MESSAGE

25 Pushing Algebra Down

IS SOONER BETTER?

We expect more mathematics of our students in today's rapidly changing world than in years past. In response to these higher expectations, an increasing number of schools are choosing to offer, or require, a course in algebra for students in grade 8. Some schools are moving to teach Algebra 1 in even earlier grades.[1] The motivation for this move is admirable and appropriate; all students need to learn challenging high school mathematics that prepares them for postsecondary programs, and too many students have been excluded from studying such high-level courses. While this solution may help some students, it's not the solution that best serves all of our students.

How We Got Here

In contrast to the traditional United States secondary mathematics program, the curriculum that our colleagues in Canada, Mexico, and the rest of the world teach does not define Algebra 1 as a separate course, but rather integrates mathematics content from algebra, geometry, and statistics into a more continuous pre-K–12 program. In the United States, we have struggled to bridge the gap between computational procedures at the elementary level and a secondary program anchored by a course called Algebra 1. In years past, we have used middle school to review and remediate students who have not mastered the arithmetic taught in elementary grades. Rather than bore the students who have

[1]Some schools organize high school mathematics with course names like Algebra 1, Geometry, and Algebra 2, but others may call courses by different names or may offer integrated mathematics courses that include algebra, geometry, statistics and other topics. In this message, any reference to Algebra 1 can generally apply also to these other high school courses.

mastered these skills, we have frequently followed the practice of accelerating them into Algebra 1 prior to grade 9. Thus we often created a cycle of inequity and untapped potential, where some students skipped over middle school (or junior high) mathematics and other students were destined to use those years to repeat what they had been taught before. Parents of students chosen for acceleration were proud that their sons and daughters were able to omit one or more years of middle school math, while we lowered our expectations for the rest of our students. In either case, we essentially gave up on middle school in terms of the possibility that students might gain something substantial in middle school mathematics itself.

Today, we recognize that this cycle of low expectations and missed opportunities for some students has resulted in a large number of students leaving secondary school ill-equipped for future options. One solution embraced by parents and policy makers has been to offer or require Algebra 1 or a high school integrated mathematics course earlier and for more, or all, students. Expecting all students to complete four years of high school mathematics that begins with this gatekeeper course is not only a good idea but also our moral and ethical responsibility. But moving in just a few years from a system that in the past limited many students to essentially no high school–level mathematics courses to a system that suddenly requires students to begin their study of high school mathematics in grade 7 or 8 may not be an appropriate or a desirable solution.

Is Earlier Algebra the Road to Advanced Placement?

One argument in favor of an early algebra course says that such a course makes it possible for more students to take five years of high school mathematics including Pre-calculus and Advanced Placement (AP) Calculus or AP Statistics. However, many communities are finding that students who start algebra early do not necessarily end up studying more mathematics. In fact, some students complete their mathematics requirement prior to grade 12 and choose not to enroll in any mathematics course for a year or more before they go on to postsecondary study or work. This is especially true if students have negative experiences in mathematics, and the result can have disastrous results after high school. Other students struggle in algebra classes, perhaps because of gaps in their background, because of a lack of adequate support for students or their teachers, or simply because students are not prepared to deal with some of the abstraction of algebra. Many of these students repeat Algebra 1 over and over again.

Making Decisions About Early Algebra

Any system offering or requiring Algebra 1 in eighth grade or earlier should seriously consider at least two important questions. First, how can the system ensure that students develop the skills and thinking that constitute a rich, contemporary middle school program that leads into Algebra 1 (or its integrated mathematics equivalent)? Second, what lies ahead for students at the other end of their high school mathematics sequence?

In terms of the first question, many middle schools today offer all students the opportunity to explore a rich array of mathematical topics anchored in proportional reasoning that extends well beyond the unit I remember teaching on ratio, proportion, and percent when I started teaching in the early 1970s. Students with a deep understanding of what it means when two quantities are proportionally related have an increased likelihood of success at Algebra 1 or the first year of an integrated high school program. As they study proportional relationships across mathematical topics, they connect critical notions of geometry, such as similarity and scaling, to ideas involving numbers and algebra. Ideally, middle school mathematics should continue to develop a strong thread of algebraic thinking begun in the elementary curriculum and should connect to important ideas in algebra and geometry. Students can use their increasing understanding of generalizations and relationships, as well as other more abstract notions, to deal with data and elementary statistics and to solve increasingly complex problems. If a middle school mathematics program does not offer this kind of powerful mathematics, balanced across all the threads of mathematics and focused on proportionality and algebraic thinking, then the school community should consider fixing the program, not accelerating students out of it. In some schools, students may be rushed to prepare for algebra as early as grade 6 or 7, narrowing their program even further to pre-algebra skills, or pre-pre-algebra skills, and missing even more of the mathematics curriculum.

