WHAT DOES THE PAST TELL US ABOUT THE PRESENT AND FUTURE IN MATHEMATICS EDUCATION?

NCTM 2018 ANNUAL MEETING

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LESSONS LEARNED IN …

CURRICULUM	ASSESSMENT	POLICY
Zalman Usiskin	Diane Briars	Linda Rosen

Comparing two generations

Decades	1960s	1990s and 2000s
Big curriculum initiatives	New math curricula	NSF curricula
New content	Geometry and algebra in K-6; emphasis on mathematics theory K-12, functions in h.s.;	Introduced technology and applications at all levels, emphasis on student involvement, discourse
Movement down in years	calculus moved to become first freshman college course for students on grade level	algebra moved to become an 8th-grade course for 40%; calculus moved to become a senior course

Comparing two generations

Decade	1960s	1990s and 2000s
Big curriculum initiatives	New math curricula	NSF curricula
Test scores	SAT scores (the only barometer of the era) rose, then fell due to increased numbers of students taking the test	SAT, ACT, NAEP 4th & 8th grade rose; mean total 12th-grade NAEP was stagnant but there were increases in every ethnic subgroup (Simpson's paradox),4 pts for whites, 18 pts for Blacks, 17 pts for Hispanics.

Comparing two generations

Decade	1960s	1990s and 2000s
Big curriculum initiatives	New math curricula	NSF curricula
Equity issues	Major gap between white students and Black or Hispanic students. Poorer students and inadequately trained teachers bewildered, left behind.	Major gap still between white students and Black or Hispanic students. Opportunities for early algebra and AP classes not available in many minority-majority schools.

Comparing two generations

Decade	1960s	1990s and 2000s
Big curriculum initiatives	New math curricula	NSF curricula
Complaints	Parent and teacher complaints about not understanding why sets and other aspects of theory were important, view that skills were being shortchanged	Mathematician complaints about students not being ready for college math, view that skills were being shortchanged

Comparable curricular moves

Decade	1970s	2010s
Reaction called	Back-to-basics	Common Core
Instructional characteristics	Fragmenting of the curriculum into behavioral (performance) objectives	Description of the curriculum as a set of standards to be mastered
Ignoring or stifling	New math and the successes of the 1960s	NCTM Standards and the successes of 1990-2010

The Common Core is the “back-to-basics” of the present generation.

- detailed specification just as with behavioral objectives in the 1970s
- increased attention to p&p calculation (more decimal places than in most existing curricula)
- no mention of calculators in grades K-8
- no algebra skill removed from the curriculum (e.g., division of polynomials kept)

Comparable classroom innovations

Decade	1970s	2010s
Reaction called	Back-to-basics	Common Core
New technology	Programmed learning textbooks	Online materials with adaptive questions
Some move to	Individualized instruction	Tailoring instruction to the individual

Comparable results

Decade	1970s	2010s
Reaction called	Back-to-basics	Common Core
SAT scores	Plummeted	constant
NAEP scores	constant	constant

It seems so logical…

If we

1. Identify in detail what should be taught.

and

2. Test over what is identified so that teachers will teach what is identified.

then

3. Performance will increase on those things we have identified.

Why does (1) identify, (2) teach, and (3) test specific objectives not yield overall higher performance?

- Works only for the short term on small bits of knowledge.
- Works for the best students, but they already score high. And it demoralizes the poorest students.
- Tests as motivation reduce the attractiveness of the subject matter, resulting in less interesting lessons and thus less interested students.

Another lesson from the 1970s

Going “above grade level” helps performance. Asking teachers not to go above grade level dampens performance.

In the 1970s, in reading there was a strong move towards not going above grade level in vocabulary. Reading scores plummeted.

In the 2010s, EdReports and adoption committees give negative ratings to materials that go beyond the core. Sticking to grade level impedes learning and may be dampening any positive effects the massive investment in the Common Core might produce.

What turned things around…

- 1978 NCSM's *Position Paper* on Basic Mathematical Skills
- 1980 NCTM's *Agenda for Action*
- 1989 NCTM's *Curriculum and Evaluation Standards for School Mathematics*

Entry from NCSM and NCTM for schools to adopt strong goals for learners of mathematics and to give license to teachers to extend those goals for the students they teach.

