Does Everybody Need to Study Algebra?

Steen, Lynn Arthur

The Mathematics Teacher; Apr 1992; 85, 4; ProQuest Research Library
pg. 258

The view expressed in “Soundoff” do not necessarily reflect the views of the Editorial Panel of the Mathematics Teacher or the National Council of Teacher of Mathematics. Readers are encouraged to respond to this editorial by sending double-spaced letters to the Mathematics Teacher for possible publication in “Reader Reflections.” Editorials from readers are welcomed.

Does Everybody Need to Study Algebra?

It is a mistake to suppose that requiring the nonmathematical to take more advanced math courses will enhance their understanding and not merely exacerbate their sense of inadequacy.

—William Raspberry

Why teach algebra to those who don’t or can’t appreciate it... Algebra isn’t essential to much of anything. ... It is useless torture, ... for the few, not the many.

—Coleman McCarthy

Even as members of NCTM rally to implement the Council’s (1989) Curriculum and Evaluation Standards (Standards), well-known critics such as Washington Post columnists William Raspberry and Coleman McCarthy—speaking from opposite sides of the political house—raise an alarm. How absurd, they say, to require algebra of all students. Ordinary people don’t use algebra in their life or work. So let students choose: those who need mathematics should take algebra, those who don’t shouldn’t have to.

Critics argue that algebra is a boring, irrelevant impediment that turns off more students than it helps. Yet the Standards document calls for a three-year core curriculum for all students. Everybody Counts (National Research Council 1989) urges that students study mathematics each year they are in school. Reformist advocates of outcome-based education (OBE) recommend that such performance outcomes as effective problem solving and communication replace seat time as the requirement for graduation while traditionalist voices call for accountability in terms of improved test scores.

Let’s face it. For most students the current school approach to algebra is an unmitigated disaster. One out of every four students never takes algebra, being diverted instead into dead-end sidings such as general or consumer mathematics. And half the students who do take first-year algebra leave the course with a lifelong distaste for mathematics. Some of these students go on to become newspaper columnists or political leaders.

In fact, none of the major voices for change in school mathematics specifically urges that the present version of first-year algebra be a requirement for all students. The Standards, Everybody Counts, OBE advocates, even President Bush’s America 2000 plan all speak broadly in terms of outcomes for high school graduates, not of particular course requirements at specific grade levels. On this the mathematics community and its critics agree: first-year algebra in its present form is not essential for a quality mathematics education.

This is not to say that algebra is not essential. Algebraic skills and associated algorithmic thinking are means to the ends of mathematical power (NCTM 1989), problem solving (OBE), and scientific competitiveness (President Bush: see Alexander [1991]). So too is geometric insight, quantitative reasoning, logical clarity, number sense, and statistical experience. Whether students enter the work force directly after high school or continue their studies in higher education, they must be prepared to employ a rich variety of mathematical skills in their work.

McCarthy and Raspberry are partially right. Rarely will high school graduates be faced with problems presented in the language of algebra. Most often they will have to think mathematically about issues laden with incomplete data, ambiguous graphs, uncertain inferences, and hasty generalizations. To perform well when confronted with

Lynn Arthur Steen teaches at Saint Olaf College, Northfield, MN 55057. He is a former president of the Mathematical Association of America and past chair of the Conference Board of the Mathematical Sciences.
problems of this complexity, students need more tools than mere algebra.

Mathematical power for all students, the theme of the Standards, requires that each student grow throughout each school year in the ability to perform effectively in a variety of authentic settings, rich with detail, surrounded by ambiguity, and embedded in a context that is both realistic and significant. This is what outcome-based performance assessment is all about. It is the educational equivalent of what the business world calls “the bottom line.”

However, students’ progress toward the goal of mathematical power will rarely be uniform. As every teacher and parent knows, students are very different: they mature at different rates; their learning patterns exhibit different strengths and weaknesses; their interests and preoccupations shift unpredictably. So to achieve the desired outcome of mathematical power for all students within the chaotic reality of real students in real schools, we must be prepared to abandon such rigid curricular structures as first-year algebra that treat all students as if they were alike. The lock-step approach of algebra, geometry, and then more algebra (but rarely any statistics) is still dominant in U.S. schools, but hardly anywhere else. This fragmented approach yields effective mathematical education not for the many but for the few—primarily for those who are independently motivated and who will learn under any conditions.

In contrast, the Standards calls for instructional patterns that group students not by curricular objectives (e.g., general mathematics or algebra) but by breadth, depth, and approach. This exhortation is not as unrealistic as it might at first appear. Although typical school exercises (e.g., solve $x^2 + 4x - 7 = x + 5$) have relatively inflexible mathematical prerequisites, authentic problems can be approached in many different ways—by estimation, by graphing, by calculator, by equation, by modeling, by computer. Thus students at many different levels of scholastic and mathematical maturity can work on similar or identical problems, each in his or her own way.

Indeed, evidence from effective programs shows that all students learn better in environments that are rich in context, community, and connections:

- **Context:** Typical mathematics homework and worksheets isolate a single dimension of knowledge from its rich natural context. Most students perform more effectively and more imaginatively when they encounter problems in a context that invites full use of their personal strengths and does not simply rely on a narrow range of skills.

- **Community:** Youth learn best in circumstances that reinforce the emotional and social contexts necessary for sustained motivation. Personal engagement is enormously important to students of all ages; effective instruction harnesses this powerful source of motivation.

- **Connections:** To make sense of formal mathematics, students need opportunities to make connections to social, historical, or personal contexts as well as to other subjects studied in school. Mathematics is connected to virtually everything, and good teaching constantly reveals these connections.

The NCTM Standards is rooted in educational research that shows the personal nature of mathematical knowledge: each student’s mathematical insight is constructed as he or she engages the material and uses it in productive ways. Students differ in how long this engagement must be and in the kinds of activities that will productively construct mathematical knowledge. Nevertheless, for all students, context, community, and connections make this engagement productive. All students, not just advanced students, can and should benefit from the rich environment of open-ended problems, group problems, active discussion, and multidimensional learning.

Effective programs provide different levels of expectation for students at different levels of need. Since students learn at very different rates, the time required for projects, practice, and review will vary greatly. More instructional time must be given to those who need it when they need it—not months or years later when it is much less effective. What this requires, and what first-year algebra too often lacks, are challenges appropriate for the student and engagement sufficient to the challenge of learning.

**Everybody Counts** stresses the nation’s need to achieve both excellence and equity in mathematics education. “Equity for all requires excellence for all; both thrive when expectations are high.” This challenge is sharpened in the Standards and, surprisingly, by critics McCarthy and Raspberry. Both the Standards and its critics seek a richer course than traditional first-year algebra. Only when we offer such a course can we then face the public with a legitimate claim for more required years of school mathematics.

Students need to learn statistics, geometry, algebra, and computing; they need to acquire both number sense (quantity, measurement, magnitude, units) and function sense (symbolic, graphic, numeric, algorithmic). They must grow in the experience of using mathematics both in school assignments and in ordinary life. Finally, what should really be first, all students must learn to read, write, speak, and listen with language that employs mathematical ideas.
The school curriculum should be arranged so that all students gain in each of these many dimensions of mathematical power each year they are in school. First-year algebra is an easy target because it advances only a narrow range of skills, leaving too many important topics for future courses that most students never take. To regain public confidence, school mathematics must continually teach students things that thoughtful adults perceive as important, which is exactly what the Standards recommends.

BIBLIOGRAPHY


