Don’t Become a Casualty of the Math Wars

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As I write these words, the civil war in Sri Lanka rages on, and we’ve been hearing reports of civilians trapped between the warring sides. Some, sadly, have died. There’s a lesson in that: You don’t have to be fighting in a war to become a casualty. So it is in math. Math? What’s math got to do with wars? For the last twenty years, the “Math Wars” have raged in the US, the UK, and Canada. Christians can thank God that these are not shooting wars, but they are still real, in the sense that they represent a serious conflict with life-changing consequences for our children and our society. Mathematics, after all, is central to science, engineering, finance, and economics, and mastery of it to the point of calculus and beyond is crucial to most careers in those and many other fields. It is also a glorious part of God’s creation, worthy of everyone’s study and admiration.

How can we avoid being caught in the Math-Wars crossfire? Some suggest we should pretend there is no war going on—ignore it, in other words—but it’s hard to see how that approach will work any better for us than it would for those helpless people in Sri Lanka. Others say, “Stay neutral,” but the only way to do that in the Math Wars is to refrain from teaching math. That’s not a very good option, however, if we want our children to have anything approaching a well-rounded education, not to mention job prospects.

No, to keep your kids from becoming casualties in the Math Wars, you need to know something about the history of the conflict, you need to know which side is less likely to harm your children, and you need to know how to recognize which side has shaped each curriculum you consider using. My purpose here is to equip you with this knowledge. I’ll end with a word of encouragement for those who feel daunted at teaching math.

First, a few pieces of terminology: *Mathematicians* are people who do math for a living. They normally have doctoral degrees in math, physics, or engineering, and most of them are college professors. *Math educators* are found mostly in schools of education, where they teach prospective math teachers how to teach, or in educational bureaucracies like the US Department of Education or local school districts, where they do things like set policies for schools. They don’t know as much math as mathematicians, but in theory they know more about teaching methods.

It is useful to distinguish four kinds of knowledge involved in math instruction. *Facts* are facts—truths like the “times table” or the definition of a prime number. *Algorithms* are step-by-step procedures, such as a method for adding two fractions with different denominators or a procedure for solving a given kind of linear equation. *Skills* amount to the ability to identify relevant facts and algorithms, and to execute the algorithms in order to achieve an accurate result. The ability to convert a fraction to a decimal number by carrying out long division is a skill. Lastly, *conceptual understanding* is a vague term, but it refers to a kind of intuitive sense of how math techniques and ideas fit together and work.

Some History

Here's what you need to know about the history of the Math Wars.[1] You may remember the New Math of the 1960s and '70s. It was mathematically sound, but on the whole badly executed in textbooks and classrooms. (Mathematicians designed it and "math educators" implemented it, to oversimplify.) It also fell victim to the general collapse in public-school order and standards that marked that period. By the '80s, there was widespread agreement that the New Math hadn't worked, but there was no consensus on what to try instead. As a result, most schools went back to adequate but often uninspiring "traditional" textbooks. Mathematicians, by and large, turned their attention away from pre-college math. Meanwhile, the math education establishment busied itself coming up with the Next Big Thing in math teaching.

In 1989, the Next Big Thing arrived when the National Council of Teachers of Mathematics (NCTM, a body dominated by math educators) released its *Curriculum and Evaluation Standards for School Mathematics*, usually referred to as the *1989 NCTM Standards*. This document set forth a vision of math teaching that emphasized applications of math for "problem solving" and that deemphasized the teaching of facts, algorithms, and skills. Calculators and computers were to free students from the drudgery of adding, subtracting, multiplying, and dividing. Conceptual understanding was to be the focus. This new vision came to be called "reform math," and it quickly found its way into state and local school standards—most notably the *1992 California Framework.* (California, as the nation's largest textbook market, shapes publishers' offerings as no other state does.)

The result was disaster. The more time students spent using reform materials, the farther they fell behind the traditional math-learning curve, and the less they seemed to know about math subjects they had supposedly covered. The US plummeted in international comparisons of math achievement. College math teachers found their students increasingly ill-prepared. Critics of reform math branded it "fuzzy math," "new-new math," and "whole math" (by analogy with "whole language"), and they organized themselves to oppose it. University mathematicians, initially at Stanford and Princeton, pioneered the opposition, which joined forces in 1995 with British mathematicians who were fighting similar battles. By 1997, the opposition to reform math had become so intense and effective that California's Board of Education was forced to scrap the *1992 Framework* and adopt new math curriculum standards written by four Stanford mathematicians, including one Nobel laureate. These *1997 California Content-Based Standards* are regarded by the opponents of reform math as something of a gold standard.

