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Challenging the Claim of the Inadequacy of the 2008 Manitoba K-8 Mathematics Curriculum*

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In 2012 Manitoba Education undertook a review of the province's 2008 K-8 Mathematics Curriculum (Manitoba Education, Citizenship and Youth, 2008), which led to a slightly revised curriculum in 2013 (Manitoba Education, 2013). This essay challenges the claim of the inadequacy of the 2008 Manitoba K-8 Mathematics Curriculum – a claim that led from the review of the 2008 curriculum to the 2013 K-8 Mathematic Curriculum. The essay will make its argument by addressing three issues linked to the claim of the inadequacy of the 2008 curriculum: that the 2008 curriculum was lacking something essential; that there was a need for an extra-ordinary curriculum review; and that the performance of Manitoba students on more recent large-scale standardized tests reflects a gap in the 2008 K-8 Mathematics Curriculum.

The Quality of the 2008 Manitoba K-8 Mathematics Curriculum

The 2008 K-8 Mathematics Curriculum was quite explicit about what the overall mathematics education objectives were for Manitoba students, which I rephrase here as follows (in no particular order):

- that students understand what they do (conceptually as well as procedurally);
- that they develop a positive attitude towards mathematics and the life-long use of mathematics;
- that students develop strategic competency, i.e. students have a variety of strategies available to solve problems mathematically and can select intelligently the use of particular strategies in particular problem contexts;
- that students can communicate mathematically;
- that students can reason mathematically;
- that students develop competency in fundamental mathematical skills (like counting and the four basic number operations).

Memorization of procedures can be counterproductive in achieving these objectives *if* understanding of the procedure (i.e., understanding why and how they work the way they do and in what contexts they can be used) has not been developed. What a curriculum built on the objectives described above would want to see happen in the implementation of the curriculum is learning opportunities that *integrate* these objectives, as illustrated in the following quote from

* This essays draws on central ideas presented in 2012 in a letter to the Minister and Deputy Minister of Education of the Manitoba government.

the well referenced report by the US-based Mathematics Learning Study Committee (the quote provides references to the literature that are not reproduced here):

> A fourth observation is that children can and do devise or invent algorithms for carrying out multidigit computations. Opportunities to construct their own procedures provide students with opportunities to make connections between the strands of proficiency. Procedural fluency is built directly on their understanding. The invention itself is a kind of problem solving, and they must use reasoning to justify their invented procedures. Students who have invented their own correct procedures also approach mathematics with confidence rather than fear and hesitation. (Kilpatick, Swafford, & Findell, 2001, p. 197).

In this sense, memorization of procedures, including algorithms, that are not linked to understanding, reasoning and strategic competency can be counterproductive in achieving the stated objectives of the curriculum.

The last objective listed above, the developing of fundamental mathematical skills, will have to include the development of fluency in executing mathematical procedures *for which a student has develop conceptual and procedural understanding*. Successful teachers of mathematics have always known that and engaged students in developing fluency in executing procedures as appropriate for the context. My knowledge of K-8 classrooms in mathematics suggests that that is indeed happening in Manitoba. However, I also know from experience as a mathematics teacher and from observations of classrooms that rote calculations, drill and practice of not understood procedures and algorithms have traditionally been very prominent in Canadian K-8 mathematics classrooms. For that reason the 2008 curriculum tries to represent an approach to the teaching of mathematics that is more *balanced* in regards to the development of fundamental mathematical skills and the other curricular objectives, as is expressed in the statement in the 2008 curriculum: “By decreasing emphasis on rote calculation, drill and practice, and the size of numbers used in paper-and-pencil calculations, more time is available for concept development” (Manitoba Education , Citizenship and Youth, 2008, p. 17).

Because memorization and fluency of the skill-aspects of procedures are not learning objectives per se – compared to the development of fundamental mathematical skills – but are rather ways of achieving some of the objectives of mathematics education as characterized above, memorizing and practicing skills *should not* appear in the curriculum as specific learning outcomes, but should rather be considered aspects of good *mathematics instruction*. The 2008 curriculum does exactly that, when learning outcomes, for instance, expect that students will “demonstrate an understanding of multiplication”, “demonstrate multiplication facts”, and “apply mental math strategies for multiplication”. The specific learning outcomes provided in the 2008 K-8 Mathematics Curriculum provided a very good curricular basis for achieving the stated general objectives of mathematics education in Manitoba.

The rich mathematics education objectives in the 2008 curriculum were ambitious but appropriate for the 21st century, in which reasoning, communication, flexible approaching of problems, and relational understanding of concepts are the needed competencies. Mathematics education research *cannot* suggest which objectives a jurisdiction should select for its students. However, such research can suggest how those objectives are best accomplished and what is in the way of accomplishing those objectives. In this regard, the 2008 Manitoba K-8 Mathematics

Curriculum was well-grounded in such research (see the reference list in the curriculum document).