The lesson for today

We need NCSM and NCTM to re-take policy leadership regarding the goals of K-12 mathematics classrooms and how to reach them, as they did a generation ago.

Some needed moves from the CCSSM

At all grades:

encouragement to use latest technology to do mathematics

At grades K-5:

fractions and decimals simultaneously

data collection and representation from Gr 1

a sensible and continuous geometry sequence

At grades 6-12:

removal of assumption that all content should prepare for calculus or statistics

strong attention to mathematical literacy, financial mathematics, logic

importance of definition of terms and deductive reasoning from assumptions (both in pure and applied situations)

overt work with problem-solving and metacognitive strategies

"WE MUST ENSURE THAT TESTS MEASURE WHAT IS OF VALUE, NOT JUST WHAT IS EASY TO TEST. WHAT IS TESTED IS WHAT GETS TAUGHT. TESTS MUST MEASURE WHAT IS MOST IMPORTANT."

Everybody Counts: A report to the Nation on the Future of Mathematics Education

National Research Council, 1989

"ALL ASPECTS OF MATHEMATICAL KNOWLEDGE AND ITS CONNECTONS [MUST] BE ASSESSED . . ."

Curriculum and Evaluation Standards for School Mathematics
NCTM, 1989

"ASSESSMENT SHOULD REFLECT THE MATHEMATICS THAT ALL STUDENTS NEED TO KNOW AND BE ABLE TO DO."

Assessment Standards for School Mathematics
NCTM, 1995

"AN EXCELLENT MATHEMATICS PROGRAM ENSURES THAT ASSESSMENT IS AN INTEGRAL PART OF INSTRUCTION, PROVIDES EVIDENCE OF PROFICIENCY WITH IMPORTANT MATHEMATICS CONTENT AND PRACTICES, INCLUDES A VARIETY OF STRATEGIES AND DATA SOURCES, AND INFORMS FEEDBACK TO STUDENTS, INSTRUCTIONAL DECISIONS, AND PROGRAM IMPROVEMENT."

Principles to Actions: Ensuring Mathematical Success for All, NCTM, 2014

1980'S

Mandated Testing

- District or State-level tests or both (70%)
- Most widely used tests

  CAT MAT SAT SRA CTBS ITBS
- "Most teachers make changes in their teaching to reflect [the form and character of the tests their students take]"

