


*MATHEMATICS: A CASE
STUDY*



Administrative Committee on
Academic Affairs
October 16, 2001

Adapted from presentation at Summer Institutes, July 2001, NASH/Education Trust

A NATION AT RISK



“WE ARE AT RISK OF BECOMING
A NATION DIVIDED BOTH
ECONOMICALLY AND RACIALLY
BY KNOWLEDGE OF
MATHEMATICS.”

Source: National Research Council, Everybody Counts: A Report to the Nation on the Future of Mathematics Education, National Academy Press: Washington, D.C., 1989.

“By the year 2000, United States students will be first in the world in mathematics and science achievement.”



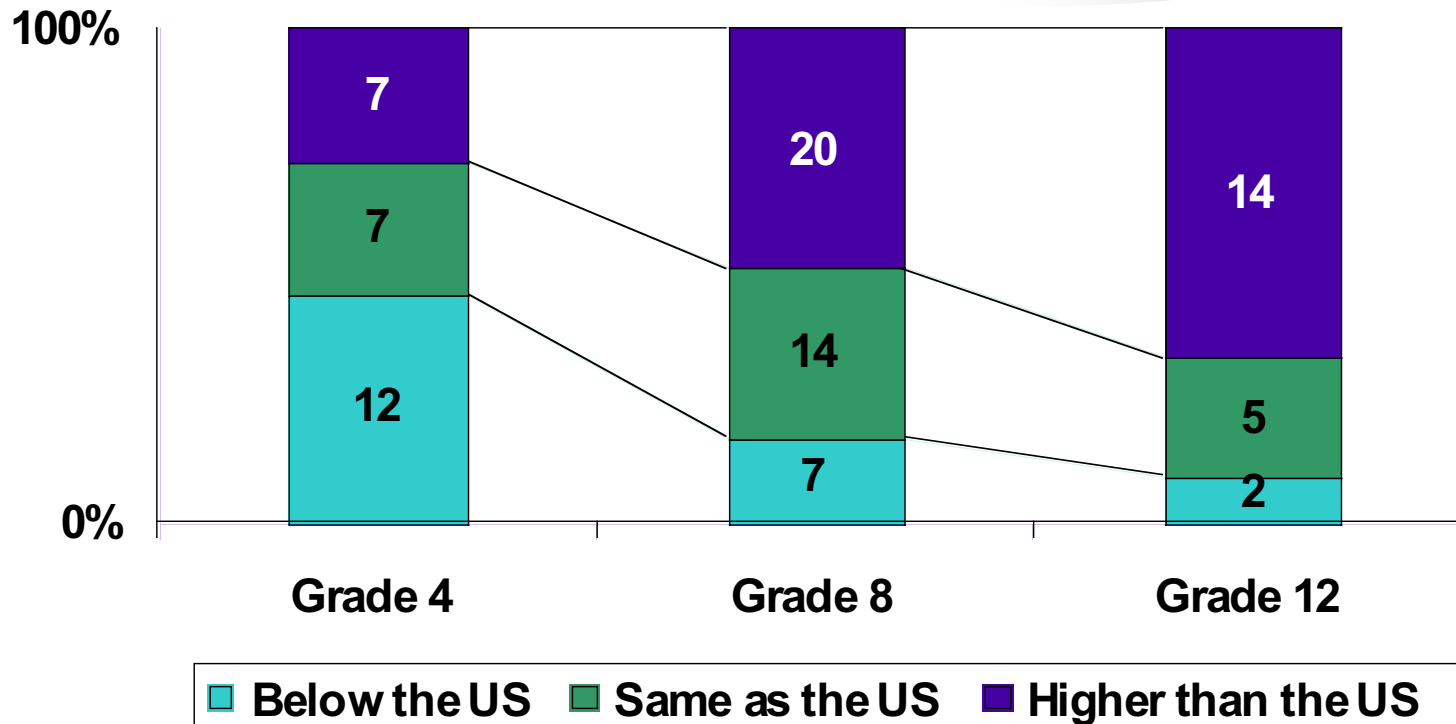
--National Education Goal #5



***ACHIEVEMENT IN
K-12***

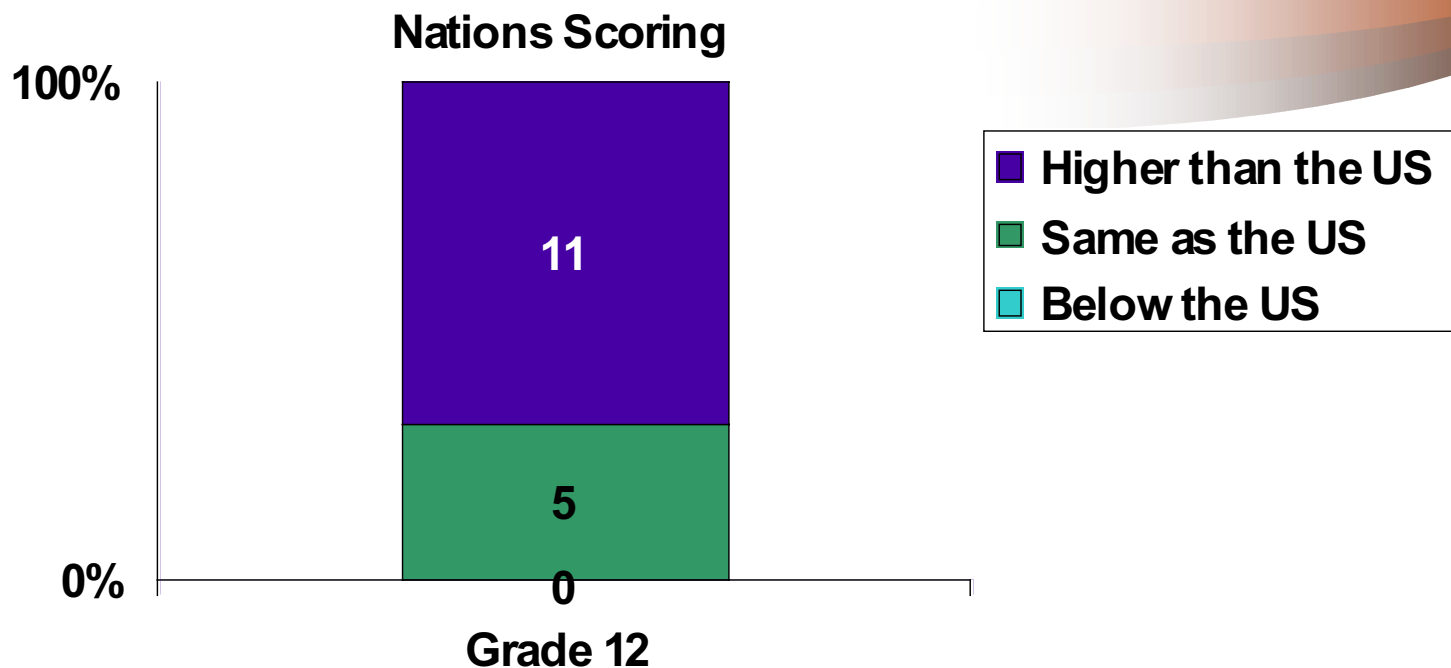
Nations' Average Mathematics Performance Compared With the US

Nations Scoring



Source: NCES 1999-081R, *Highlights From TIMSS*

Average Advanced Mathematics Performance of Advanced Mathematics Students in All Countries



***U.S. students with pre-calculus, calculus, analytic geometry or AP calculus instruction, representing about 14% of the U.S. cohort. Of the higher-performing countries, all but four include more of their age cohort in this category.**

Source: NCES, TIMSS, Pursuing Excellence: A Study of U.S. Twelfth-Grade Mathematics and Science Achievement in International Context, 1999.



*ACHIEVEMENT IN
HIGHER EDUCATION*

Many College Graduates Demonstrate Weak Quantitative Literacy Skills

	Grads: 2 Yr. Colleges	Grads: 4 Yr. Colleges
Level 5: High	5	13
Level 4	30	40
Level 3	44	40
Level 2	17	10
Level 1: Low	4	3

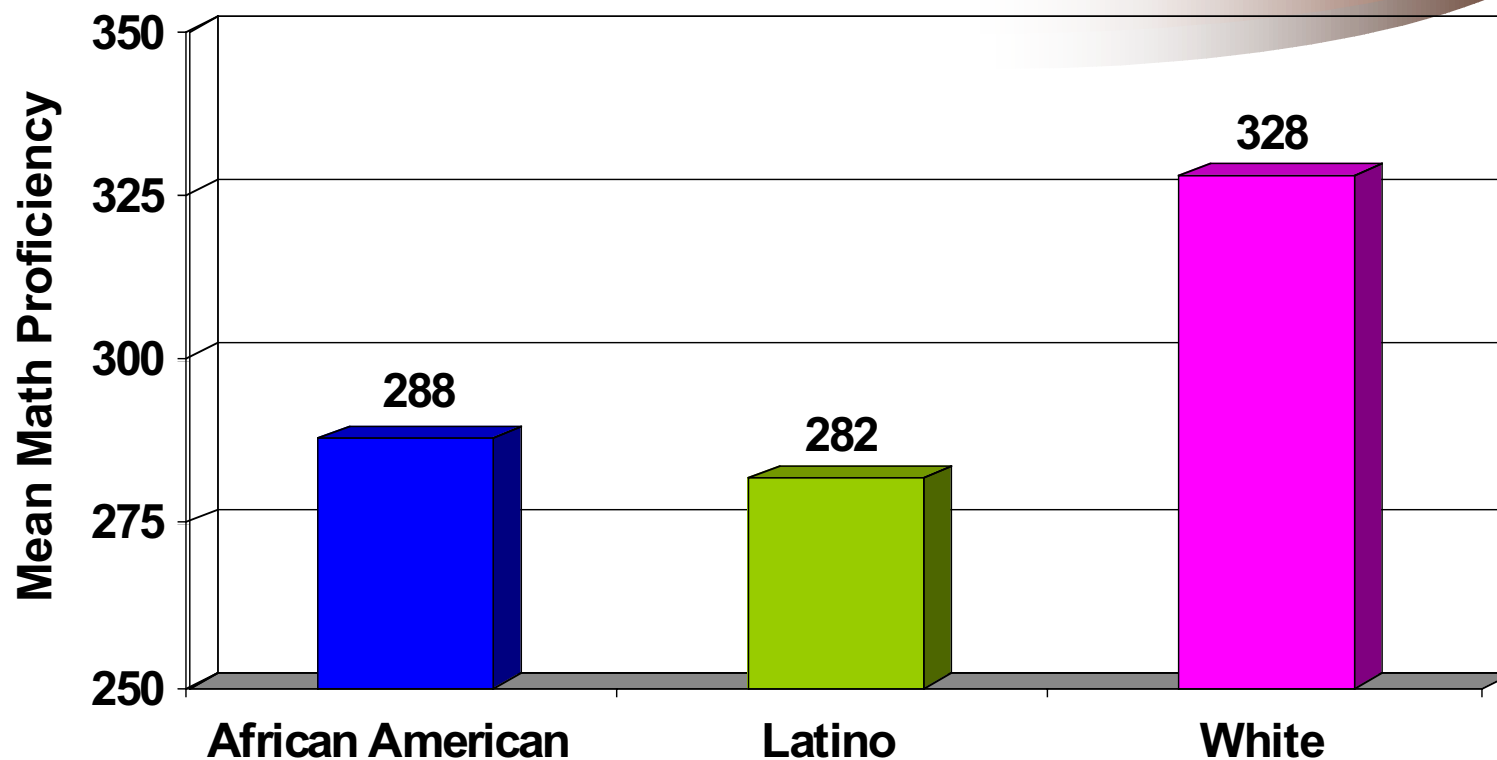
Source: USDOE, NCES, National Adult Literacy Survey, 1992, in Literacy in the Labor Force: Results from the NALS, September 1999, p. 61.