The *1997 Standards* didn't end the Math Wars, however. The reformists have resisted the *Standards*' implementation in California, have opposed their adoption by other states and districts, and have fought hard to keep reform curricula in schools, sometimes by "false advertising," claiming that a curriculum meets the California standards when it doesn't, or dumbing down standardized tests to make results from reform materials look better than they are. Significantly, the National Science Foundation has poured large amounts of money into the development of reformist textbook series, so that reform books dominate the market today.

The anti-reformists, sometimes called “traditionalists,” have had to fight tooth-and-nail, using the political process, to expose and dislodge reformist influences on schools. They are making headway, but it is slow and difficult. There are abundant data showing that “traditional” curricula work much better than reform math curricula, but the reformist camp has many advantages in the conflict. It is not clear which side will prevail in the end.

But why should we listen to the mathematicians rather than the math educators? The educators say that reform math works. Why not believe them? Math is unusual in the degree to which it builds on itself, so that deficiencies in a child’s math training often show up many years later. There is reason to think, for example, that the single most important determinant of a student’s success in calculus and other college-level math is the quality of the instruction he received in grades 4 through 6. So when choosing elementary curricula, it’s essential to get input from those teaching math at the college level. There’s an important sense in which they are the only people who really know whether any of our math teaching is working.

Christian homeschoolers should recognize reform math as yet another expression of the Romantic “progressive” educational philosophy most commonly associated with John Dewey, with its emphasis on student-directed and discovery-based learning and its antipathy toward the idea that education necessarily involves adults (especially parents) imparting things to children that the children would otherwise not acquire. Accordingly, they will not be surprised to hear that reform math doesn’t work.

Assessing Curricula

So much for history. You just want your kids to learn math. How are you to assess the available curricula?

It would be nice if you could look for a helpful little sticker on each curriculum that said “Reform” or “Anti-Reform.” But there aren’t such stickers, and even if there were, you wouldn’t be able to trust them. Publishers and educrats have been known to describe curricula as “conforming to the *California Content-Based Standards*” which do anything but conform to them.

Certainly, if a program is promoted as based on the NCTM documents or as embodying “math reform,” it should be avoided. From the other side, there are useful reviews of curricula at the two main websites of the anti-reform movement, *www.nychold.org* and *www.mathematicallycorrect.com*. Unfortunately, these reviews cover few programs and levels, and they largely ignore curricula targeted to homeschoolers. An even bigger problem is that new editions of the programs are coming out constantly, rendering reviews of prior editions obsolete. Many formerly strong math programs have been ruined in new editions. I would like to be able to recommend specific programs, but I’m not up-to-date with current editions, and even if I were, and made recommendations on that basis, this article would be obsolete in a matter of months. It would be a full-time job to keep up with the new editions that are constantly pouring onto the market.

To be more specific, I would like to be able to recommend (though not for calculus) **Saxon Math**™ or **Singapore Math**. I've used older editions of Saxon Math books, and they are superb, but the current editions may or may not be as good. I've heard mixed opinions about them—and about the latest Singapore Math editions—and I've not had the opportunity to examine them. Of course, you can often find older editions on the used-textbook market, but it can be hard to obtain solution manuals and other ancillaries.

So, in short, you're probably going to have to evaluate your curriculum options yourself. But don't panic! There is a key idea and some practical questions you can use in your evaluations.

The idea at the heart of the math wars concerns the relationship between "conceptual understanding" and "basic skills." Reformers almost always bill their programs as geared toward "conceptual understanding," "high-order thinking," and the like, and they disparage "rote memory," "rote learning," "pencil-and-paper skills," and algorithms. There are several problems with this way of looking at things. The first is that *all* math curricula aim to promote conceptual understanding. Advertising a curriculum in these terms ("We aim at *conceptual understanding*!") is like the raisin canister I once saw that promoted its brand of raisins on the grounds that they were fat-free. That may be a reason to favor raisins over other foods, but it can hardly be a reason to favor one brand of raisins over another.

The second problem is that there is a large body of evidence showing that the most universally successful way to impart conceptual understanding *is by requiring thorough mastery of skills and algorithms*.[2] The real conflict here is not between conceptual understanding and skills, but between two ways of promoting conceptual understanding. One, favored by the reformists, is the way math teachers like to teach, which we might summarize as "explain it till the light comes on and then assign the homework"—though the reformists often leave out the homework. The other method, which I will call drill-and-practice, provides minimal explanation or exposition up front, quickly gets the students working problems by carrying out the right steps, and then expects that the light will come on after a few minutes or days or weeks of practicing. Probably the purest implementation of this method is found in older editions of Saxon Math. Most traditional curricula fall somewhere between the two extremes that I've described.

