ALBERTANS for EDUCATION

PO Box 277
Calmar, AB T0C 0V0
Phone: 780-984-4114
Fax: 780-985-3877

September 10, 2018

Dear Minister David Eggen and Alberta Education,

This is an exciting time for our education system, as the curricular rewrite provides an opportunity to make critical corrections to the 2007 Mathematics Curriculum that is deeply flawed in its over-emphasis on an inquiry/discovery-based pedagogy. The consequence of which were significant decline in mathematical skills in students across the province as documented in the PATs, Diploma Exams, PISA, TIMMS, and PCAP scores; in effect, closing doors to many career choices, especially in the STEM field.

Because of our advocacy, clarifications were introduced by the government in 2014 and 2015 in an attempt to band-aid the broken Math Curriculum. It is wonderful to see the continued attention and effort by your ministry to further improve the way mathematics is taught in the classroom.

The framework of the K-4 Math Draft curriculum released in July 2018 is very promising as it once again integrates the use of algorithms and recall (i.e. memory work) as well as an earlier introduction to fractions in an attempt to ensure mastery of the fundamentals.

However, in its current form -- as assessed by eminent mathematicians, physicians, engineers, scientists and professionals (i.e. end-users of mathematics) -- the K-4 Math Draft curriculum fails to meet the standard of excellence necessary to equip our children with the foundational skills required to go on to higher learning, to succeed at daily living or STEM careers, to explore new ideas and to think critically.

A well-written curriculum, as do any scientific procedures or medical therapeutic guidelines, uses language that is explicit, clear, concise and consistent in a given direction, such that any teacher with any level of training can enter a classroom mid-course and carry on teaching with minimal disruption or confusion as to what is expected of them and their students at that grade level.

A well-written curriculum safeguards a student from gaps in knowledge and required skills as they move from one grade level to the next, or between one school to the next. We cannot allow learning in the formative years be left to chance as endorsed by a vague curriculum such as this K-4 Math Draft. The blind hope that a previous teacher would have taught a skill or standard algorithm adequately, when there are no definitive content or expectations, so that the next teacher could just carry on building upon previous lessons is naive and dangerous. Because mastery of math is sequential, the curriculum must clearly define the set of knowledge/skills students are expected to master by the end of a specified year. Of course, accommodations can be made for students who struggle or have learning disabilities.

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A strong curriculum challenges every student, even those with learning disabilities, to achieve their fullest potential, and equips them to meet challenges with confidence and creativity, due to the strong base upon which they can further their learning.

A strong curriculum is social justice. Equalizing the knowledge base and skills for all students ensures opportunities for all students, especially those with lower socioeconomic status and/or are disadvantaged in other ways.

The notion that a curriculum can be "too prescriptive" is counterproductive. All respected professions have guidelines from which practitioners follow to meet "best practice" standards for their profession. Likewise, effective and/or "good" teachers will use "best practices" along with the art of teaching to achieve the "best" results for their students.

The following are **8 key recommendations** that must be integrated into the *K-4 Math Draft Curriculum* prior to implementation, to ensure the highest success for all students.

1. Standard algorithms (e.g. vertical addition/subtraction with carry/borrow) must be written explicitly into the "compose/decompose quantities" (addition/subtraction) strand by Grade 2 and in every grade level thereafter.

Rationale - *Traditional/standard algorithms are evidence-based proven, efficient, effective methods of calculations. The first mention of algorithms in the draft curriculum is not until Grade 4. This is too late. Algorithms must be practiced from an early age as the brain is cognitively ready and receptive to absorbing these skills. Practice helps strengthen neuronal pathways. Vague language referencing unspecified "strategies" (e.g. "applying variety of strategies", "strategies can be chosen", "strategies can be refined over time", "preferred strategies") places students at risk of not learning any one method, or even the algorithms, consistently and adequately to master the fundamentals of mathematics. We cannot hope that a child will eventually "discover" that the algorithms are actually effective and preferred. Precious time for neural connections is lost. Direct instruction is a proven method of instruction. This vague K-4 Math Draft language (as with the 2007 discovery-based Math Curriculum) is a serious disservice to student. This is not acceptable and does not meet the standards of excellence that our students deserve.*

2. Standard algorithms (e.g. long division/multiplication) must be written explicitly into the "share & group quantities" (multiplication/division) strand as early as grade 4 and every grade thereafter.