Description: Quantitative Literacy Level 3



- **CAN** Determine correct change using information on a menu
- **CAN** Use information stated in news article to calculate amount of money it takes to raise a child
- **CAN'T** Determine shipping and total costs on an order form for items in a catalog
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Math Proficiency Gaps Persist: College Graduates



Source: US Department of Education, National Center for Education Statistics. *Adult Literacy in America*. (p. 36)
Washington, DC: US Department of Education, 1992.

*“Mathematics and science education
will be strengthened throughout the
system, especially in the early
grades.”*



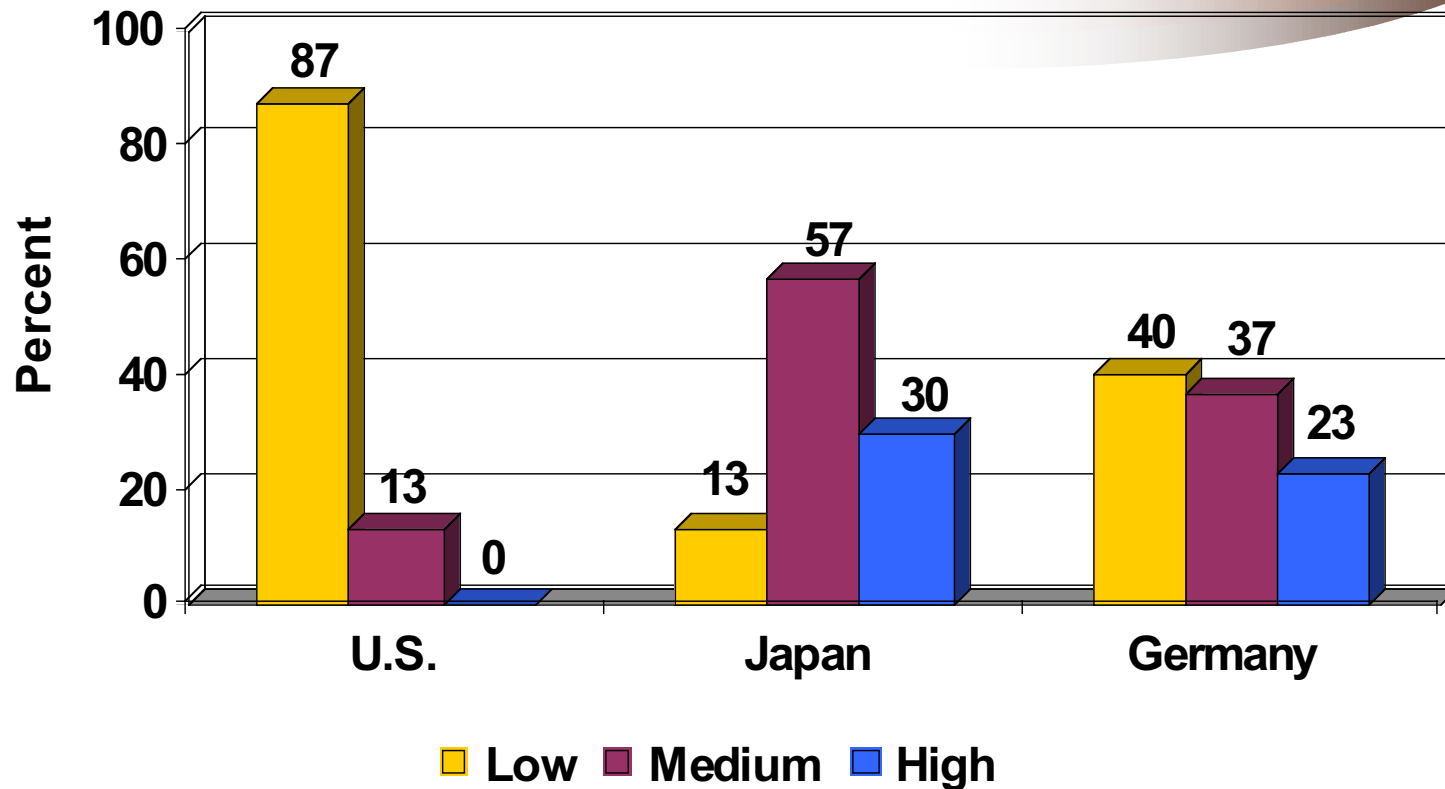
--National Education Goal #5, Objective 1



CURRICULUM:

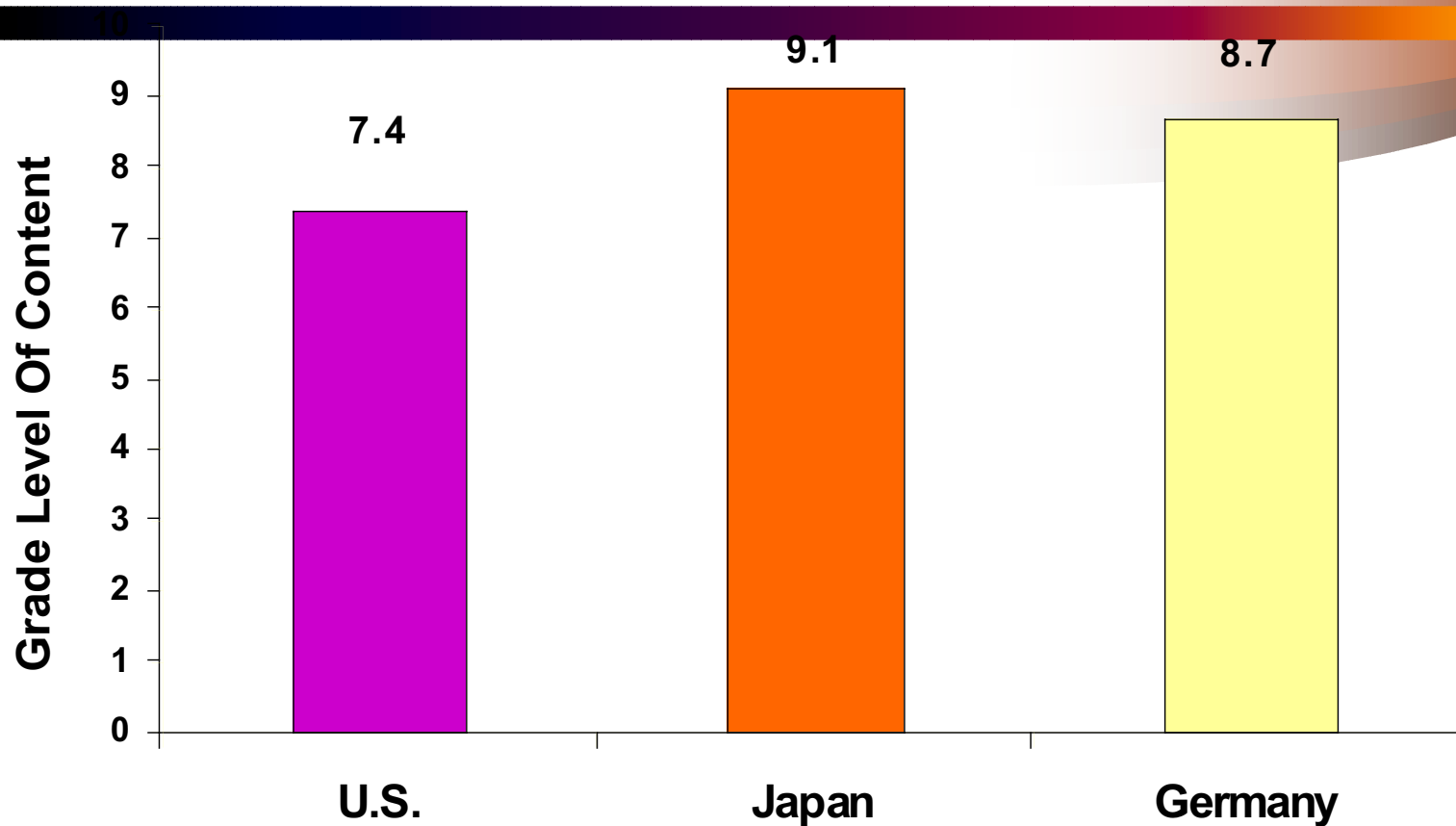
K-12

Quality of Mathematical Content of 8th Grade Lessons



Source: TIMSS : unpublished tabulations, Videotape Classroom Study, UCLA, 1996, in Pursuing Excellence: A Study of US Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum and Achievement in International Context, 1997.

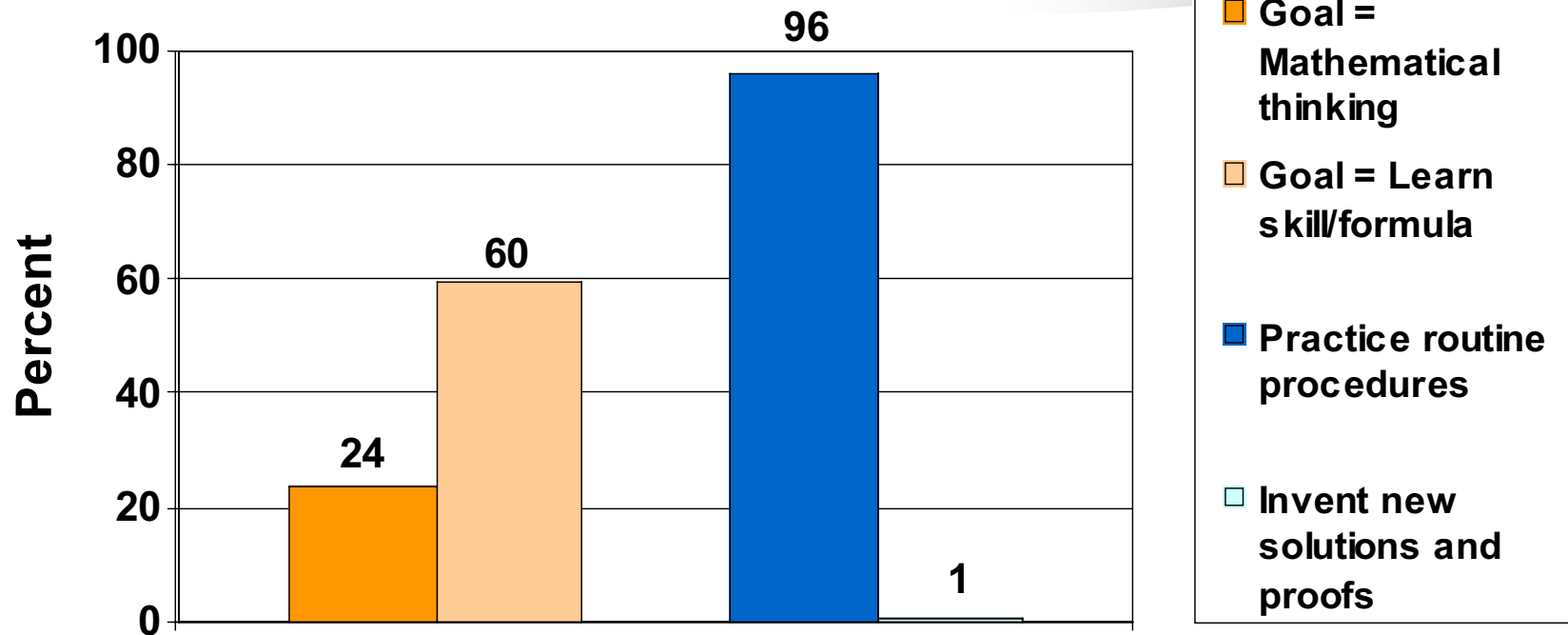
Average Grade Level of Content in 8th Grade Lessons, by International Standards



Source: NCES, "Pursuing Excellence: A Study of U.S. Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum, and Achievement in International Context", 1997.