The second point is equally important. There is little or no reason to accelerate a student into Algebra 1 unless the student intends to continue mathematics study through the equivalent of Geometry, Algebra 2, Pre-calculus (including Trigonometry), and a fifth year of secondary study in an academically appropriate course such as Calculus or Statistics. Furthermore, when students begin their high school study as early as grade 7, or when they are permitted to double up on mathematics courses via semester block scheduling, schools should ensure that even more options are available after the traditional high school mathematics sequence, such as an applied statistics course, discrete mathematics or quantitative reasoning, for example, so that students can study some mathematics every year they are in school. These options might be available as part of the high school's course offerings or offered in conjunction with a higher education institution. If a school does not make such

courses available or does not encourage students to continue studying mathematics every year, there is little purpose to accelerating students into secondary mathematics prior to grade 9.

What Can We Do?

Whether students are in a good traditional program or a good integrated mathematics program, they should begin high school mathematics early only if they are highly motivated to do so, if they intend to study mathematics every year in school through at least the calculus or statistics level, if the system is structured to accommodate this advanced study, and if they also study proportionality and the most important components of a good middle school program prior to beginning high school study. Whenever students begin their study of algebra, what is most important is that they are taught a rich algebra program in a way that engages them in solving challenging problems and helps them learn powerful tools and mathematical habits of mind they can use long after they complete the course.

We must expect all of our students to learn mathematics well beyond what we previously expected. We need all students to be more proficient than in the past, and we need many more students to pursue careers based on mathematics and science. But we should move students into high school mathematics very carefully, not precipitously, and we should ensure that every student is supported well to succeed in a rich, relevant, rigorous mathematics experience every year they are in elementary and secondary school.

Reflection and Discussion

FOR TEACHERS

- What issues or challenges does this message raise for you? In what ways do you agree with or disagree with the main points of the message?
- How can we give students more mathematics without necessarily starting them earlier?
- How can we teach algebra at the elementary, middle, and high school levels in a manner that engages, challenges, and prepares all students for the mathematics they need for their future?

(*continued*)

FOR FAMILIES

- What questions or issues does this message raise for you to discuss with your son or daughter, the teacher, or school leaders?
- How have you considered both the advantages and the challenges your daughter or son will face if accelerated into high school mathematics in grade 8 or earlier?
- Before making a decision to accelerate, what paths have you determined are possible through high school that include a mathematics course every year?

FOR LEADERS AND POLICY MAKERS

- How does this message reinforce or challenge policies and decisions you have made or are considering?
- How is the development of algebra and algebraic thinking incorporated as a continuous part of your pre-K–12 curriculum, or how can it be incorporated?
- What provisions are in place for students when they complete Algebra 1, Geometry, and Algebra 2, or Integrated Mathematics 1, 2, and 3? Do you have adequate options for students every year in high school, regardless of whether students plan to pursue a mathematics-intensive major or proceed into other postsecondary study or workforce training programs?

RELATED MESSAGES

- Message 9, "Increasing Access or Ensuring Failure?," considers what needs to happen in a system as we raise graduation requirements.
- Message 2, "Untapped Potential," discusses the need for all students to have rigorous and relevant mathematics experiences.

FURTHER READING

- *Radical Equations: Civil Rights from Mississippi to the Algebra Project* (Moses and Cobb 2002) discusses the relationship of algebra to civil rights and presents a different and compelling perspective about students studying Algebra 1 in eighth grade, including a discussion of the Algebra Project that Moses created.
- *Thinking Mathematically: Integrating Arithmetic and Algebra in Elementary School* (Carpenter, Franke, and Levi 2003) looks at

the development of algebraic thinking and its relationship to arithmetic in elementary grades.

- *College Knowledge* (Conley 2008) discusses what it takes to succeed in college today beyond entrance requirements, including discussions of issues around the implementation of Advanced Placement courses and the discrepancies between what high schools and colleges expect of students.