Review of Draft Texas Mathematics Standards 2012

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Documents reviewed

Text of Proposed Revisions to 19 TAC
Chapter 111. Texas Essential Knowledge and Skills for Mathematics
Subchapters A, B, and C. (Elementary, Middle School, and High School)
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Note to readers: This is a formative review of a set of as-yet-unofficial, draft standards, for K-12 mathematics in Texas, not (as of this writing) adopted or rejected or revised by the State Board of Education or other cognizant authorities. As such, it is intended primarily to provide constructive comment and feedback, not a summative judgment.

Overview

In our 2010 report, *The State of State Standards—and the Common Core—in 2010*, we reviewed the math standards that were in place in all fifty states and the District of Columbia, as well as the final draft of the Common Core State math standards. At the time, the Texas standards earned a mediocre C, in part because the standards were "somewhat minimal and lack[ed] specificity."

The new standards are an improvement. Some content that was previously missing from the standards has been included, the standards remain clear and well organized, and the high school content remains strong.

Unfortunately, Texas has overcorrected its minimalist problem by adding too many standards—many of which descend inappropriately into pedagogy—and including a lot of unnecessary repetition. Worse, the new draft standards overemphasize process, and arithmetic is not given suitable priority.

General Organization

For each grade, K-8, the Texas standards include a brief introduction offering an overview of the grade. Then (for each grade) the standards are divided into strands such as *Number and operations, Algebraic reasoning*, and *Data analysis*. Finally, a list of standards is provided for each strand.

The high school standards are organized similarly, except that they are presented by course instead of grade. Texas uses the traditional course sequence: Algebra I, Geometry, Algebra II, pre-Calculus.

Clarity and Specificity

Many of the Texas math standards are clear and well-written, such as:

Multiply and divide positive rational numbers fluently. (grade 6)

Unfortunately, too many standards are of an excessively small grain size, and there is a great deal of repetition. Because of this, Texas ends up with too many standards, often more than fifty per grade, making it difficult to glean priorities and tease out important content.

Further complicating matters, many standards include pedagogical suggestions that obscure the content goals that students must attain. Consider, for instance, the following:

> *Represent quotients of decimals to the hundredths, up to four-digit dividends and two-digit whole number divisors, using objects and pictorial models, including area models. (grade 5)*

Directing teachers to use objects is prescribing pedagogy, and confuses what content or skill the students should master. The job of academic standards is to delineate content, not to prescribe instructional strategies for imparting that content to students.

Content and rigor

Content priorities

While the grade-specific introductions attempt to articulate content priorities each year, they miss the mark. Take, for example, the following:

> *The primary focal areas in Grade 3 are place value, operations of whole numbers, and understanding fractional units. These focal areas are supported throughout the mathematical strands of number and operations, algebraic reasoning, geometry and measurement, and data analysis. [Grade 3]*
>
> *The primary focal areas in Grade 4 are use of operations, fractions, and decimals and describing and analyzing geometry and measurement. These focal areas are supported throughout the mathematical strands of number and operations, algebraic reasoning, geometry and measurement, and data analysis. [Grade 4]*

These examples are confusing—what, precisely are the top priorities being articulated here?

In addition to being confusing, Texas gets some of its priorities exactly wrong. In the elementary grades, for instance, arithmetic should be an unambiguous priority, yet in these draft standards it is not. In the examples cited above, arithmetic is not a clearly articulated priority. And, making matters worse, arithmetic standards comprise less than half of the expectations students are supposed to learn in these critical years, which does not properly emphasize this important content.

Too many standards also combine far too much information, making it difficult to discern what is most critical. For example:

Represent constant rates of change in mathematical and real-world problems given pictorial, tabular, verbal, numeric, graphical, and algebraic representations, including d=rt.

Although students should indeed learn everything in this standard, not all of the representations have equal priority. By lumping things together like this, the standards give the false impression that they are all equal and perhaps deserve equal time and emphasis. It is important for standards to set appropriate priorities, and this common type of standard misses the mark.

Content strengths

Much of the content is covered well, including the crucial:

Recall basic facts to add and subtract within 20 with automaticity. (grade 2)

Even if poorly phrased, this standard is unambiguous. Arithmetic is generally developed well, with a few caveats (noted below). And the standards do not ask students to use calculators in grades K-5.