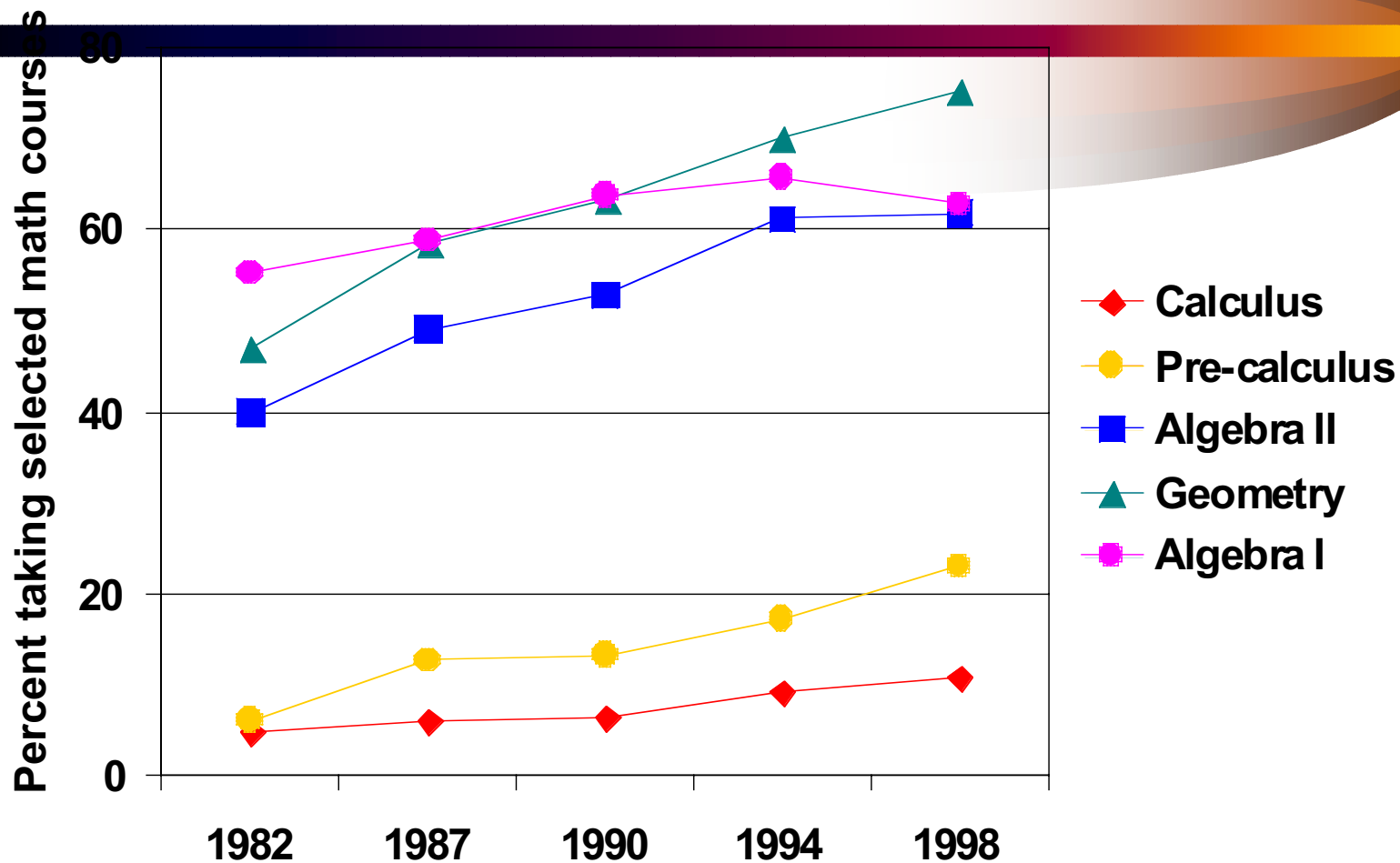
Math Emphasis Favor Skills Over Understanding

United States 8th Grade Math Teachers



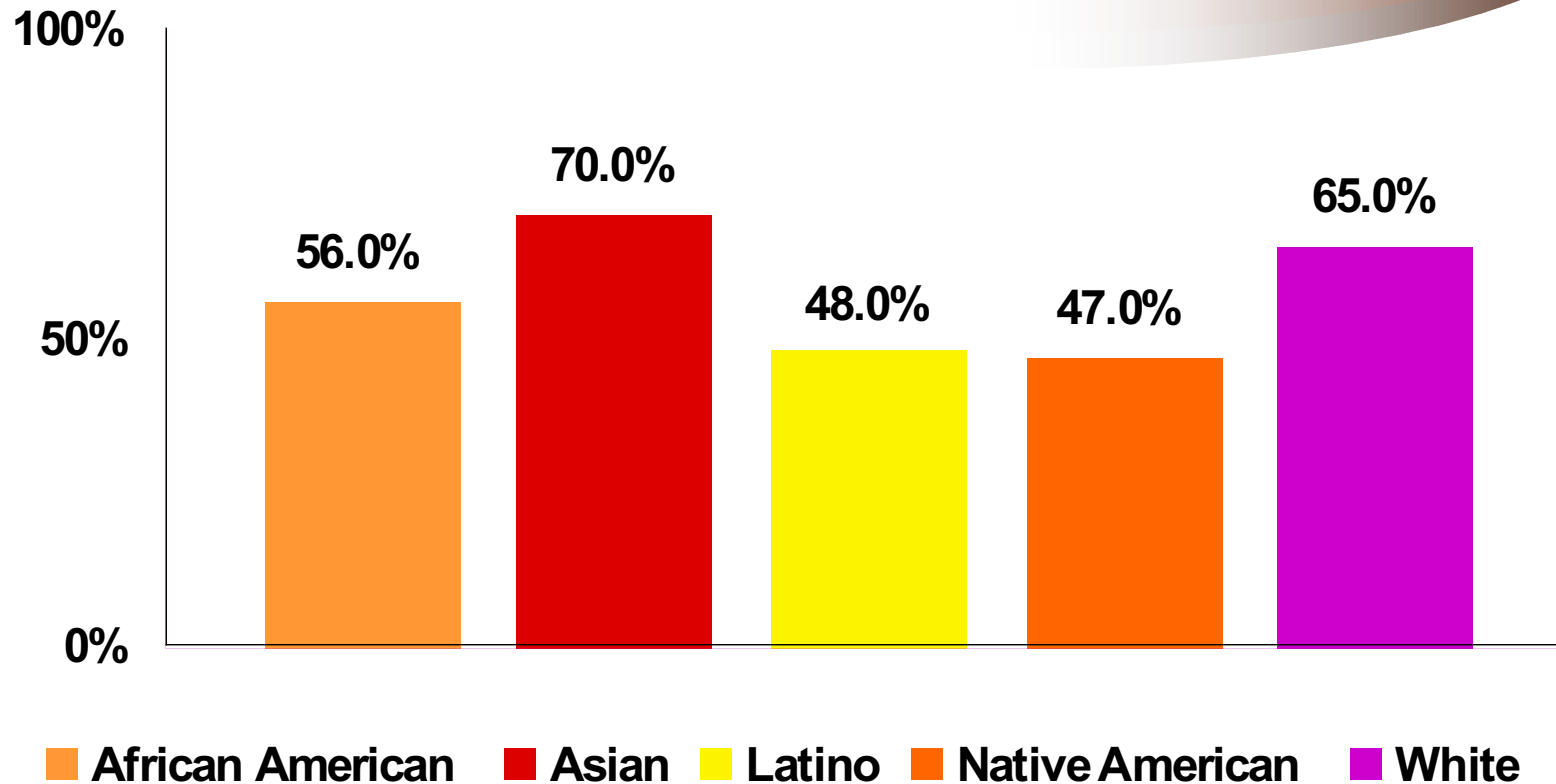
Source: Pursuing Excellence: A Study of US Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum and Achievement in International Context, 1997.

High School Graduates Taking More Mathematics



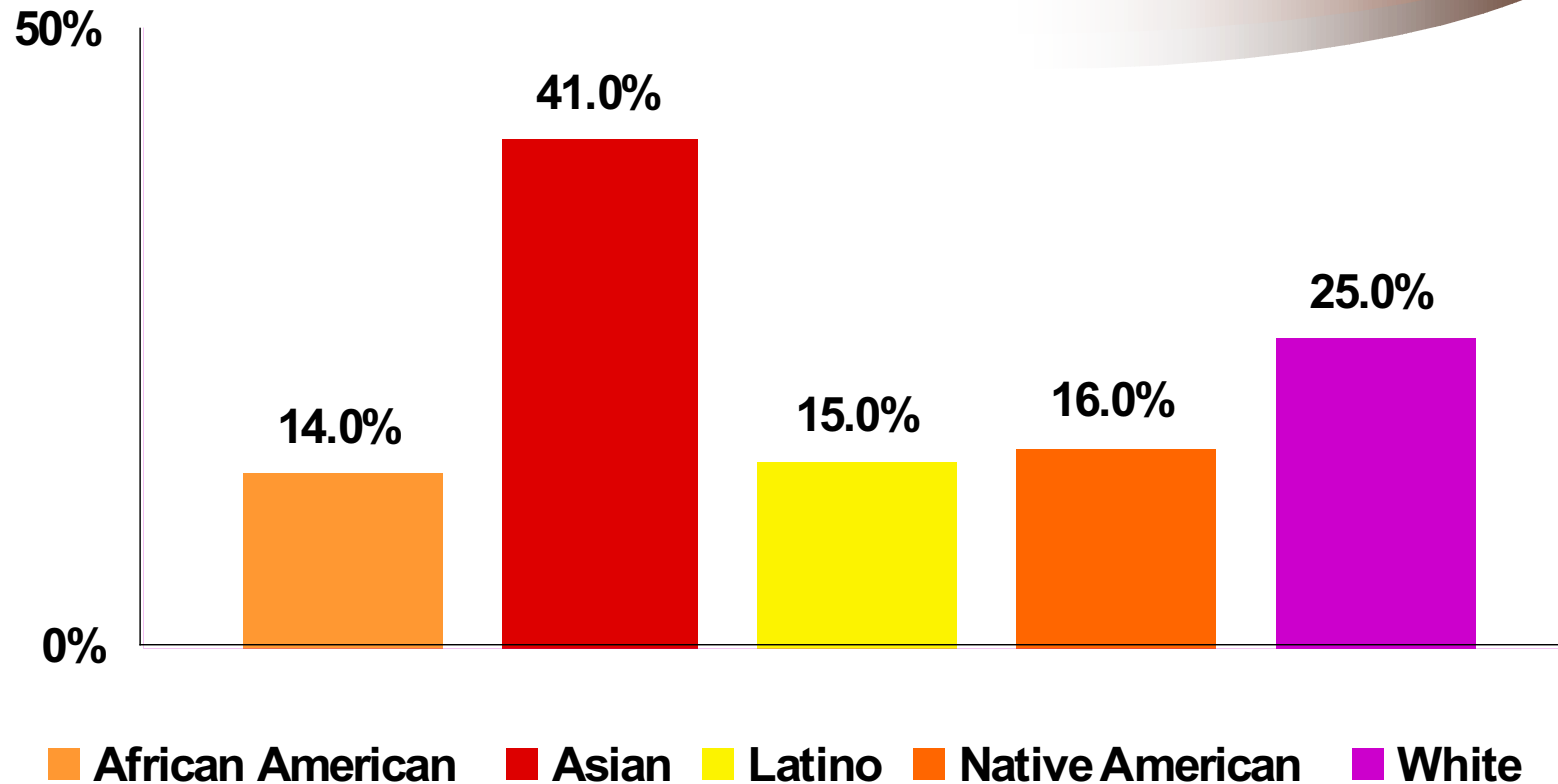
Source: HS&B, HSTS, NELS data, in NCES Digest of Education Statistics, 2000, Table 140.