Romberg, Wilson & Khaketla, 1989

1989

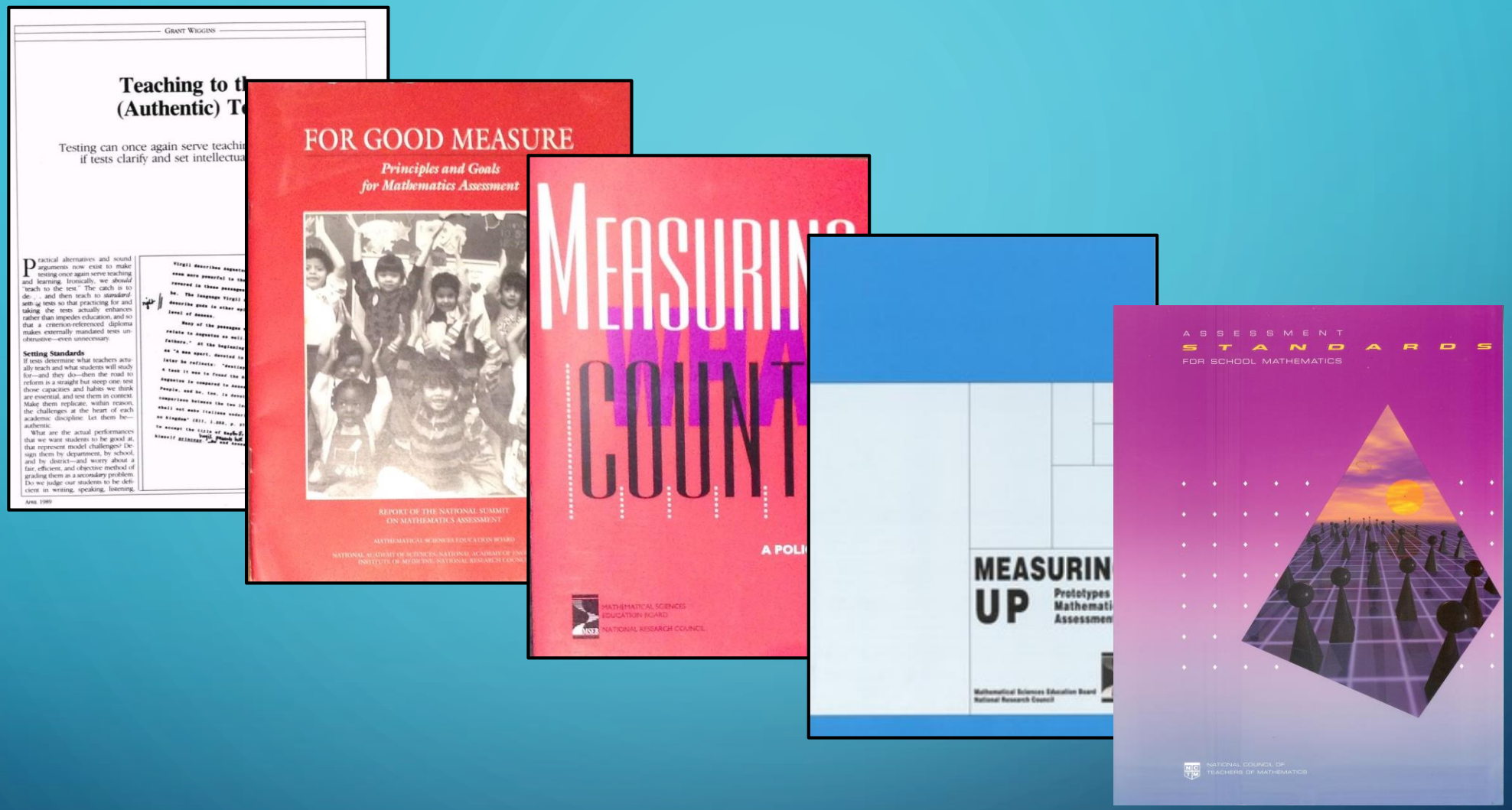
"AT A TIME OF MAJOR REFORM IN MATHEMATICS EDUCATION, WE, AS LEADERS IN URBAN SCHOOL DISTRICTS, ARE CALLING FOR THE ALIGNMENT OF ALL MATHEMATICS TESTS WITH THE NEW STANDARDS DEFINED BY NCTM.

WE ARE MOST CONCERNED ABOUT THE IMPACT OF STANDARDIZED NORM-REFERENCED TESTS ON INSTRUCTION. THESE TESTS ARE USED TO EVALUATE SCHOOLS, STAFFS, PROGRAMS, AND STUDENTS. THE FEDERAL GOVERNMENT HAS MANDATED THAT URBAN SCHOOLS USE THESE TESTS TO EVALUATE FEDERALLY-FUNDED PROGRAMS, E.G., CHAPTER 1."

1989

"WE BELIEVE THAT STANDARDIZED MATHEMATICS TESTS MUST BE CHANGED. . . THE EMPHASIS MUST SHIFT FROM COMPUTATION TO THE CONCEPTUAL DEVELOPMENT OF ALL TOPICS IN THE MATHEMATICS CURRICULUM, INCLUDING REASONING, COMMUNICATION, CONNECTIONS, PROBLEM SOLVING, ESTIMATION, AND MENTAL ARITHMETIC."

Mission Statement, Urban Mathematics Collaborative Supervisors
1989



Assessment to address equity issues

1990'S & EARLY 2000'S

Assessment Development Projects

- Balanced Assessment Project
- Mathematics Assessment Resource Service (MARS)
- New Standards Project

Performance Assessments Part of Mandated Tests

- CA, CT, MA, MD, MI
- New Standards Reference Examination
- Portfolio Assessment--VT, KY
- Common assessments across states, NECAP

NCLB

- Testing at every grade
- Census testing, not matrix sampling
- Common scale
- "Value-added" measures to measure growth
- Teacher and school evaluation

CCSS ASSESSMENT CONSORTIA

- Designed to assess all of CCSS-M, including Standards for Mathematical Practice.
- Developing technology tools to make performance assessments more affordable.

