Mathematics Curriculum:

Essential Knowledge for Mathematicians Working to Improve K–12 Education

Given the central role of mathematics in the K–12 education of all students, mathematicians should understand the focus of school mathematics and the influences that shape that focus. Every higher education institution that is engaged in teacher education expects departments of mathematics to offer mathematics courses aimed at the education of future teachers. In order to prepare future mathematicians to educate preservice K–12 teachers and to contribute to the articulation of ongoing iterations of mathematics curriculum expectations and textbook development, studying mathematics curricula should be a part of all Ph.D. programs in mathematics.

We raise questions and provide examples to make our case for the systematic education of doctoral students in mathematics about the history and development of K–12 mathematics expectations and text materials.

Mathematicians should be knowledgeable about the history and evolution of mathematics curricula. For example, consider the sequence of algebra, geometry, advanced algebra, and precalculus used in secondary schools in the United States. One hundred years ago compulsory ages for school attendance were still being established, and few students graduated from high school. In order to meet the needs of those students attending only two years of high school, it was felt that students should study some algebra and geometry. Thus a yearlong algebra course followed by a yearlong geometry course was organized and offered. For those students who remained in high school for a third year, a more advanced treatment of algebra was offered.

What are the ramifications of there being no national mathematics curriculum in the United States? The tradition is that each state or locality is responsible for establishing mathematics expectations for its school population. What mathematics is learned, when it is learned, and to what extent specific mathematical topics are emphasized varies from school to school and state to state. This patchwork quilt approach impacts what mathematics knowledge students bring to higher-education institutions. Learning how mathematics curricula have been established and are set by states and other entities can help mathematicians better understand some of the strengths and weaknesses inherent in our educational system and enable them to become more effective in helping to improve the system.

What are the many diverse and powerful forces that influence the K–12 mathematics curriculum? While societal needs and the discipline of mathematics are two forces influencing the mathematics curriculum, there are many other forces that shape the topics and the emphasis given to these topics in mathematics textbooks. Currently accountability systems, including high-stakes assessment prompted by the No Child Left Behind federal legislation, are major forces influencing many K–12 mathematics curriculum decisions. Other forces impacting mathematics curricula include research about how students learn; evolving technology, such as graphing calculators, symbolic manipulation tools, dynamical geometry exploration tools; and recommendations from learned societies.

What is the process underlying the development of mathematics text materials? Historically most mathematics textbooks are not researched and piloted before being sold commercially. The notable exceptions are federally supported mathematics curriculum, most of which are funded by the National Science Foundation. It should also be noted that during the last two decades the elementary-secondary publishing industry for mathematics has gone from having considerable competition among independent publishing houses to a quartet of mega-publishers. These publishers are businesses and as such are primarily concerned with sales and profit. As with any business, they are customer driven and not necessarily driven by the content concerns of academic communities.

What previous eras of change or tugs of war has the curriculum experienced and what prompted them? History does repeat itself. Current "math debates" about the lack of involvement of mathematicians in K–12 curriculum development were preceded more than forty years by criticism of the domination of the "new math" era by mathematicians. Knowledge of these tugs of war provides a valuable context within which to interpret current debate and perhaps make more reasoned and informed judgments that will raise the intellectual level of the ensuing debates.

What visions for the mathematics curriculum have been offered by mathematicians that are yet to be realized? In 1902 E. H. Moore in his AMS Presidential Address called for a revamping of the K–12 mathematics curriculum, with more attention given to how mathematics was taught. Hyman Bass echoed a similar message in discussing the need to teach mathematics better in 2001. Knowledge of such visions provides a context to better understand areas of the mathematics curriculum where progress has been made and where work remains.

How have major committee reports impacted mathematics curriculum? Major CBMS and NCTM documents have provided additional visions for the K–12 school mathematics curriculum. Understanding both the rationale for and substance of the recommended changes is essential for promoting constructive discussion and criticism.

What role can and should mathematicians play in the process? Mathematicians have assumed many leadership roles in promoting change in mathematics curriculum. By learning about the contributions of previous mathematicians to mathematics curriculum, future mathematicians can become more active and informed contributors to mathematics curriculum change in the future. Knowledge of the history of mathematics curriculum development will help them better understand the challenges of curriculum change and provide insight into effective ways mathematicians can contribute to the development of mathematics curriculum in an ever-changing educational system.

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This Opinion piece is based on the work of the Center for the Study of Mathematics Curriculum, supported by the National Science Foundation under Grant No. ESI-0333879.

Letters to the Editor

End Torture and Detention

As expressed in the UN charter, torturing and detaining people indefinitely without due process is a serious crime against humanity (http://www.hrweb.org/legal/undocs.html). We call on all governments (especially our own): to stop these ugly practices; to prosecute individuals who are involved in such practices; and to ask courts to bring these individuals to justice, whether they are involved directly or by giving orders and setting policies.

By now an overwhelming amount of evidence (news, pictures, testimonials, admissions, Amnesty International and UN reports, and even FBI reports) makes it clear that these kinds of shameful inhuman practices have been taking place. This distresses us greatly and moves us to speak out.

—Selman Akbulut, Paul Gauthier, Mary Gray
(the chair and two members of the AMS Human Rights Committee)*
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*This is not an official position of the AMS HRC. In fact, some of the other members of the HRC feel that this issue is not within our mandate.

(Received July 1, 2005)

The Message of "Who Wants to Be a Mathematician"

When attending the Joint Mathematics Meetings in Atlanta, I watched the contest "Who Wants to Be a Mathematician". I acknowledge that it is a big event for the participants, but unfortunately it sends a completely wrong message to the high school students. The students are required to solve problems in extremely limited time, usually 60 or 90 seconds. Thus, the message is: if you want to be a mathematician, you have to be able to answer math questions very quickly. This is wrong, wrong, wrong!!! In fact, one of the main reasons why it is so difficult to teach math to students at the universities is that most of them were not taught in school how to think, and they were not even taught that one should think about math problems. Tests of the type "answer 60 questions in 60 minutes" are quite popular. They should be banned. Many times I heard from frustrated parents who tried to explain math to their kids that the kids told them they cannot do this in school: "I cannot think, I have no time for that, I have to know when I am asked." And then those kids get to universities and we try to teach them to think, but it is too late for this.

Instead of the "Who Wants to Be a Mathematician" contest, which only makes the situation worse, the AMS should organize more contests of the Mathematical Olympiad type, where problems are more difficult but the participants have enough time to think.

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(Received July 2, 2005)

Ad Reinhardt

Martin Gardner mentions the "black paintings" of "Ed Rinehart" in your recent interview. The painter he referred to was of course the pioneer conceptual artist Adolph "Ad" Reinhardt.

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(Received July 2, 2005)