Percentage of High School Graduates Completing Algebra II, 1998



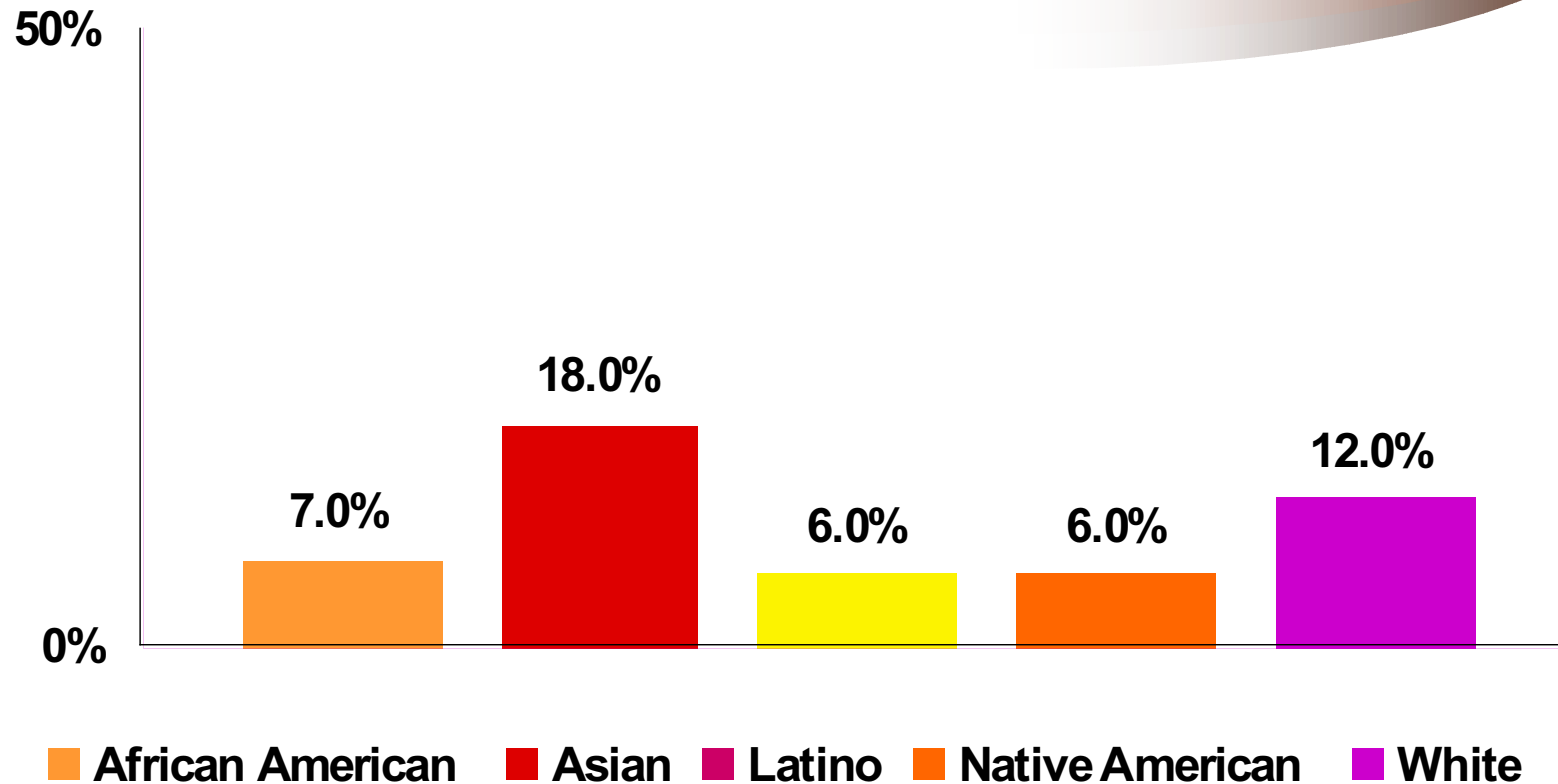
Source: HS&B, HSTS, NELS data, in NCES, Digest of Education Statistics, 2000.

Percentage of High School Graduates Completing Pre-calculus, 1998



Source: HS&B, HSTS, NELS data, in NCES, Digest of Education Statistics, 2000.

Percentage of High School Graduates Completing Calculus, 1998





***CURRICULUM:
Higher Education***


UNDERGRADUATE MATHEMATICS COURSE ENROLLMENT



- ✓ ENROLLMENTS IN MATHEMATICAL SCIENCES COURSES HAVE DOUBLED IN THE LAST 20 YEARS, BUT THE INCREASES HAVE ALL BEEN AT THE LOWER LEVELS, WITH REMEDIAL ENROLLMENTS LEADING THE WAY.

Committee on the Mathematical Sciences in the Year 2000, A Challenge of Numbers: People in the Mathematical Sciences. National Academy Press: Washington, D.C., 1990.


Many Freshmen Must Take Remedial Math Courses, 1995



All institutions	24%
Public 2 year	34%
Public 4 year	18%
High Minority Enrollment	35%
Low Minority Enrollment	21%

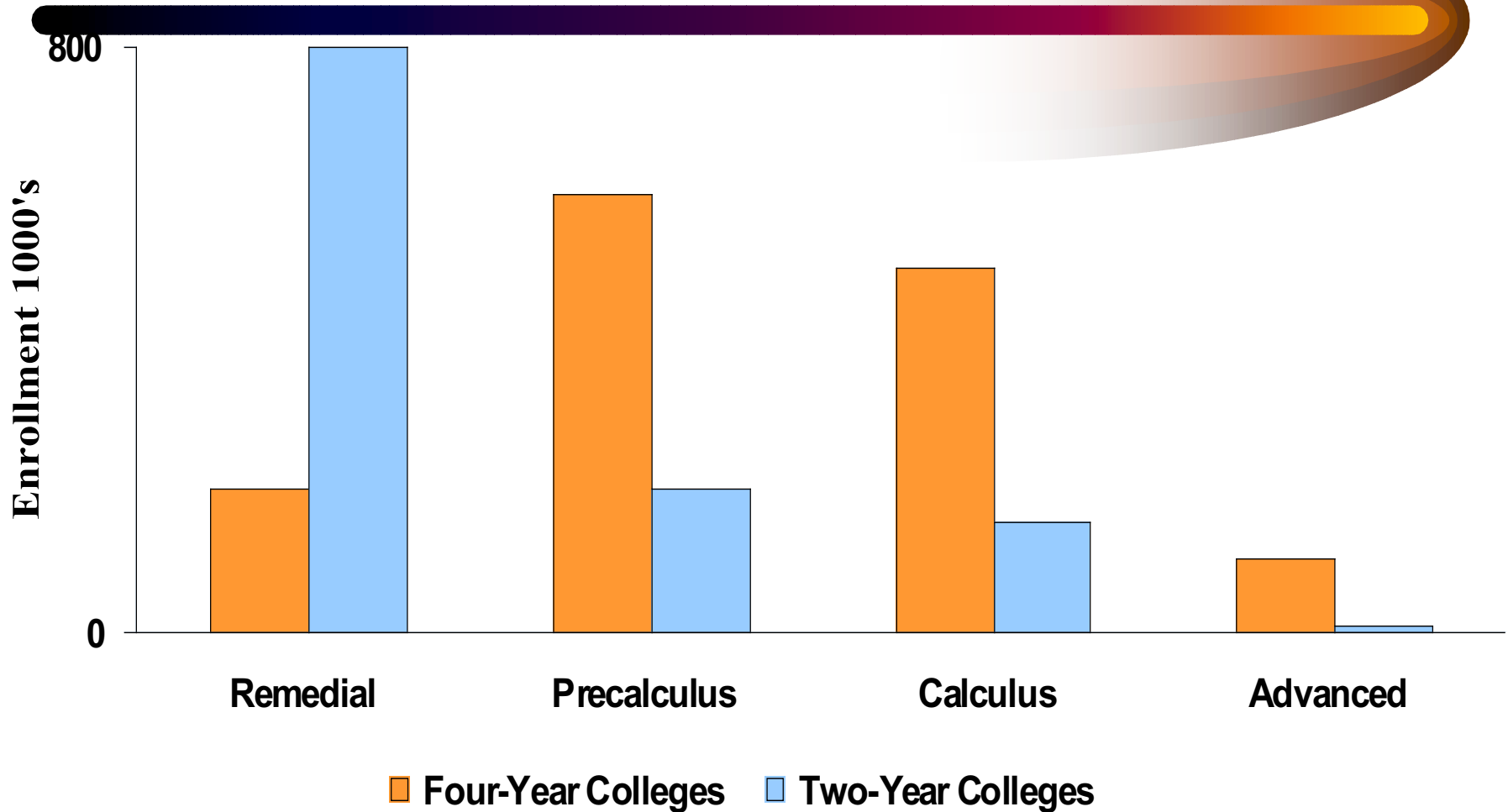
Source: USDOE, NCES, PEQUIS, Remedial Education at Higher Education Institutions in fall 1995 (1996), in *The Condition of Education 1999*, p. 88

COLLEGE MATHEMATICS ENROLLMENT



- ✓ Two thirds of all college mathematics enrollments are below the level of calculus.
- ✓ 96% of all college mathematics enrollments are in courses also taught in High School.
- ✓ In America today, the profile of mathematics in higher education is not that much different from that of mathematics in high school.