Issues:

- Testing time
- Desire for "state" assessments rather than common assessments

ESSA

Requires that state assessments

- Be aligned to the challenging State academic content standards;
- Address the depth and breadth of those standards; all of a state's standards be assessed.

Does not require that tests include performance assessments.

Allows states to use "nationally recognized high school assessments" (SAT, ACT) as part of their assessment system.

- Design to distinguish students; not measure proficiency
- Lack of performance assessment; not assessing mathematical processes/practices

FORMATIVE ASSESSMENT

Effect of formative assessment on student achievement

Paul Black & Dylan Wiliam

Assessment Purpose: Making Instructional Decisions

"Integrating assessment and instruction in the classroom means . . . assessing students' learning to inform teachers as they make moment-by-moment instructional decisions about students' work in the classroom."

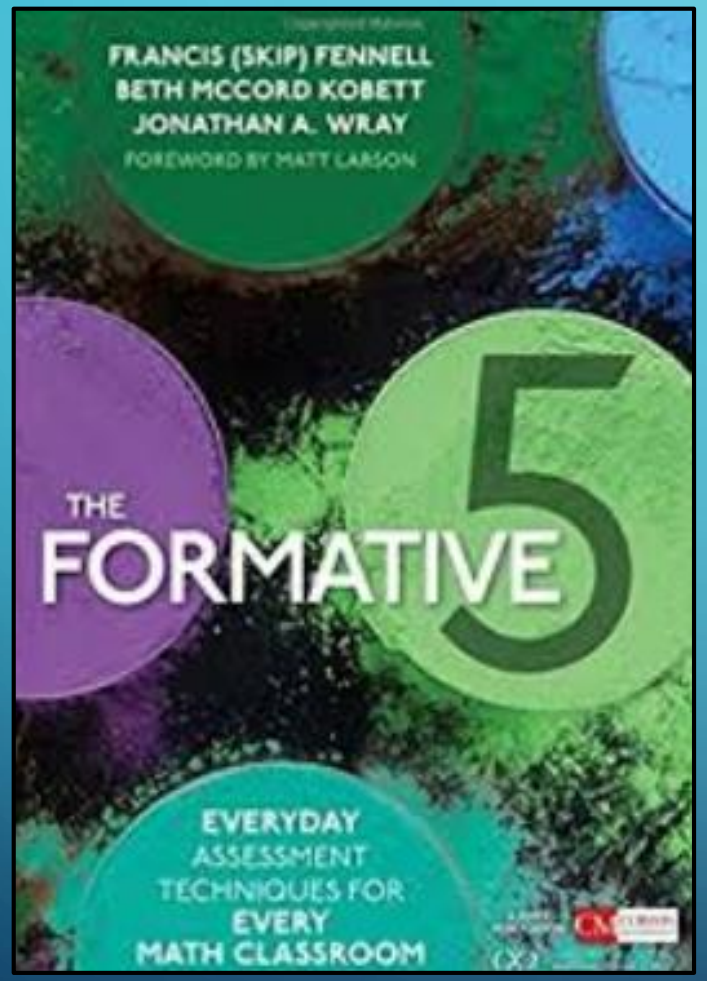
Assessment Standards for School Mathematics, NCTM 1995

