

Some Perspectives on Contemporary Mathematics Standards

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We live in an era of changing mathematical standards. Organizations such as the National Council of Teachers of Mathematics (NCTM), the American Mathematical Association of Two-Year Colleges, and the National Urban League have all published recommendations regarding what should be taught, how it should be taught, how it should be assessed, and what constitutes an effective mathematics program.¹ On the basis of these recommendations, U.S. states and districts have adopted standards to guide student learning and designed tests to measure how well students are achieving these standards. Some states even tie student promotion and teacher retention to performance on standards-based assessments.

BY TED HODGESON AND JIM BALLARD

The standards have had an impact on Christian schools and teachers, as well. Textbooks, curricula, and tests have been heavily influenced by published mathematics standards. Seminars and journal articles promote standards-based activities, and the

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Organizations like the National Science Foundation have lauded the standards' impact on teaching and learning. However, the guidelines have also stimulated heated debate and even protests. In California, for instance, the publication of detailed state standards created a backlash, spearheaded by concerned parents and university faculty. The uproar and the ensuing debates have become known as the "Math Wars."

While not proposing a particular course of action, the authors of this article feel we can contribute some expertise to an analysis of the standards argument. We both teach mathematics at public universities, including classes for future K-12 teachers. As practicing researchers and teacher edu-

cators, we are familiar with the standards documents and have even conducted seminars supporting their implementation. On the other hand, we both have parochial school teaching experience and bring a Christian perspective to the standards debate. We understand the concerns of parents and teachers regarding the widespread adoption of mathematics standards.

In this article, we will offer an overview of standards and then discuss how they would change the teaching of mathematics. Then we will summarize the arguments for and against the standards. Finally, as Christian educators, we will present our own views. Are the standards compatible with biblical principles? We reiterate that we do not advocate a

particular position. Rather, we hope to inform readers about the standards debate and help them to make decisions that will benefit all of their students.

An Overview of Mathematics Standards

Although influenced by events in the early 1980s, the current movement can be traced to the release of four standards documents by the NCTM between 1989 and 2000. Given the far-reaching influence of the *Standards*, these can be considered the prototypical documents. Many state and district standards mirror the recommendations of the NCTM. In fact, some state and district documents even refer readers to the *Standards*—the common term for four NCTM standards documents—for details about their recommendations.

The *Standards* were developed in response to several perceived needs:

1. The need for a mathematically literate workforce;
2. The need for members of society to be lifelong learners so they can adapt to a rapidly changing world;
3. The need to create educational and professional opportunities for all students;
4. The need for an electorate that is capable of interpreting quantitative information.

The 1989 standards document includes recommendations about what should be taught in schools and how mathematics programs are to be evaluated. Subsequent documents (1991, 1995, and 2000) deal with pedagogy and student assessment. This article will focus on the curricular and pedagogical recommendations.

The most recent edition of the *Standards* (2000) is divided into four grade levels: K-2, 3-5, 6-8, and 9-12. At every level, the initial five standards focus on fundamental mathematical content: numbers and operations, algebra, geometry, measurement, and data analysis and probability. In addition, there are five process standards for each grade level: problem-solving, communication, reasoning and proof, connections, and representation. These processes define what it

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means for students to “do” mathematics. The *Standards* also include pedagogical recommendations.

The *Standards* are sometimes criticized as too vague. However, their lack of specificity is intentional. Rather than identifying the individual skills students are to know, the authors of the *Standards* intend for the document to serve as a framework. The NCTM believes that the details of the mathematics curriculum are the responsibility of local educational associations.

Overall, the NCTM’s content, process, and pedagogical recommendations stand in stark contrast to traditional ways of teaching mathematics. For instance, the *Standards* emphasize problem-solving at all levels. Not only are students to become proficient problem-solvers, but they are also to receive all of their mathematics instruction within the context of problem situations. By contrast, most traditional texts present word problems only after students become proficient at the underlying computational skills. In other words, the word problems serve only as a context for applying computational skills.