1995 FALL ENROLLMENT IN MATHEMATICS COURSES



Source:

“The number of teachers with a substantive background in math and science will increase by 50%”



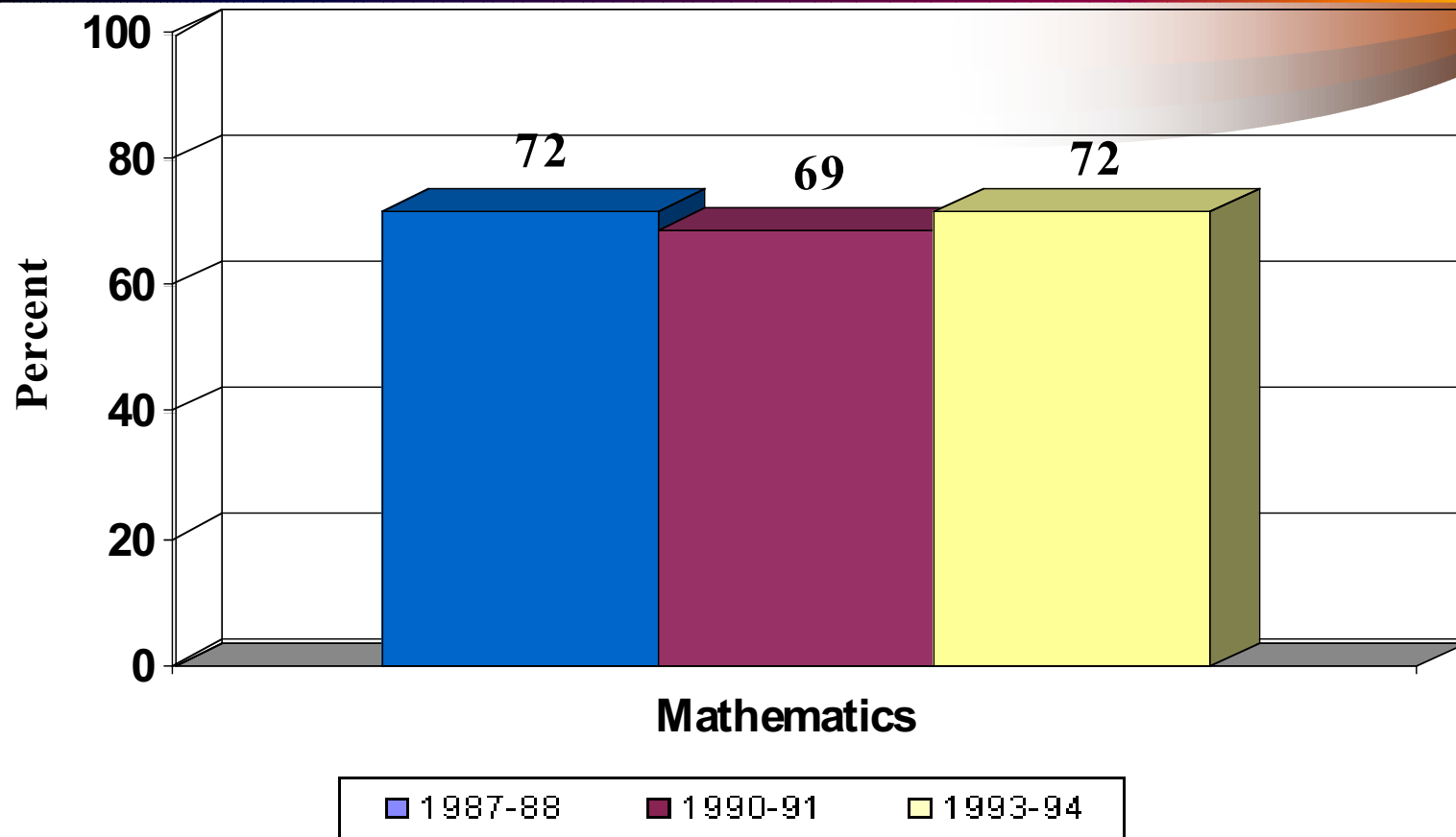
--National Education Goal #5, Objective 2



TEACHERS: K-12

How Far Have We Come?

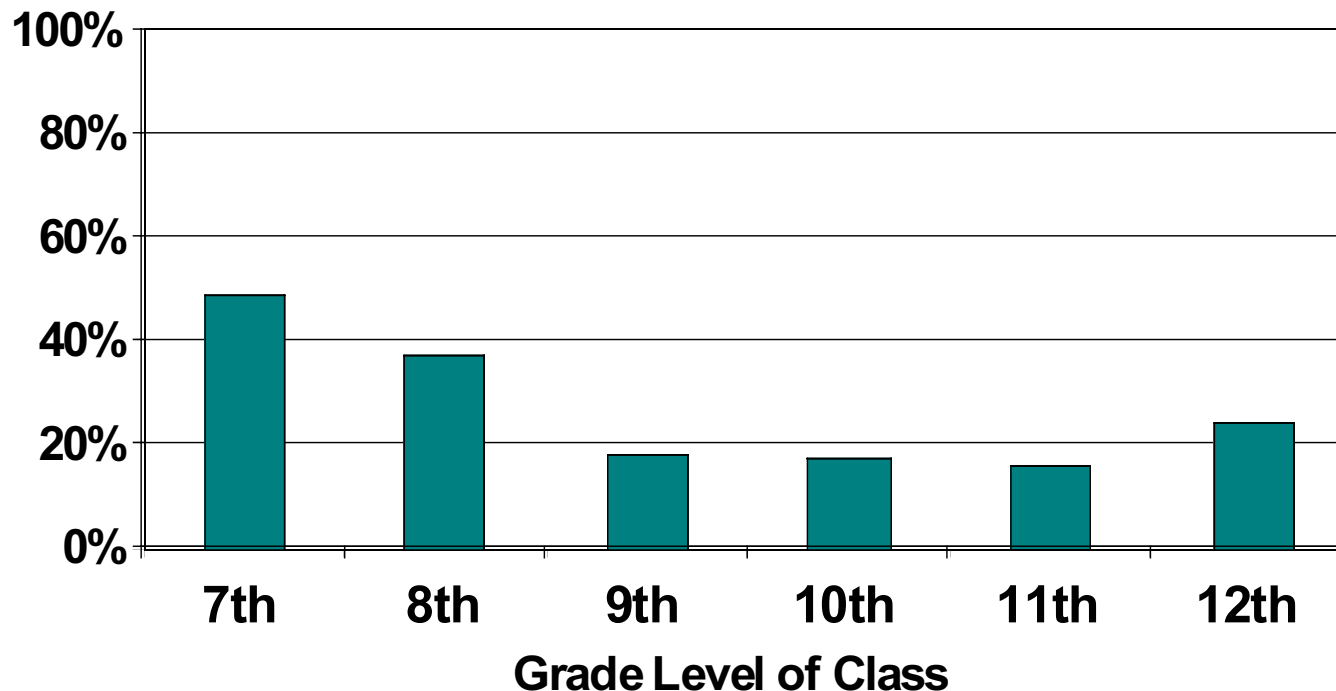
*Percentage Public High School Math Teachers With
a Major or Minor in Field*



Source: Richard M. Ingersoll, "The Problem of Underqualified Teachers in American Secondary Schools," *Educational Researcher*, Vol. 28, Number 2, March 1999

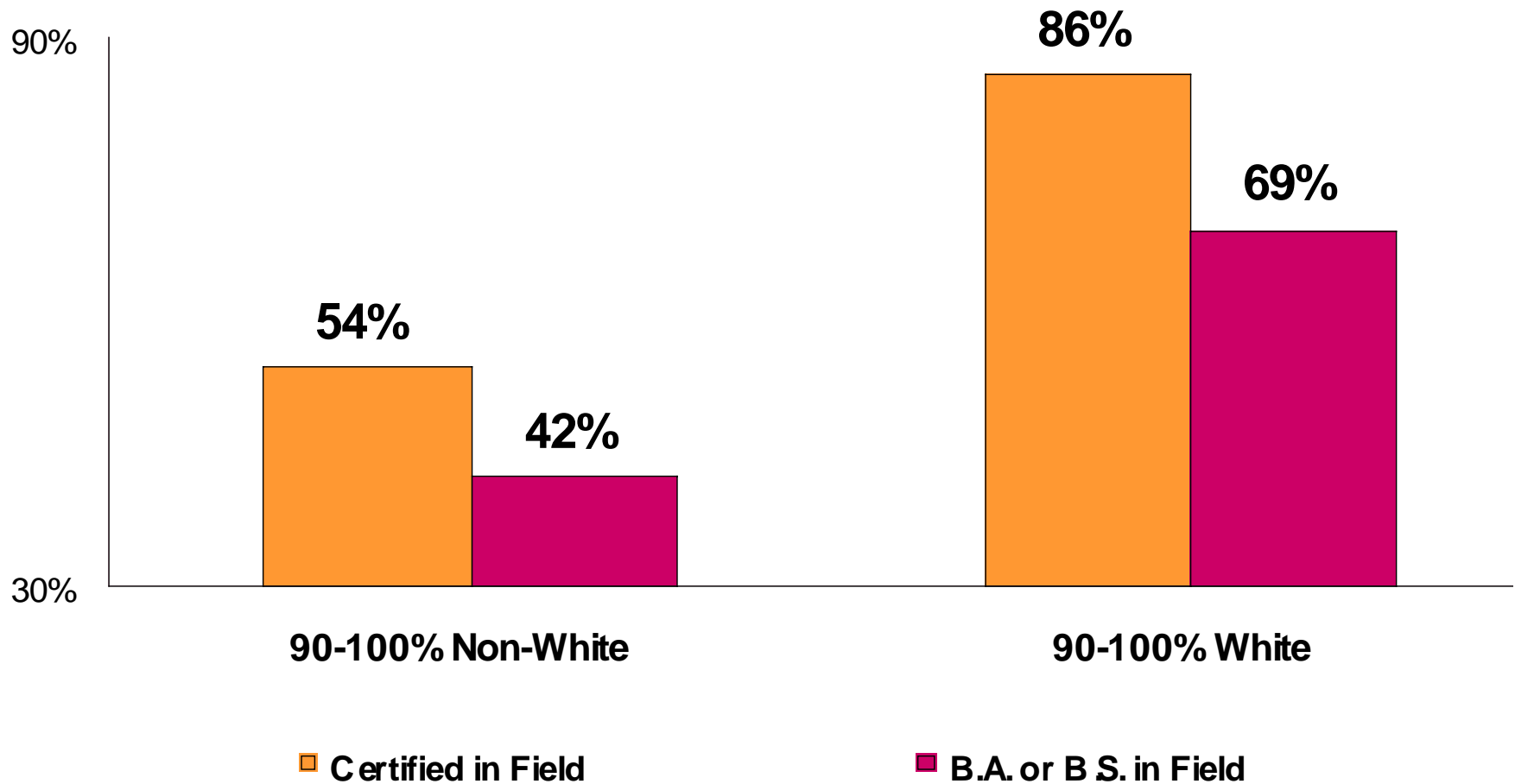
Middle School Math Students Most Likely to have Underqualified Teachers

Percent of public secondary students taught by teachers without major or minor in math



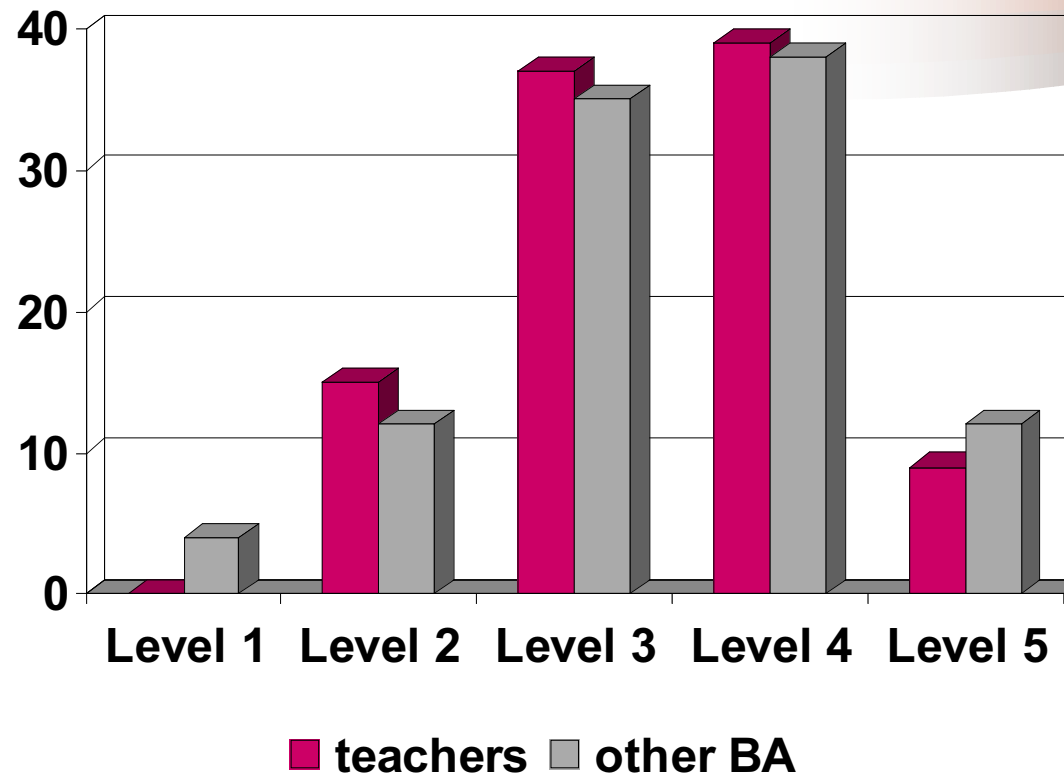
Source: Richard M. Ingersoll, "The Problem of Underqualified Teachers in American Secondary Schools," *Educational Researcher*, Vol. 28, Number 2, March 1999

