shouldn't memorize basic multiplication or learn how to do long division or carry numbers. I don't see the usefulness in that. (i.r.t. McDonald, 2013, Sept. 13)

However, some readers cautioned that basic skills need to be understood:

> Why does everybody believe the myth that when time table were memorized only, with no attempt to understand the relationship between the facts, we had 100% success? We have always had a sizeable group of students who do not know their times tables! Reducing this portion of math to simple memorization means students will not be prepared for the proportional reasoning expected of them in junior high. (i.r.t. Alphonso, 2014, Mar. 25)

Despite some cautioning by readers, the primacy of basic skills was repeatedly emphasized demonstrating that one expected goal of learning mathematics is for students to master quick mental calculations through immediate recall which was often assumed to require memorization.

[1] Online quotes may be abbreviated and with minor corrections to spelling or grammatical for clarity to reduce frequent use of [sic] insertions. We reference online responses using 'in response to' (i.r.t.) followed by the author of the newspaper article author and date of publication. Given that hundreds of responses were often provided to each article, an article may appear more than once, but the comments reflect different responders. A repository of newspaper articles are accessible here: https://sites.google.com/a/ualberta.ca/mathnewsrepository/

*2. Need to be able to problem solve.*

Readers saw a deficiency of basic facts as closing the door to problem solving proficiency and advanced mathematics. A reader warned, “You can’t problem solve effectively without a foundation of factual knowledge. It’s naïve to think otherwise” (i.r.t. Wente, 2014). Problem solving with a prerequisite of computational skills was a frequent assertion:

> The time to teach HOW to solve problems is after the student has mastered by rote the mechanics of addition, subtraction, multiplication and long division. … In the bad old days we saved abstract math analysis and reasoning for late middle school, when the kids were ready for it and already knew the basics. (i.r.t. Hopper, 2014, Feb. 28).

A goal of learning mathematics includes problem solving and abstract thinking, where computational fluency enables more sophisticated mathematical thinking. The discrepancy seemed to primarily when problem solving should occur, rather than whether it not it was seen as essential.

*3. Need to be functionally numerate citizens.*

Readers related experiences where young people lacked confidence in interactions involving calculations. Noticing that “there is a disconnect between how we use math in our everyday lives and how math is taught in school. Simple concepts like compound interest would be great exercises in an elementary math class” (i.r.t. McDonald, 2013, Jan. 25). Functional numeracy emphasized the practical utilization of mathematics for everyday use:

> The thing is that not everyone is going to be engineers or scientists. Thus, not everyone needs to have the complex deep understand of the underlying nature of the equations used. This is why rote learning works so well for the vast majority of people. In order to get by in society, a basic knowledge of wrote learned equations will suffice for most situations (eg. memorizing times tables or learning long division). The vast majority of people have no need to understand more than that. Once you start forcing all kids to do this “creative” learning, especially the ones who aren’t actually interested in math or don’t have the same comprehension level, you will actually cause them to tune out and learn even less. (i.r.t. Wente, 2014, Mar. 4).

A goal of mathematics education extends beyond computation in this category and acknowledges functional numeracy (Mooney, et al., 2012), using mathematics in everyday situations to make decisions.

*4. Need to understand mathematical principles.*

While being functionally numerate was assumed to be an expected goal, for many readers, being numerate required understanding the underlying mathematical principles:

> Because if I could drill 5 * 5 = 25... 50 million times into your brain you'll likely be using and flexing the parts of your brain required for recall and memorization. But this does nothing for understanding, for example, an algorithm, why it might be needed, how it's

> implemented or if it's the right one to use. You'll just know that 5 * 5 = 25, and anyone who says differently is wrong. (i.r.t. McDonald, 2013, Jan. 25).

Many readers questioned the reliance on memorization as a goal, but saw a balanced approach including underlying mathematical principles as essential. This view is consistent with productive teacher and student actions for “procedural fluency from conceptual understanding” (National Council of Teachers of Mathematics, 2014). Within the curriculum, part of the goal of learning mathematics is for understanding procedures and concepts.