The Pros and Cons of Standards

Pros: According to Loucks-Horsley and Bybee,² opponents and proponents agree on the need for clear goals to guide the teaching and learning of mathematics. The disagreements focus on the standards themselves. What is important for students to learn? How should they be taught?

According to Burrill and Kennedy,³ all recent U.S. standards have a number of features in common:

- They are directed at *all* students.
- They emphasize understanding of fundamental content and processes, rather than mere memorization of facts and rote performance of algorithms.
- Beyond defining what students should know and be able to do, they also focus on teaching, professional development, assessment, programs, and system support.
- They emphasize content more

than curriculum; that is, they leave decisions about the order, structure, and organization of mathematics content to states and local districts.

Most standards documents purport to address societal needs. One of the most important, according to proponents, is the need for equity. To understand why equity appears so prominently in the standards documents, consider the mathematical half-life phenomenon. In the U.S., if 100 students begin a freshman-level mathematics class, only 50 of them will continue on to the sophomore-level class. Of these 50, only 25 will take a junior-level class. Finally, of the 25 juniors in mathematics, only 12 will enroll in a senior-level class. Thus, of the 100 students who studied math in the 9th grade, only 12 percent will receive advanced training in mathematics.

If, as businesses claim, mathematics proficiency is needed for effective participation in the workforce, then traditional curricula do not serve the needs of students or society. For that reason, mathematics standards emphasize the need to educate *all* students. This does not imply, as some opponents claim, that all students are to receive the same training. Rather, proponents emphasize the importance of preparing all students to think and

reason.

Reacting to the needs of society and the business community, proponents also seek to expand “content” of school mathematics. They accuse traditional mathematics programs of focusing on a narrow range of skills, mostly in the areas of arithmetic, algebra, and geometry, which mainly prepare students for careers in mathematics. Although the vast majority of students enter fields that require problem-solving and reasoning, few of them will need sophisticated mathematical skills. Proponents of contemporary standards claim that traditional mathematics programs serve the needs of only a select few students.

Cons: By their very nature, national standards, which purport to guide the mathematical training of all students, produce dissension. In reviewing the politics of standards, Kirst and Bird identify four main areas of tension:

1. Between local control and political consensus;
2. Between the needs for specificity and flexibility;
3. Between new curricular goals and the ability of the educational system to incorporate them; and
4. Between educational authorities and the public’s understanding of

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what the new standards entail.⁴

In our view, resistance to contemporary standards (both at the national and state levels) falls into one of three categories. First are allegations that mathematics standards are part of a broader social movement designed to reshape students' values. In the 1980s and 1990s, teaching strategies like Outcome-Based Education and Goals 2000 sought to redefine school curricula to be more "inclusive." While history does tend to be written by the victors, many (including the authors of this article) believe that these social-education programs purposefully undermine traditional values. Given the real (or, as advocates would claim, perceived) social agenda of the educational establishment, there is concern

Standards' position on technology and algorithms to illustrate the concerns of the mathematics community:

The NCTM, for example, officially prescribes the early use of calculators with an enthusiasm the authors of this report deplore, and discourages the memorization of certain elementary processes, such as long division of decimally expressed real numbers and the pencil-and-paper arithmetic of all fractions, that we think essential, that should be second-nature before the calculator is invoked for practical purposes.

Raimi and others in the mathematics community are critical of what they perceive as poor pedagogy and inappropriate content.

Contemporary mathematics standards, and the *Standards* in particular, do redefine the mathematics curricu-

symbolic manipulation, which have long been considered the hallmark of mathematics.

At the university level, we are seeing more ill-prepared, mathematically illiterate students. In the eyes of many in the mathematical community, contemporary teaching methods contribute to this problem by failing to emphasize the skills students need to succeed in advanced mathematics courses.

Schools and parents form the third source of resistance. Contemporary standards recommend changes in mathematical content and methods of instruction. Due to a variety of factors, however, schools are reluctant or unable to change. For example, parent groups, who see the standards as untested educational theory, often express concern about their impact on their children's academic future.

Furthermore, some schools are hindered by a lack of resources. To implement contemporary mathematics standards, schools must adopt textbooks that align with the standards and provide teacher training. Such change requires money, something that all schools (both public and private) are simply not blessed with.