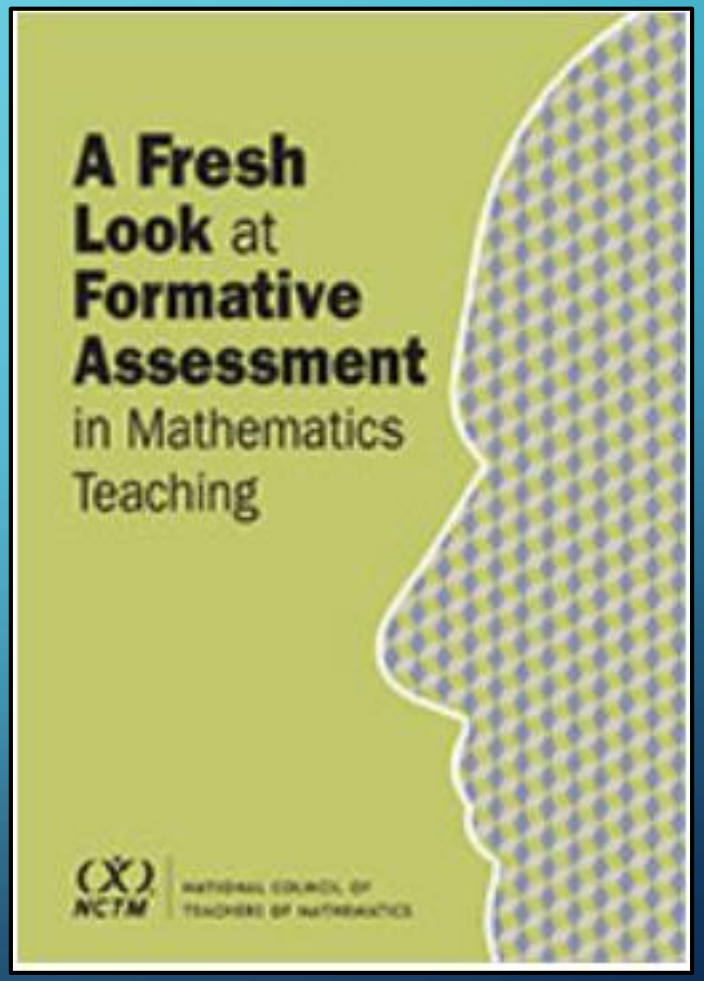
Effective Mathematics Teaching Practices

Elicit and use evidence of student thinking. Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

Principles to Actions: Ensuring Mathematical Success for All, NCTM 2014

NEW FORMATIVE ASSESSMENT RESOURCES





WHAT HAVE WE LEARNED?

- How to design and score high quality performance assessment items.
  - Large banks of high quality performance items
- How to use technology in design and scoring of performance assessments. (In progress)
- Educational policies can (unintentionally) undermine creation and use of high quality large scale assessments.
- We need on-going strong advocacy efforts for educational policies that require that mandated large scale assessments (1) assess all aspects of mathematical knowledge AND (2) include high quality performance assessments to do so.

TOUCHSTONE YEARS IN MATH POLICY

THEN	AND	NOW
1965		2010
1988		
1994		Present

Funding for Elementary and Secondary Education, 2015

STATE GOVERNMENTS CONTRIBUTED 47.1% OF TOTAL
LOCAL GOVERNMENTS CONTRIBUTED 44.6% OF TOTAL
FEDERAL GOVERNMENT CONTRIBUTED 8.3% OF TOTAL

ELEMENTARY AND SECONDARY EDUCATION ACT 1965 "WAR ON POVERTY"

- Emphasized *equal access* to education and *established high standards and accountability*
- Sought to *close achievements gaps* by providing each child with fair and equal opportunities to achieve an exceptional education
- *Funding* for professional development, instructional materials, and resources to support educational programs

ELEMENTARY AND SECONDARY EDUCATION ACT 2010 "EVERY CHILD SUCCEEDS ACT"

- Upholds critical *protections for disadvantaged and high-need students*
- Requires that all students in America be taught to *high academic standards* to prepare them to succeed in college/careers
- Requires *annual statewide assessments* that measure students' progress toward those high standards
- Supports *local innovations* developed by local leaders and educators
- Sustains and expands investments to increase access to *high-quality preschool*
- Expects *accountability and action to effect positive change* in our lowest-performing schools, where groups of students are not making progress, and where graduation rates are low over extended periods of time.