Math & Science Classes With a High Percentage of Minority Students Are More Often Taught by Underqualified Teachers



Source: Jeannie Oakes. *Multiplying Inequalities: The Effects of Race, Social Class, and Tracking on Opportunities to Learn Mathematics and Science* (Rand: 1990)

Math Literacy of Teachers Versus Other BAs



Source: ETS, Barbara A. Bruschi and Richard J. Coley, “How Teachers Compare: The Prose, Document and Quantitative Skills of America’s Teachers”, Princeton, NJ, 1999, p. 6.

Description: Quantitative Literacy Level 3

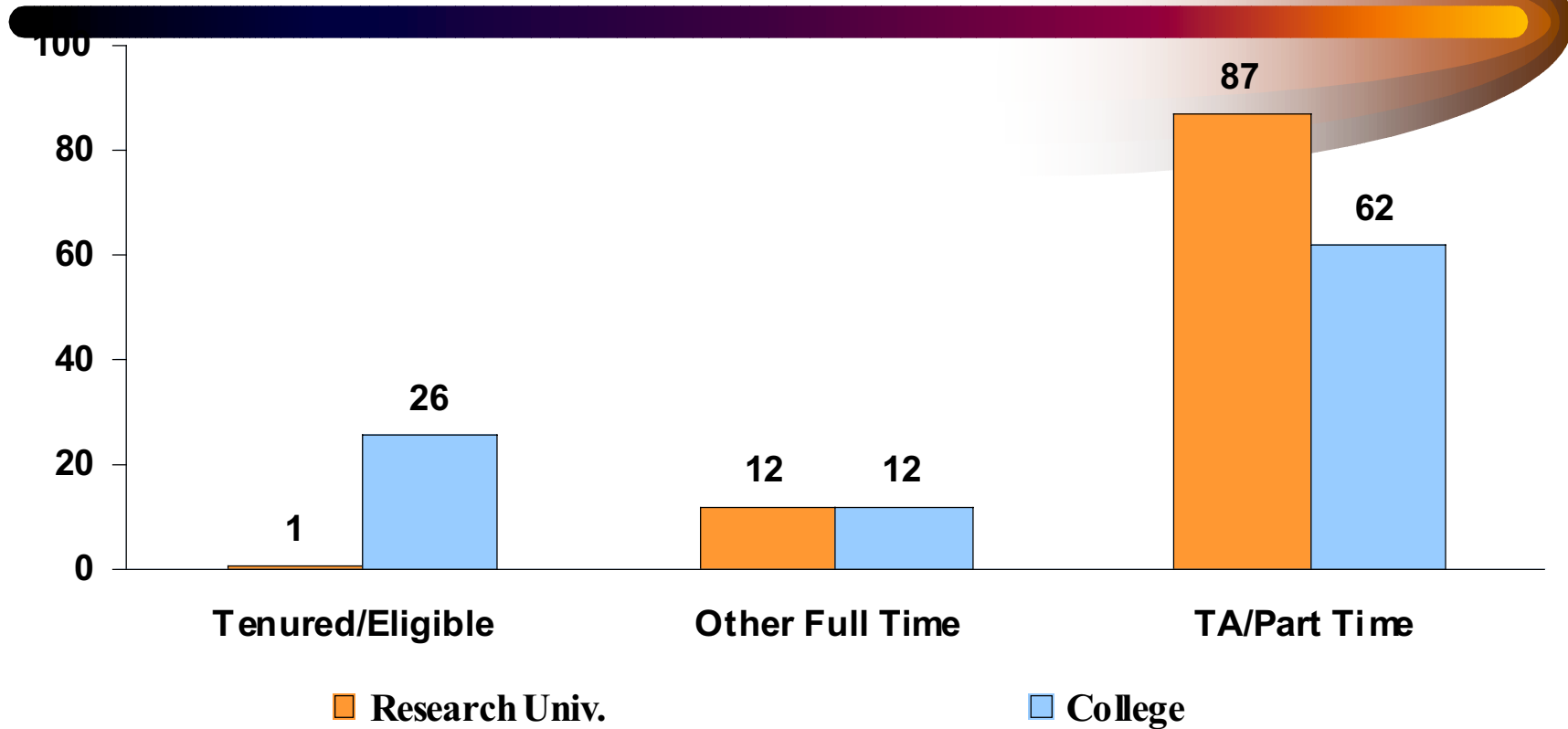


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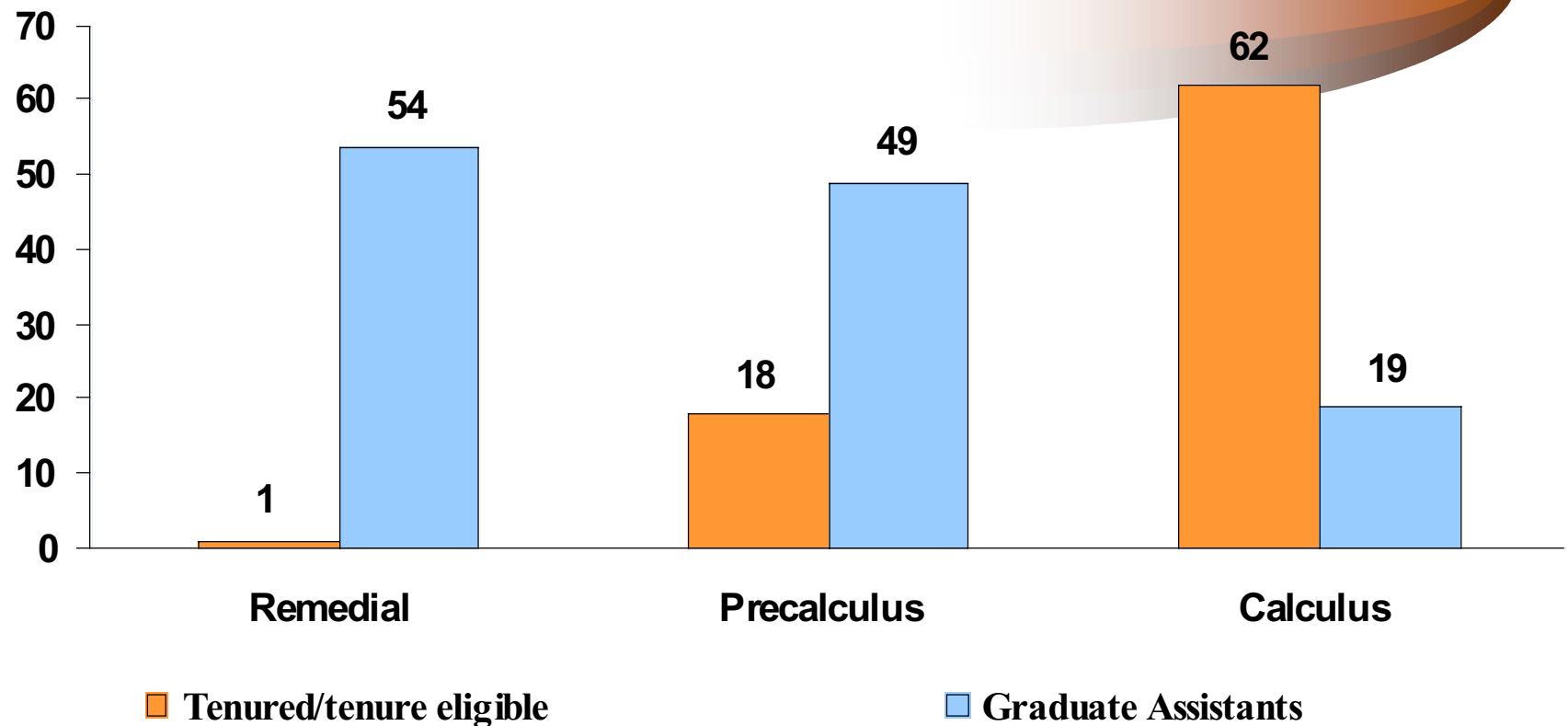
TEACHERS:
Higher Education

WHO IS TEACHING REMEDIAL MATHEMATICS?



Source: Fall 1995 Conference Board Mathematical Sciences Survey

WHO'S TEACHING FRESHMAN MATHEMATICS IN RESEARCH UNIVERSITIES?




Source: Fall 1995 Conference Board Mathematical Sciences Survey

GRADUATE TEACHING ASSISTANTS

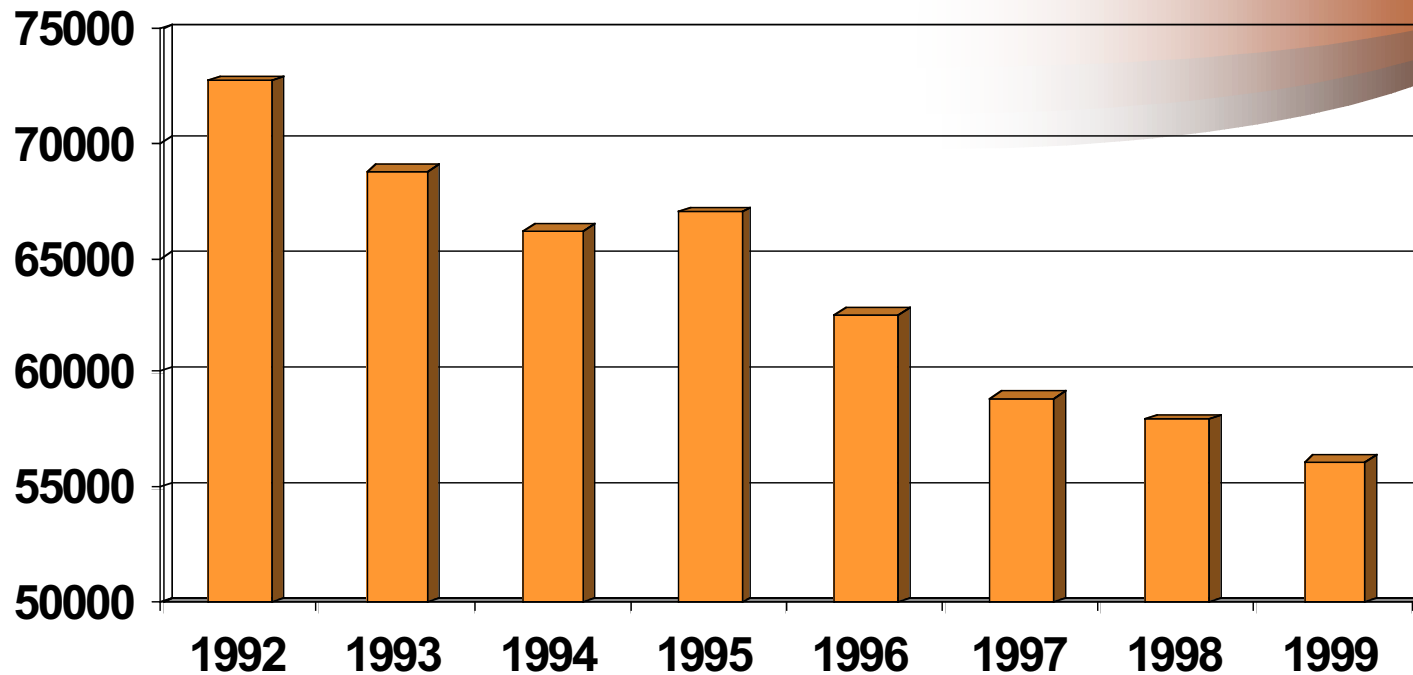
- Approximately half of the graduate mathematics students in the United States are nonresident foreigners.
- “Heavy reliance on the use of graduate teaching assistants, many of whom have limited experience or training for the responsibilities placed on them, has far-reaching consequences.”