Assessing the Appropriateness of the Current K-8 Mathematics Curriculum

In 2012 Manitoba Education called a meeting of different groups linked to mathematics education in Manitoba to review the appropriateness of the then Manitoba K-8 Mathematics Curriculum with respect to the "fundamental skills" in the number strand of the curriculum. I want to make two comments on this *process* of assessing the quality of the mathematics curriculum.

First, as argued above, the 2008 curriculum provided a range of general objectives for the teaching and learning of K-8 Mathematics, and research suggests an *integrated* approach to addressing those objectives. Thus, any review of any aspect of the K-8 curriculum should have given consideration to *the group* of general learning objectives the curriculum is based upon and the integrative nature of accomplishing those objectives. Focusing on only one selected general objective runs counter to what the curriculum as well as research in mathematics education suggests.

Second, the assessment of the qualities of a curriculum as a form of educational program is a field of study in educational research, and accordingly should be undertaken with consideration of the research and practice in that field. Members of faculties of education could have provided the needed leadership for such a review. There is a good reason why, for instance, one of the departments in the Faculty of Education at the University of Manitoba is called "Department of Curriculum, Teaching, and Learning". A systematic and scholarly-based review of the appropriateness of the curriculum (against established criteria) would have provided a much more appropriate and promising process.

To illustrate the complexity in undertaking such educational program review, I like to point to the distinction that has been made in curriculum studies between the intended curriculum (the curriculum document), the implemented curriculum (what teachers teach), and the realized curriculum (what students actually learn) (see, for instance, Bauersfeld, 1979, and Robitaille, 1981). This distinction is to account for the many factors at play in the relationship between an intended curriculum like the 2008 K-8 Mathematics Curriculum and the development of students' mathematical competencies. For instance, considering the rationale for this distinction, assessing the appropriateness of a curriculum based on similarities and dissimilarities to curricula in jurisdictions whose students score higher on national or international standardized tests has to be considered at best naïve in light of what curriculum studies has to teach us – which is also illustrated by the fact that students in Alberta scored significantly higher on the mathematics component of the 2010 Pan-Canadian Assessment Program testing (third highest) than students from Manitoba (second lowest) (see Council of Ministers of Education Canada, 2011), *although* the general and the specific learning outcomes of the Alberta K-8 Mathematics Curriculum almost completely match those of the 2008 Manitoba Mathematics Curriculum.

Assessing Student Learning

In 2012 the quality of K-8 mathematics education in Manitoba was discussed quite intensely in the local media and other venues. I will comment on two particular points made in the discussion, both of which concern the question of an appropriate use of results of national and international large-scale standardized tests for assessing success in K-8 mathematics education.

First, the performance of Manitoba students on standardized assessments was particularly used as leverage to criticize the quality of K-8 mathematics education in Manitoba and the curriculum in particular. Canadian students "perform[ed] significantly above the OECD average in mathematics" in the 2009 PISA study (OECD, 2010, p. 14). While on the 2010 Pan-Canadian Assessment Program testing Manitoba students ended up second last among eleven Canadian provinces and territories and a bit lower than in the 2007 assessment, Manitoba students are still *relatively* close to the average Canadian mean score. The smaller giants might be small among giants, but they are still giants.

There are many reasons to be cautious in the use of results from large-scale standardized tests. To really draw helpful conclusions from the performance of Manitoba students in national and international standardized testing, one needs to look closer at the type of problems Manitoba students found challenging. To only look at the ranking is not very helpful, as rationalized above. Furthermore, one also needs to consider other factors that might have had an impact on Manitoba students' performance in the mathematics assessment. For instance, there might be a link between the *relative* low performance of Manitoba students in the mathematics component of the 2010 Pan-Canadian Assessment Program testing and the *relative* low performance in the reading component.

Second, in some of the discussions about K-8 mathematics education in Manitoba comparisons were drawn between the performance of Manitoba students and the performance of students from countries that performed at the top (by scores) of the mathematics portion of the PISA studies, like students from Singapore. Such comparisons *per se* are not very helpful, unless they serve to support an already taken position about the flaws of K-8 mathematics education in Manitoba. Provincial and national mathematics education programs – as is true for all educational endeavours – are value driven. For one, they are driven by a vision of what it means to be mathematically literate; and the question needs to be asked, to what degree these kinds of testing tools indeed do justice to the respectively developed visions of being mathematically literate. Also, educational endeavours are driven by educational issues like gender and socio-economic equality and the development of other human capacities like artistic and creative capacities. Provincial and national decisions made on these educational issues are not reflected in a province's or country's standing in the score ranking of the respective assessments.

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