In high school there is the seldom seen, but very important:

Transform a quadratic function $f(x) = ax^2 + bx + c$ *to the form* $f(x) = a(x - h)^2 + k$ *to identify the different attributes of f(x). (Algebra II)*

This is a strong and important standard, although impaired by the lack of specificity contained in the phrase "different attributes."

High school coverage and organization are very good. Linear equations are covered well as are quadratic equations with the exception of not using complex roots. The standards cover exponentials, logarithms, trigonometric functions and their inverses, trigonometric identities, and polar coordinates. Geometry is reasonably well done, too.

Content weaknesses

Although arithmetic is generally well covered, the new draft Texas standards fail to establish the standard algorithms as the capstone standards for arithmetic. They are incorporated generally in the following manner:

Use strategies and algorithms, including the standard algorithm, to multiply up to a four-digit number by a one-digit number and to multiply a two-digit number by a two-digit number. Strategies may include mental math, partial products, and the commutative, associative, and distributive properties. (grade 4)

In addition to being overly wordy, this standard seems to offer alternatives to having the standard algorithm as the capstone standard for whole number multiplication. This is misguided. Worse, the standard algorithm is left out altogether for decimal multiplication:

Solve for products of decimals to the hundredths, including situations involving money, using strategies based on place-value understandings, properties of operations, and the relationship to the multiplication of whole numbers. (grade 5)

Although common denominators are mentioned for comparing fractions, they are not mentioned for the operations on fractions.

Occasional mathematical errors have also crept into the draft standards. Here are examples of two different types of errors:

Understand that the equal sign represents a relationship where statements on each side of the equal sign are true. (grade 1)

Represent problems using an input-output table and numerical expressions to generate a number pattern that follows a given rule such as given the rule "Add 3" and the starting number 1, use the expressions 1+3, 2+3, 3+3, and so forth to generate a table to represent the relationship of the values in the resulting sequence and their position in the sequence. (grade 4)

The first example is not a good definition of the equal sign. Not only does it imply that 2=1 (each side is a true statement), but it is about "statements" rather than expressions. The second tries to give an example to clarify its contorted language, but gets the numbers wrong; it should be 1, 1+3, 1+6, 1+9, etc.

The incorporation of process standards into the content strands adds little value and often introduces unnecessary repetition and confusion. For example, the following standard is repeated every year verbatim:

Apply mathematics to problems arising in everyday life, society, and the workplace.

This is an empty standard at any grade, and it borders on absurdity in Kindergarten. In any case, it contains no mathematical content whatsoever.

The "personal financial literacy" strand, which is included for all grades grade K-8, is problematic. While there is plenty of good mathematics that could be developed here, the mathematics actually included in the strand is minimal and sometimes non-existent. Most of the standards do not belong in mathematics at all, but are social science standards, mostly for economics, but not mathematics. It is a shame that such a good idea is handled so poorly. A number of examples should make the point:

Distinguish between wants and needs and identify income as a source to meet one's wants and needs. (Kindergarten)

Explain how human capital is related to work. (grade 1)

Explain that credit is used when wants exceed the ability to pay and that it is the borrower's responsibility to pay it back to the lender, usually with interest. (grade 3)

Identify the advantages and disadvantages of different methods of payment, including check, credit card, debit card, and electronic payments. (grade 5)

Describe the information in a credit report and how long it is retained. (grade 6)

In addition to not being actual mathematics, the authors must not have been told the grades they were writing for.

Finally, the introduction to grades 6-8 contains:

> *While the use of all types of technology is important, the emphasis on algebra readiness skills necessitates the implementation of graphing technology. (grades 6-8)*

This is a false and ideological statement. Graphing technology is not necessary for the development of algebra readiness skills; in fact, it is likely to undermine the real skills needed in algebra.

Texas's standards are strong in places, particularly in high school. But the weaknesses discussed above indicate that, while the Lone Star State would improve upon its thoroughly mediocre 2006 math standards by substituting the present draft, the present draft is nowhere near the best of the standards that were in place in states such as California and Florida. Moreover, though this comment may cut little ice in Texas, the present draft lags behind the Common Core math standards on a number of fronts.