ESEA FRAMEWORK: THEN AND NOW

1965

- Title I – Financial Assistance To Local Educational Agencies For The Education Of Children Of Low-Income Families
- Title II – School Library Resources, Textbooks, and other Instructional Materials
- Title III – Supplementary Educational Centers and Services
- Title IV – Educational Research And Training
- Title V – Grants To Strengthen State Departments Of Education
- Title VI – General Provisions

2010

- Title I – Improving Basic Programs Operated by State and Local Education Agencies
- Title II – Preparing, Training, and Recruiting High-Quality Teachers, Principals, or Other School Leaders
- Title III – Language Instruction for English Learners and Immigrant Students
- Title IV – 21st-Century Schools
- Title V – State Innovation and Local Flexibility
- Title VI – Indian, Native Hawaiian, and Alaska Native Education
- Title VII – Impact Aid
- Title VIII – General Provisions
- Title IX – Education for the Homeless and Other Laws

DWIGHT D EISENHOWER PROFESSIONAL DEVELOPMENT PROGRAM

- Launched in 1985, first authorized in 1984 under Title II of the **Education for Economic Security Act**
- Reauthorized as Eisenhower ***Mathematics and Science Education*** Program in Title II, Part A, of ESEA in 1988
- Reauthorized as Eisenhower ***Professional Development*** Program under Title II, Part B, of ESEA in 1994