Rationale - *Traditional/standard algorithms are evidence-based proven, efficient, effective methods of calculations. Algorithms must be practiced from an early age as the brain is cognitively ready and receptive to absorbing these skills. Practice helps strengthen*

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neuronal pathways. Vague language referencing unspecified "strategies" (i.e. "applying variety of strategies", "strategies can be chosen", "strategies can be refined over time", "preferred strategies") places students at risk of not learning any one method, or even the algorithms, consistently and adequately to master the fundamentals of mathematics. We cannot hope that a child will eventually "discover" that the algorithms are actually effective and preferred. Precious time for neural connections is lost. Direct instruction is a proven method of instruction. This vague K-4 Math Draft language (as with the 2007 discovery-based curriculum) is a serious disservice to student. This is not acceptable and does not meet the standards of excellence that our students deserve.

3. The K-4 Math Draft expects Grade 3 students to "apply strategies to single digit multiplication number facts to products of 81 and related division number facts." The Draft must also include, for Grade 3, "RECALL multiplication facts up to 5x5 and related division facts" as per 2014 clarifications made to the current curriculum. Perhaps even consider expecting "recall" of single digit multiplication facts to products of 81 starting in Grade 3, and practiced again in Grade 4.

Rationale - *The current draft expects "recalling of single digit multiplication number facts to products of 81 and related division number facts" in Grade 4, whereas in Grade 3 students need only to "apply strategies to single digit multiplication number facts to products of 81 and related division number facts." This is too late. Students are cognitively ready to memorize and practice multiplicative facts by Grade 3. Practice needs to start early in order for mastery to occur to prepare students for more complex algebraic calculations in higher grades. Repetition is good for neuronal connections and the strengthening of long-term memory, to free the working memory for problem-solving. Vague references to "strategies" is not acceptable.*

4. It must be made clear that a student who has mastered standard algorithms will NOT be forced to use other strategies.

Rationale - *Traditional/standard algorithms are evidence-based proven, efficient, effective methods of calculations, for hundreds of years. Direct instruction is a proven method of instruction. The vague K-4 Math Draft language referencing unspecified "strategies" (i.e. "applying variety of strategies", "strategies can be chosen", "strategies can be refined over time", "preferred strategies") places students at risk of not learning any one method, even the algorithms, consistently and adequately to master the fundamentals of mathematics. This was one of the major flaws with the inquiry-based 2007Math Curriculum that resulted in inefficient teaching and ineffective learning . History should not repeat itself. Allowing a student to use his/her finger to count, for example, up to Grade 4 because it is his/her "preferred strategy" is an injustice for the student. We need to aspire for more for every student. And when they've mastered the algorithms, they should be allowed to build upon that to problem-solve and think critically, rather then be shackled by the expectation to "explore" multiple strategies.*

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5. The K-4 Math Draft retains too much emphasis on "estimation". References to estimation practices (i.e. 20 references) should be removed from strands in the lower grades.

Rationale - *One cannot master estimations before precise computations are mastered; so prior to Grade 4, estimations only confuse students.*

6. Introduce "addition of fractions" and "comparison of fractions" in Grade 4.

Rationale - *The best-performing curricula in the world begin fractional arithmetic in Grade 3 or Grade 4. Also note Siegler et al study pointing out the importance of procedural fluency with fractional arithmetic in elementary school.*

7. "Time and experience", "data (statistics)" and "algorithms (not standard algorithms)" strands have little to do with math. Therefore, not all strands need equal weighting during each school year, and from year to year.

Rationale - *These topics, although not unimportant, take time away from the mathematical part of curriculum. There needs to be an explicit weighting system indicating no more than 1/4 of the school year, for example, should be devoted to such topics to allow adequate instruction time for practice and fluency of standard mathematical operations. The statistical graphs are extremely easy and common sense, and actually require little teaching, while statistics can actually be introduced in later grades. Most students are able to tell time by Grade 2. Hence, there is no need to stretch lessons on time over five years. Strong arithmetic skills are an absolute must for understanding algebra later on, for becoming a successful STEM student..*

8. The strand on "algorithms" emphasizes learning ABOUT algorithms rather than LEARNING algorithms.

Rationale - *We advocate for evidence-based practices, i.e. traditional/standard algorithms, and we appreciate the fact that Alberta Education no longer views the word "algorithm" as a forbidden word since algorithms are integral to the operation of our world/society. However, this strand dedicated to" algorithms" is not actually on the traditional algorithms, which are critical to mastery of arithmetic and algebraic skills. Instructional time devoted to this "algorithm" strand subtracts from time available for core content that should be learned at this age — in particular LEARNING and MASTERING important algorithms. This strand is in fact an attempt to teach the basics of programming (coding) in a mathematical context. "Coding" could be an optional addition to the K-12 curriculum, but it should not by taking hours from precious time for real math.*

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Thank you so much for your time and dedication to improving our children's education.

Sincerely,

Dr. Nhung Tran-Davies, MD, CCFP, Clinical Lecturer, Author
on behalf of respected Mathematicians, Engineers, Physicians and Albertans for Education