*5. Need to develop discipline and intellectually through mathematics.*

Readers voiced concern that without memorization, and with discovery learning, children’s development would be hampered. Asserting the perception that “the memorizing of facts is part of the essential development of the brain” (i.r.t. McDonald, 2013, Sept. 13) indicates a commitment to intellectual development. Additionally, the idea that “Our education is based on playing and creating and there is not much school work until grade 11” (i.r.t. Alphonso, 2013, Dec. 3) is attributed on the lack of structure with discovery learning, tantamount to a lack of self-discipline. Another goal of learning mathematics is related to the structure of the discipline that calls on students to develop a hard work ethic through repetitive practice.

**Essential Supports for Learning**

In addition to the perceived goals of mathematics learning, our analysis revealed a number of concerns regarding the supports necessary to ensure student success.

*6. Need teachers who can teach according to curriculum expectations.*

Readers were critical of elementary school teachers’ effectiveness to teach mathematics due to the likelihood that many of them had their “own difficulties with math,” limited confidence, and minimal education to overcome these issues (i.r.t. McDonald, 2013, Dec. 3). The current strategy-based curriculum “sounds like yet another excuse for teachers who are math challenged to avoid it even more” (i.r.t. Anderssen, 2014, Mar. 1). The concerns suggested that either teachers needed to have more expertise in the teaching of mathematics or the curriculum had to be simplified and structured to match teacher knowledge. The perceived mismatch between teacher expertise and curriculum expectations was a concern.

*7. Need teaching resources that are clear to parents and teachers.*

Criticisms of the quality and clarity of teaching resources featured in many of the responses: “It also doesn't help that the textbook being used is absolute garbage” (i.r.t. Morrow, 2014, Jan. 8). Even parents with mathematical expertise found the clarity challenging:

> I've looked at my kids' fuzzy math textbook and could not make head or tail of it. Neither can my friends, many of whom are engineers and scientists. And yet we all excelled at school, loving math and going through High School IB with overall averages of 95%-plus. (i.r.t. Tran-Davies, 2014, Jan. 1).

Readers commented frequently on the need for a sequenced and structured approach found elsewhere such as JumpMath (jumpmath.org), Singapore Math (singaporemath.com) and Kumon (kumon.ca). These programs were seen to use resources that teachers could implement systematically and parents could understand and utilize to support their children's learning at home.

*8. Need to ensure success without substantial extracurricular support.*

As a final subcategory within essential supports for learning, readers generally espoused the need for homework, but expressed frustrations with what they perceived of as unacceptable levels of support needed from parents and tutors to attain essential skills.

> We are already spending too much time trying to decipher and interpret the math they are bringing home. More onus on the parents - that's not our job. It shouldn't be our job to teach our kids math!! (i.r.t. Alphonso & Maki, 2014, Jan. 7)

Other parents were concerned about the necessity of "sending their kids to after school tutoring agencies so they can learn basic math skills" (i.r.t. Wente, 2014, Mar. 4). More disconcerting was the potential for a two-tier system created:

> Kumon and similar private education providers will profit handsomely from the money spent by parents who can afford to give their kids a proper education. The rest of the masses will be raising dishwashers in training." (i.r.t. Wente, 2014, Mar. 4)

Parents want to ensure that in-class time is used effectively such that children have opportunity to learn the expected goals without spending inordinate time at home helping their children with homework or spending money on tutoring agencies.

## Scholarly Significance

Current research continues to demonstrate that reform-based curriculum and pedagogy have significant advantages over traditional approaches in nearly every area including problem solving, mathematical modelling, explanation/evaluation of results, disposition towards mathematics, inclusivity of Indigenous students, and equity for potentially disadvantaged students (e.g., Baroody, 1999; Boaler, 2002; Erlwanger, 1973/2004; Henry & Brown, 2008; Pesek & Kirshner, 2000; Russell & Chernoff, 2013; Thompson, et al., 2013). Yet, for decades attempts to communicate the advantages to parents have largely failed and will likely continue to fail unless parents' concerns are more clearly understood and addressed. While the rationale behind the expected learning goals and supports for learning have been the primary focus of debate in the current math wars, our work suggests that the end-points for learning and the supports needed are concerns held by most stakeholders in education. Our research attempts to fill that gap by not only describing perceptions, but also by providing a starting place for conversation by reframing public opposition into collective concerns.

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