“The number of U.S. undergraduate and graduate students, especially women and minorities, who complete degrees in mathematics, science, and engineering, will increase significantly.”



--National Education Goal #5, Objective 3

Junior/Senior Mathematical Sciences Majors Declining



72,000 >> 56,200 = -22%

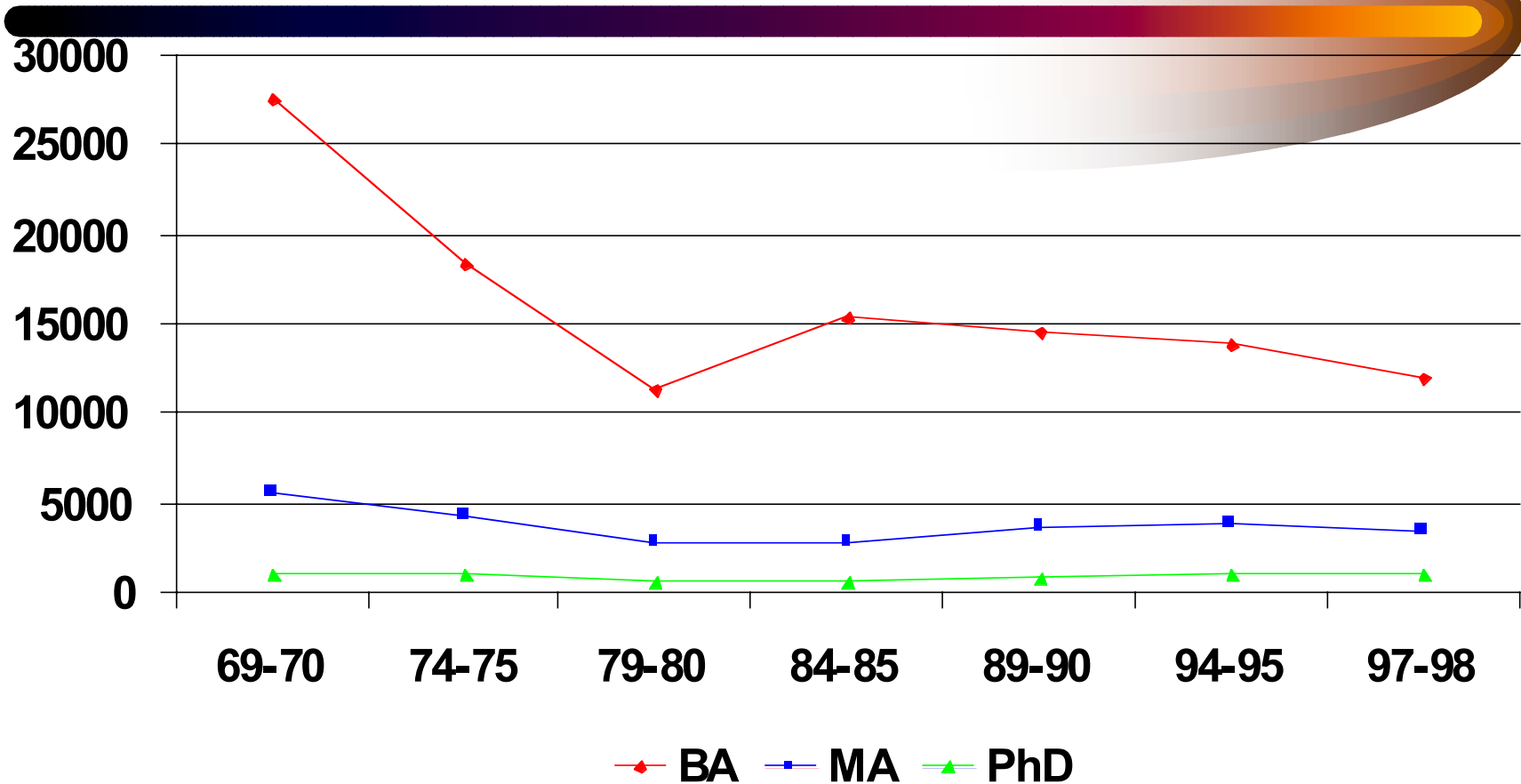
Source: 1999 Annual Survey of the Mathematical Sciences (Second Report), AMS, Vol. 47, Number 8.

Math Majors Declining

	1990-91	1997-98	Percent Change, 91-98
Bachelor's degrees awarded in mathematics	15,310	12,328	-19.5%
Percent of total bachelor's degrees awarded	1.4%	1.0%	-28.6%

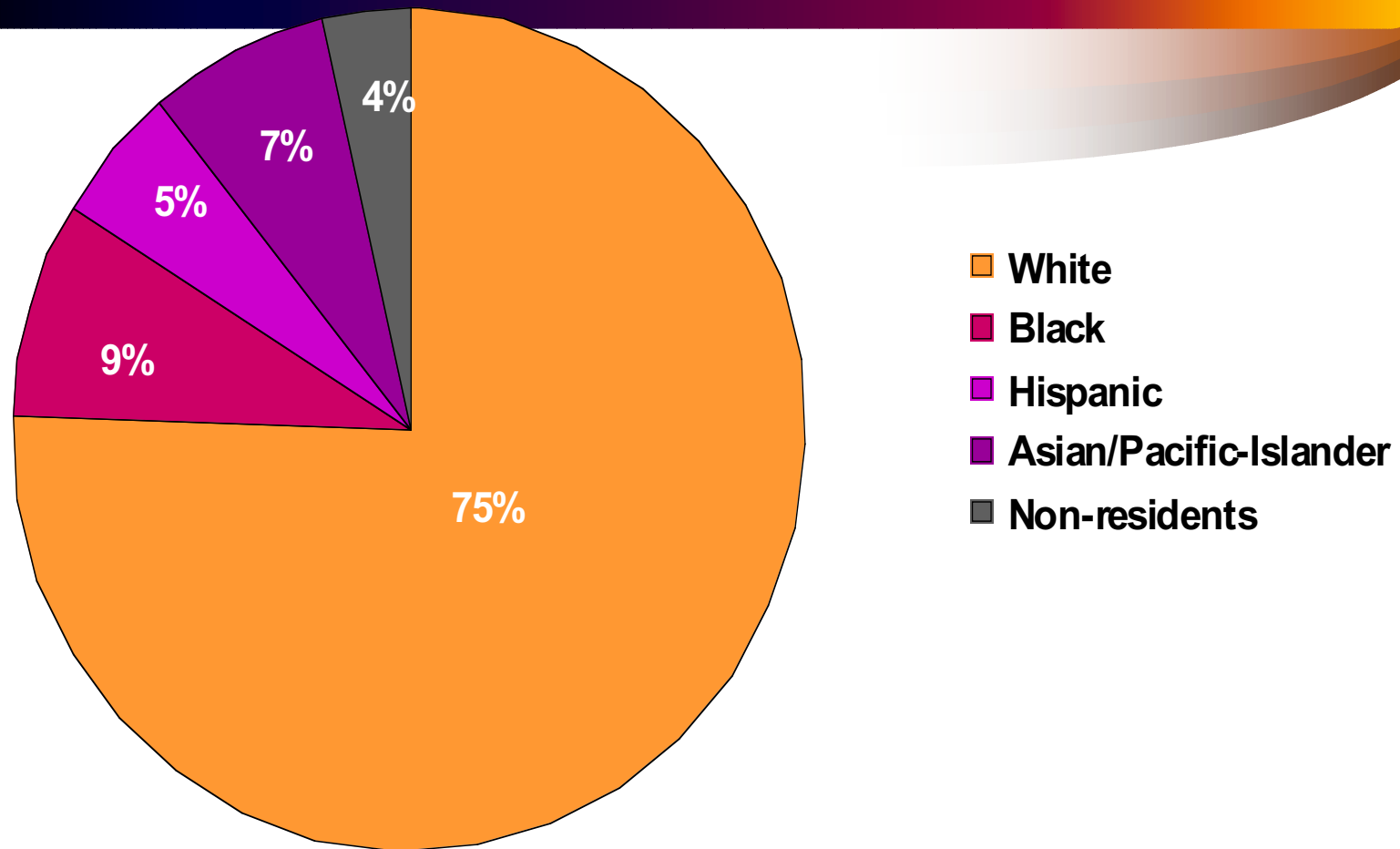
Source: HEGIS and IPEDS data, in NCES, Digest of Education Statistics, 2000.

