COMMON CORE STANDARDS

General Comments on the Algebra-Related Standards, K - 6

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Formulating and disseminating national math standards is an ambitious goal, but also one that can backfire if the standards are not capable of being attained by a large portion of the intended student population.

Before "national standards" are proposed for adoption, they need to be pilot-tested. Failure to conduct this pilot testing has the potential to cause more damage to students than the educational system that is already in place.

For the pilot testing to be effective, it cannot be conducted with teachers who volunteer to participate. Rather, districts and teachers must be selected at random from the inner city, suburban and rural areas and asked to participate so that a reasonable assessment can be made.

Proposed standards should be ones that can reasonably be attained by at least 80% of the intended student populations through instructional means which teachers can reasonably be expected to learn and implement.

This pilot testing will determine, for example, if some of the math standards related to algebra in grades K - 6 are overly formalistic and, whereas they may have some value for mathematically gifted students who may have the intention of becoming professional mathematicians, they would further discourage the average and below average student.

For an example, in the 6th grade standard students are expected to understand that through the use of the multiplicative identity and the distributive and commutative laws they can get from $y + y + y$ to $3y$ as follows: $y + y + y = y(1+1+1) = y(3) = 3y$. This is only one of many examples where a formalistic approach is used for an obvious result.

Indeed, in the standard for grade 3 the students have been informed that multiplication by a whole number can be considered as repeated addition. Hence, adding the same item three times, namely y, is the same thing as having three of those items, that is, 3y.

So that while on the one hand there is an excessive formalism in many of the standards in the area of algebra – a formalism which is not likely to endear many students to mathematics, but rather cause them to wonder why the subject is so obtuse and dry – standards that would give students an early and solid foundation for algebra through concrete and pictorial means, is lacking.

For example, in kindergarten or first grade (and not in grade 6) the students can learn to represent an apple by the letter "a". They can then work with questions such as $2a + 3a$ (2 apples and 3 apples are 5 apples), so $2a + 3a = 5a$. Likewise, "g" can represent a grape. Hence students can be asked, "What is the total number of apples and grapes that we have in basket containing: $3a + 2a - a + 2g - g$?" In this manner, young students can become comfortable working with mathematical expressions containing letters.

Later on, in grades 2 or 3, "a" and "g" can represent the cost of an apple and the cost of a grape, respectively and the students can be asked for the total cost of $4a + g$ (4 apples and one grape) if each apple costs 25 cents and each grape is 5 cents.

Additionally, in the current set of standards it is only in grade 6 that students are asked to use the idea of maintaining equality to solve equations of the form $x + p = q$ and $px = q$ where x, p, and q are all non-negative rational numbers. In other words, at the same grade level that the students are being asked to use properties of equality to solve $x + 3 = 10$ and $4x = 20$, they are also expected to solve $x + 2/5 = 3/4$ and $2/5x = 3/4$. It should be clear to the reader that the former are much more simple and obvious than the latter and should therefore be presented several years earlier.

Indeed, using concrete or pictorial methods, it is know that 4th and 5th graders, including inner city minority students, can solve equations such as $4x + 2 = 3x + 10$ with unknowns on both sides of the equation. They do so by first transforming the abstract equation into a physical or pictorial representation (the same physical or pictorial icon is used for each x, e.g., 4x is represented by 4 of the icons; the constants can be represented by numbered cubes or boxes) and then physically or pictorially maintaining the balance by removing the same number of icons (x's) from each side of the equation or the same value from the constants.

Students in the 4th and 5th grade can then transfer this learning to solving word problems such as, "Four times a number, increased by 2, is the same as twice the number, increased by 10."

By moving away from the formalism that is suggested in a number of the standards related to algebra and instead replacing those with standards that recommend concrete and pictorial representation and solution of algebraic equations -- an activity that students enjoy doing because they can understand the process and experience success-- the standards will be empowering younger students and laying a foundation for later success in algebra. Otherwise, algebraic equations will continue to be seen as abstract even by students who have strong arithmetic skills.

In summary, this educator believes it would be a grave error to propose the draft core standards for national implementation absent an extensive pilot testing with a broad population of students and teachers. This testing will likely take from one to three years.

Recommending the draft core standards, absent this pilot testing, poses the risk that the attempt to raise the level of mathematics education in the United States via the formalistic and "rigorous" algebra-related standards, may backfire, that is, it may lead to a higher level of failure and frustration then already exists in the mathematics classroom and may therefore result in a very strong back-to-basics movement.