One thing that has become clear through the Math Wars is that the drill-and-practice method works extremely well for virtually all students. I have seen students with genuine learning disabilities come to understand relatively difficult math after a few months of practice. Many students can read expositions of concepts till the cows come home and won't achieve understanding by that means, ever. Really strong students fare reasonably well with that approach, but no one else does. Of course, the really strong students will learn the math any way we teach it. Another advantage of drill-and-practice is that it is relatively teacher-proof; that is, the quality of the teacher is much less crucial than it is with a book that features lots of up-front explanation for each new idea.

A third problem with the "conceptual understanding" claim of the reformists is that their books have greatly reduced the number of concepts to be understood, as compared with a traditional curriculum. Many reform books, for instance, entirely omit long division. After all, it's hard, and the student can just use a calculator. The problem is that it turns out to be important not only for dividing numbers, but for understanding other, more advanced concepts and methods—the most obvious example being polynomial long division, usually encountered in a pre-calculus course or even later.

Which brings us to the questions you should ask about any curriculum you're considering.

First, ask yourself (or the salesman), "Does it aim for conceptual understanding through entertaining exposition and examples, or through repeated practice of basic skills and algorithms?" If the second is true or both are true, then the curriculum passes its first test. If only the first is true, then it flunks.

Next, ask, "Does this program give the student repeated practice at every skill and algorithm over a long period of time?" Reinforcement by repetition is the key to sustainable mastery of math, and without it, a curriculum just won't work. Find a skill that is taught in the book, and then look through successive exercises to see how many times that skill will be practiced. Ideally, it will appear a few times a day for two or three weeks, and then will appear from time to time for the rest of the book.

Now ask a very specific question: "Does the curriculum advise you to let the student use a calculator to perform any operation that he has been doing for less than two years?" If it does, don't use that curriculum. If conceptual understanding is achieved through mastery of skills, then you don't want to help the student forget the skills he has learned—which is exactly what calculator use does.

Another specific question: "What facts and algorithms does it teach?" You're looking for such things as the times tables, columnar addition and subtraction, long multiplication, long division, solving systems of two linear equations in two unknowns, etc.—whatever is appropriate to the grade level.

Two superficial evaluation criteria that I also recommend are, first, if the book is full of photos, colors, sidebars, and lots of "Why should you learn this? Because it's used by scientists!" features, that's a bad sign. Second, I don't recommend books with more than two authors. Such books tend to read like they were written by a committee—possibly because they were written by a committee.

Most of us, if we didn't know better, would select books with lots of colors and sidebars and so forth, and with each idea introduced with a thorough exposition followed by exercises on that section's new idea. Well, now we know better—thanks, in part, to the Math Wars.

Encouragement

Are you afraid of teaching math because you didn't "get" math when you were little? Good news: What you're really afraid of is having to explain each concept with crystal clarity when your child first meets it, so that he will understand it and be able to start to do exercises. But if that isn't the best way to teach math—which it isn't—then you don't need to feel that pressure! With a good drill- and practice-oriented book, your children will learn math about as well as they would with a great math teacher teaching them, maybe even a little better.

Can you help your child step through an algorithm like adding a column of numbers, if you have a book to follow that lays it out step-by-step? Then you can lay the groundwork for his mastering math at a high level.

Can you sympathize with a child who just doesn't understand the explanations in math books of new concepts? Then you can encourage him to follow the steps, one after another, in one exercise after another, and sooner or later, understanding will dawn.

To summarize: Teach the child to master a new skill by following the directions one step at a time; have him practice it repeatedly; encourage him that he can learn the next skill just as he learned the last one; and eventually see him start to feel like he understands. Does that sound like something you can do? Then you can teach your child math. In fact, one thing that the Math Wars have taught us is that no one has found a better way to do it.

Biographical Information

Norman M. Birkett graduated from Princeton University. For fifteen years, he programmed computers and managed projects for the financial industry. For nine years, he taught in a Christian school—including calculus, pre-calculus, and logic—and helped supervise the math program. Several of his students have distinguished themselves in college math. Norman and his wife Katharine self-publish textbooks (www.classicallegacypress.com), including his Logic I: Tools for Thinking.

Endnotes

[1] For a fuller version, see David Klein, "A quarter century of US 'math wars' and political partisanship," available at http://www.csun.edu/~vcmth00m/bshm.html, and for a much fuller version, see David Klein, "A Brief History of American K-12 Mathematics Education in the 20th Century," available at http://www.csun.edu/~vcmth00m/AHistory.html (both visited 26 Feb. 2009).

[2] For a brief account of this area, see H. Wu, "Basic Skills versus Conceptual Understanding: A Bogus Dichotomy in Mathematics Education," available at http://www.aft.org/pubs-reports/american_educator/fall99/wu.pdf (visited 26 Feb. 2009).

Pull quotes:

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