Our Perspective on Mathematics Standards

In her book *Education*,⁶ Ellen G. White examines the techniques used by Jesus, the Master Teacher. We find her work to be particularly relevant to this discussion on standards because of the model it establishes for assessing educational processes. Simply put, this means asking, "What would Jesus do?" A common criticism of mathematics standards is their emphasis on discovery methods of instruction. Critics allege that rather than teaching a concept clearly and directly, the standards encourage students to discover mathematical truth through exploration. Yet, is this not what Jesus often did through the use of parables? He could simply have told His followers and the crowds the Truth, and in

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about whether contemporary mathematics standards truly serve the best interests of students.

The mathematical establishment comprises a second form of resistance. In general, they feel concerned about attempts by national and state authorities to redefine mathematics and how it should be taught. In their critique of state mathematics standards, for example, Raimi and Braden⁷ point to the

lum. As we note in our Overview, the *Standards* emphasize processes (e.g., problem-solving and connections) and content (e.g., probability) that do not fit within the realm of traditional school mathematics. Moreover, the *Standards* recommend a shift in teaching style from traditional stand-and-deliver methods to more student-centered approaches. At the same time, the *Standards* de-emphasize proof and

some cases He did (e.g., His explanation of the parable of the sower in Matthew 13:18 to 23). However, Jesus used parables because He knew that lessons are best learned when the learner actively grapples with the meaning of the lesson and applies it to his or her own life.

We mention Jesus' use of parables to illustrate what we believe to be a fundamental truth about mathematics standards: *There is no clear biblical consensus regarding contemporary mathematics standards.* From our perspective, both opponents and proponents of standards have valid arguments, yet neither side has a corner on Truth. As an example, consider the concerns of the mathematics community. Some mathematicians claim that contemporary standards leave students unprepared for the rigors of university mathematics courses. In part, we believe that this is true. For instance, a comprehensive study of one standards-based curriculum found that, for a variety of reasons (including tracking), students in the traditional curriculum enter the university with better algebraic skills than those using the standards-based curriculum.⁷

What the mathematics community fails to recognize, however, is that preparation for careers in mathematics is only one goal of school math courses. The vast majority of students will be mere consumers of quantitative information. Traditional school programs have long ignored the needs of these students. Moreover, even though national and state standards have been in place for almost 10 years, there is little evidence that American mathematics programs have changed appreciably. So can the increase in mathematical illiteracy be blamed on the new standards, or is it an indictment of a traditional approach that ignores the needs and interests of students?

We do believe there is some merit in contemporary mathematics standards. For instance, the 1991 *Professional Standards for Teaching Mathematics*, which focuses on pedagogy, strongly supports the empowerment of students. The document recommends

that, rather than relying on lecture, teachers employ a variety of techniques, such as student exploration and discovery, student-to-student and student-teacher discourse. While one must be cautious about advocating one-size-fits-all pedagogical recommendations, we strongly believe that many students thrive in the sort of active learning environment advocated by the *Professional Teaching Standards*. In much the same way that the prodigal son (Luke 15) needed to experience life's hardships in order to repent, some students need to experience mathematics—through active, hands-on exploration—in order to learn the subject.

In closing, we encourage you to acquaint yourself with the new mathematics standards. As you do so, however, take an active, critical role. Do the standards resonate with your own experience and observations? If so, what evidence can you offer in support of them? If not, identify what you see as discordant and, in the process, examine your own positions and teaching style. Whether you find yourself in agreement with all of the standards, some of the standards, or none at all, we believe that you will benefit from this process of reflection. Like us, you may find that the real value of contemporary mathematics standards results from the introspection they elicit. ✍

NOTES AND REFERENCES

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Ted Hodgson is Associate Professor of Mathematics Education in the Department of Mathematical Sciences at Montana State University in Bozeman, Montana. **Jim Ballard** is an Assistant Professor of Mathematics in the Department of Mathematics at the Oregon Institute of Technology in Klamath Falls, Oregon.

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