Curriculum and Teacher Education in Light of the Common Core

MSRI CONFERENCE: THE MATHEMATICAL EDUCATION OF TEACHERS

MAY 12, 2011

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Categories of preK-12 Teacher Education

	Elementary (preK-6)	Middle (6-9)	Senior High (9-12)
Pre-service	C	C	C
Inservice general	P, S	P, S	P, S
Inservice specific	S, D, I	S, D, I	S, D, I

Avenues of education:
C = college or university courses
P = professional organization meetings
S = school or school district inservices
D = developers' conferences
I = instructional materials

Avenues for inservice education by the developers in their curriculum

- Explanations, background, and alternate approaches in teacher editions
- Sessions at conferences or inservices in school districts held by the developers to deal with specific concerns
- Student edition prose and questions

Content in teacher's editions

- Mathematical background
- Connections with content studied earlier or to be encountered later
- Answers to all questions
- Alternate approaches to lessons

Common teacher concerns about a specific curriculum

- Developers' views concerning how lessons should be taught
- More knowledge about mathematics that they have not previously taught
- How the latest technology is or can be utilized
- How to get students to read
- What to say to parents
- What is available on line

Common teacher concerns about a specific curriculum (cont')

- How to adapt for students with special needs
- How to cover desired material in the time available
- How to deal with diverse students
- How much time to spend on test-prep
- What to do with students who have forgotten the previous year's standards
- What to do with students who score poorly on the common core tests

The curriculum as defined by materials is not the same as the taught curriculum no matter how teacher-proof one tries to make the materials.

The common core standards will be interpreted in different ways by different teachers.

Many different sequences are currently in well-researched courses that broadly fit the common core standards algebra-geometry-algebra pathway; all the well-researched curricula (including those that are termed “integrated”) can live with the Smarter Balance plan to test at the end of the three-course sequence only; none can live with the PARCC plan to test four times a year.

How tests undermine learning

- Instead of teaching mathematical ideas, teachers will teach test questions and focus on key words and forms in which the questions are stated and answers are expected.
- The curriculum becomes incoherent and disintegrated.
- Poor performance in mathematics is viewed by a student as confirming that he or she “does not have it”.

The most frustrating aspect of working with inservice teachers

Many teachers have not studied enough mathematics that is relevant to the mathematics they teach. Any advice we offer is distorted by a lens of ignorance.

Mathematics taken by the best undergraduate mathematics majors

- Dominated by analysis (calculus, real variables, differential equations)
- Higher (abstract) algebra
- Often with little to no coursework in

  geometry

  modeling

  statistics

  technology

Prospective mathematics teachers need more: Geometry

- General definition of congruence and similarity through transformations
- Applications of transformations to graphs of functions and relations
- Matrices for isometries and similarities
- Transformations as functions; inverse transformations; identity transformation; compostion of transformations

Prospective mathematics teachers need more: Modeling

- Modeling emanates from real situations that seek out mathematics for their resolution, not from applications of a particular mathematical topic that one wants to apply.
- The ideas of modeling begin in the early elementary grades

Prospective mathematics teachers need more: Statistics

- Three kinds of statistics courses, from three different departments:

Department	Course emphases
Mathematics	Emphasizes properties of distributions
Statistics	Emphasizes work with data sets
Education	Emphasizes tests and comparisons of groups

Prospective mathematics teachers need more: Technology

- Computer algebra systems
- Dynamic geometry
- Spreadsheets
- Statistical software
- Simulations

We can no longer tolerate teachers of middle school mathematics who have no certification to teach mathematics.

We need to push for specialized teachers of mathematics in the elementary school.

The mathematics that teachers need is a type of applied mathematics.

- It has mathematics as its academic base.
- It involves a context (the classroom) from which problems arise.
- It involves a specialized mathematics – "teachers' mathematics" – that is particularly pertinent to that context

The number of mathematically well-prepared teachers depends on:

(1) the number of mathematically well-prepared students leaving high school plus the number of students who are not so well-prepared but can be ramped up in college;

(2) the percent of (1) who can be attracted to consider a major in mathematics;

(3) the percent of (2) who become majors; and

(4) the percent of majors who wish to teach below the college level.

Number of students with each score on AP Calculus Exams in 2010

Exam score	Calculus AB n	Calculus AB %	Calculus BC n	Calculus BC %
5	52,148	21.2	39,012	49.4
4	40,418	16.4	12,164	15.4
3	44,376	18.0	14,218	18.0
2	27,590	11.2	4,573	5.8
1	81,335	33.1	9,031	11.4
Totals	245,867		78,996	
≥ 3	84,940	55.7	65,394	82.8

Source: The College Board, Student Score Distributions
AP Exams – May 2010

How can we get more of our best students to want to become teachers of mathematics in our schools?

Thank you!

Number of AP Calculus Exams 2000-2010

Year	AB	BC	Total
2000	**137,276**	**34,142**	**171,418**
2001	146,771	38,134	184,905
2002	157,524	41,785	199,309
2003	166,821	45,973	212,794
2004	175,094	50,134	225,228
2005	185,992	54,415	240,407
2006	197,181	58,603	255,784
2007	211,693	64,311	276,004
2008	222,835	69,103	291,938
2009	228,847	76,383	303,553
2010	**245,867**	**78,998**	**324,865**

Source: The College Board, AP Annual Reports to the Nation, 2005 to 2011

Percents of students with each score on AP Calculus Exams (2004-2010)

	AB					BC				
Year	2004	2006	2007	2009	2010	2004	2006	2007	2009	2010
Score										
5	20.4	22.3	21.0	21.0	21.2	39.8	41.9	43.5	41.4	49.4
4	19.9	20.5	18.7	18.7	16.4	18.8	19.7	17.9	17.6	15.4
3	19.0	18.6	19.1	18.0	18.0	20.9	19.7	18.8	20.0	18.0
2	17.6	15.5	15.4	15.8	11.2	7.7	6.4	6.4	7.6	5.8
1	23.0	23.2	25.7	26.4	33.1	12.8	12.3	13.5	13.4	11.4
≥3	59.3	61.3	58.8	57.7	55.7	79.6	81.3	80.2	79.0	82.8
Mean	**2.97**	**3.03**	**2.94**	**2.92**	**2.81**	**3.65**	**3.72**	**3.71**	**3.66**	**3.86**

Source: The College Board, AP Annual Reports to the Nation 2005 to 2011