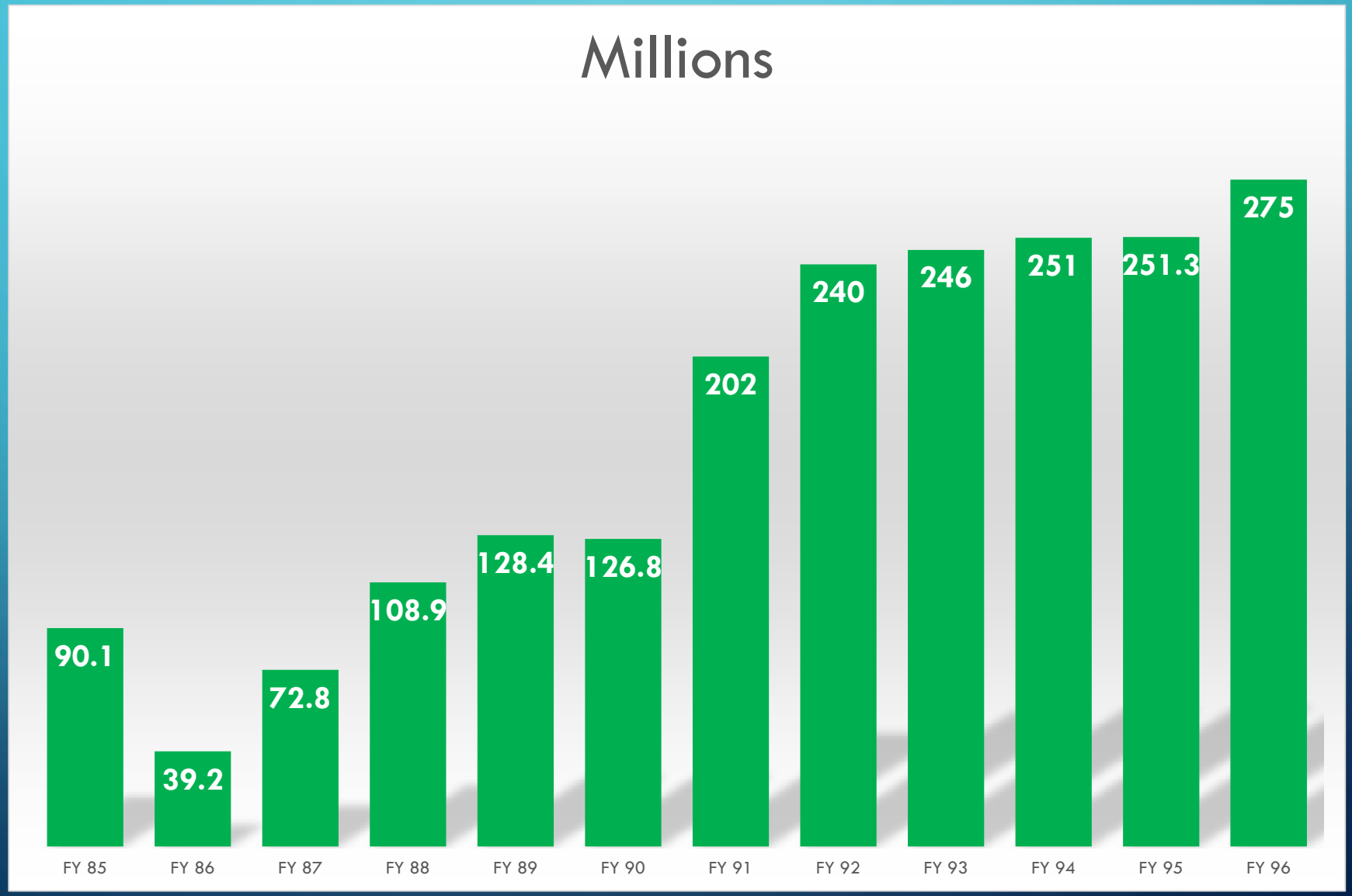
GOALS OF EISENHOWER PROGRAM 1988

- Support sustained and intensive high-quality professional development
- Ensure that all teachers will provide challenging learning experiences for their students in K-12
- Focus attention on meeting the educational needs of diverse student populations, including at risk students (females, minorities, individuals with disabilities, individuals with limited English proficiency, and economically disadvantaged individuals)

DRAMATIC CHANGES IN 1994

- High quality PD as part of ***comprehensive planning*** by states and local districts to provide to all students the opportunity to meet challenging state content and student performance standards in the core academic subjects.
- Encouraged ***coordination of activities*** with other PD activities, Goals 2000, Title I, other ESEA programs, and other federal and state programs.
- Expanded the program to ***all core subjects*** in context of introduction and implementation of state content and performance standards.
- Required state and local shares of the ***first $250 million*** in appropriated funds be devoted to professional development.
  - In practice, some states and districts requested waivers of that requirement

EISENHOWER APPROPRIATIONS
FY 85 – FY 96



EVALUATION OF EISENHOWER PD PROGRAM: NOT A STRONG ENDORSEMENT

- Most Eisenhower supported activities are traditional—workshops, conferences, courses—rather than reform (study groups, mentoring, networks)
- District-run PD using Eisenhower money usually last about 25 hours, in contrast to IHE-run PD which last about 51 hours
- Few Eisenhower activities emphasize the collective participation of teachers from the same department, grade level, or school
- Enormous variability between the Eisenhower programs

Source: Garet, M; Birman, B; Porter, A; Desimone, L; Herman, R
"Designing Effective Professional Development: Lessons from the Eisenhower Program"; American Institutes for Research, 1999.

NCLB (2002)	ESSA (2010)
Title II Part A	**Title II Part A**
All teachers highly qualified by June '06 • Combined Eisenhower PD and Class reduction size, allow more activities • All interventions must be scientifically-based • Alignment with state standards	• *Equitable* distribution of teachers • PD includes principals, librarians, paraprofessionals • Job-embedded, evidence-based PD • *New* STEM Master Teachers Corps to train, recruit, and retain teachers • Funding weighs poverty over population
Title II Part B	**Title II Part B**
Math and Science Partnerships • Competitive grants for PD, recruitment and curriculum redesign • PD as career-long process • Alignment with state standards	National Activities

"Being an NCTM member has different kinds of value. There are the tangible benefits you receive and the products you value—like the journals you get with your membership and the discounts available to you on NCTM books and conferences. But there are also the ancillary benefits—less tangible but still very real—that you receive from NCTM's work on behalf of the profession."

"The Council has gone from being unknown, ignored, and excluded to being an organization of influence. It's now a trusted resource for legislators and policymakers and widely consulted as an authoritative voice on issues related to mathematics education and STEM learning."

"A Learning Organization for the 21st Century"

Matt Larson, NCTM President's Message

WHAT HAVE WE LEARNED?

- Wonderful to have an influential champion but very difficult to identify and nurture, but champion has his/her own reasons for rallying around mathematics
- Don't set up false dichotomy—"Make Mathematics First" is swimming up stream
- Empower yourself and make yourself heard

QUESTIONS?

CURRICULUM

z-usiskin@uchicago.edu

ASSESSMENT

djbriars@comcast.net

POLICY

lrosen2@gmail.com