Mathematics Degrees Awarded



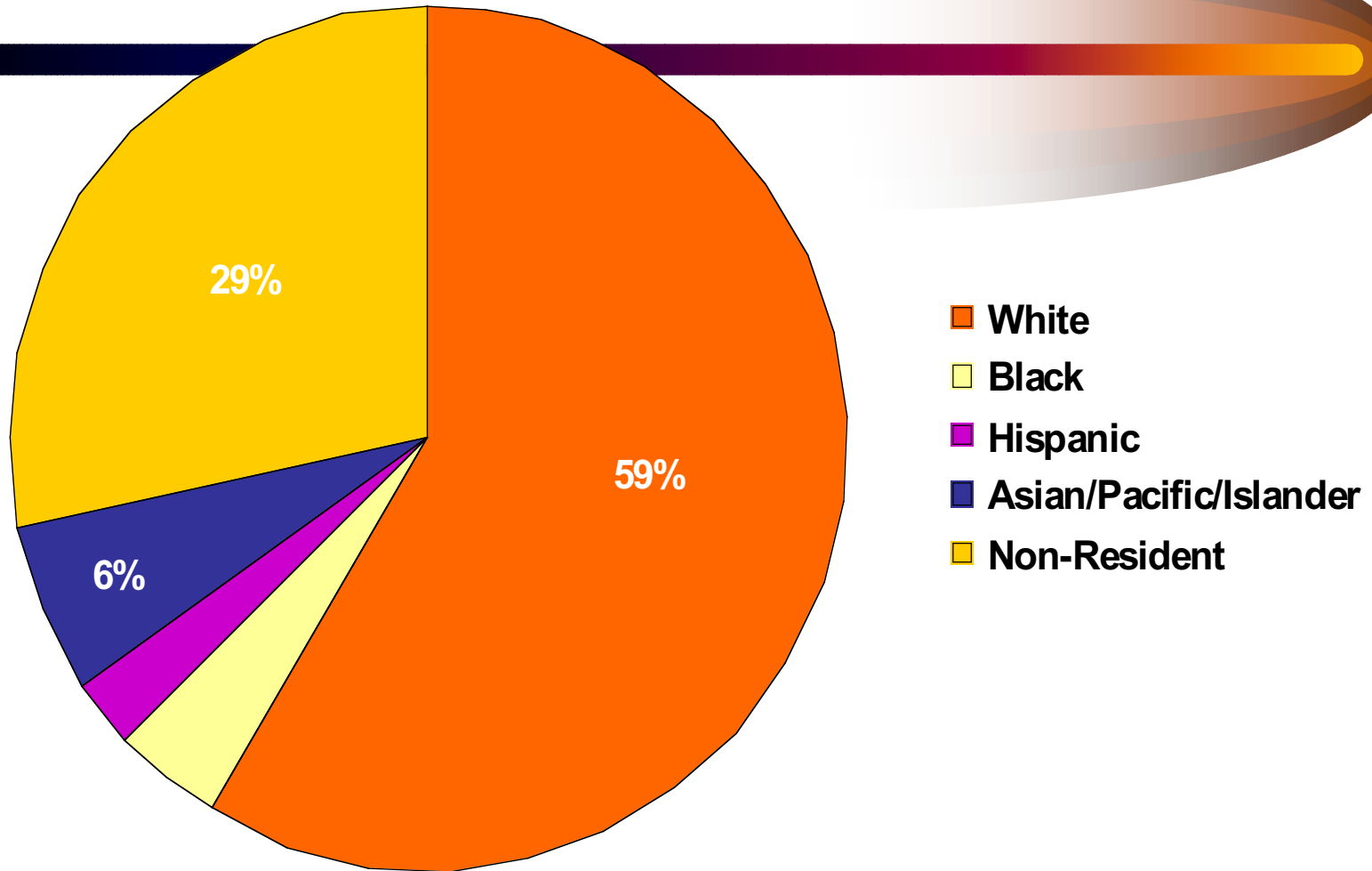
Source: Tabulated by NSF Division of Science Resource Studies; Data from NCES/IPEDS and NSF/SRS, in Science and Engineering Degrees: 1966-98.

1997-98 BACHELOR'S DEGREES AWARDED IN MATHEMATICS



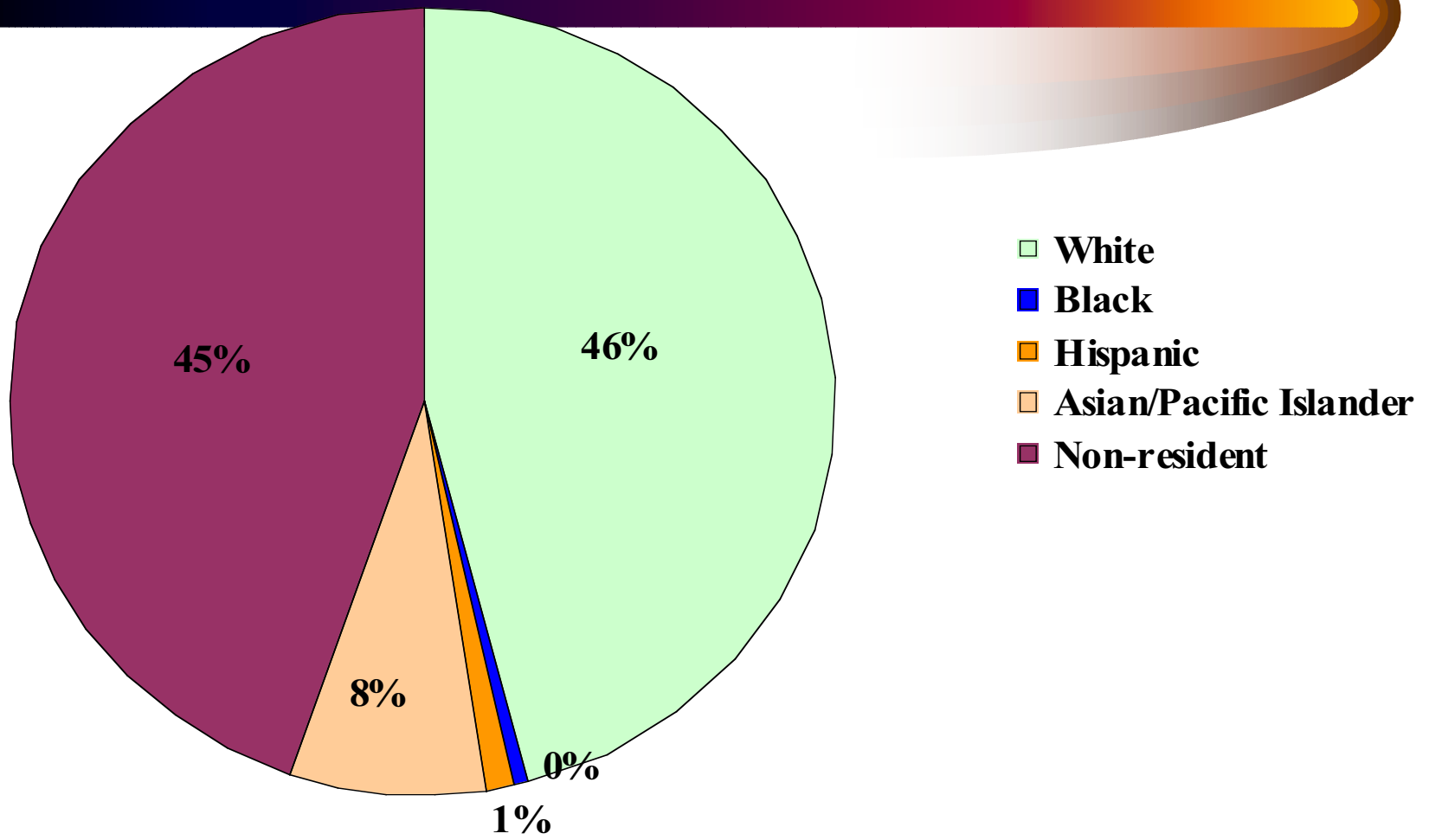
Source: NCES, Digest of Education Statistics, 2000.

1997-98 MASTER'S DEGREES AWARDED IN MATHEMATICS



Source: NCES, Digest of Education Statistics, 2000.

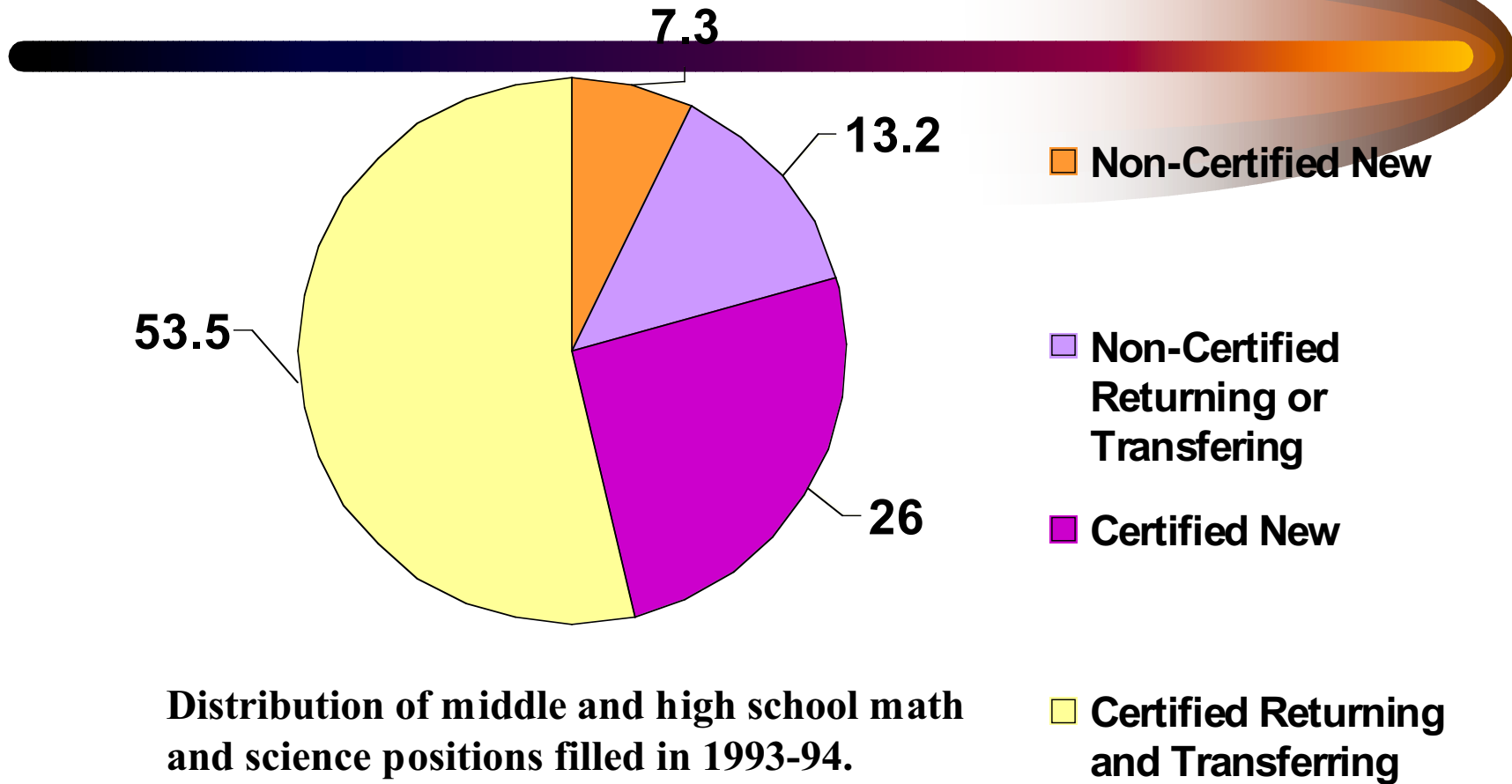
1994-95 DOCTORATES AWARDED IN MATHEMATICS





***MATH TEACHER
DEMAND***

Shortage of Certified and Fully Qualified Math Teachers



Distribution of middle and high school math and science positions filled in 1993-94.

Source: NCES, SASS data, in *Before It's Too Late: A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century*, 2000.

Demand is Far Outpacing Supply



- An estimated 240,000 middle and high school mathematics and science teachers will be needed over the next 10 years.
- Of this total, nearly 70% will be newcomers to the profession.

Source: *Before It's Too Late: A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century*, 2000.

MATH MAJORS IN THE WORKFORCE



- Mean Salary: \$50,902
- (30% above mean for all with BA only)
 - 15% employed in Education
 - 64% in for profit sector
 - 3% in non profit sector
 - 8% self employed
 - 10% government

Source: Andrew Sum, Northeastern University

SOME RECOMMENDATIONS FOR THE ROLE OF ARTS AND SCIENCE FACULTY IN MATHEMATICS



- College faculty must become actively involved in the education of teachers if the teaching of mathematics in the schools is to improve significantly.
- Colleges and universities should assign significantly higher priority to mathematics teacher education.
- All college and university faculty members who teach mathematics or mathematics education should maintain a vigorous dialogue with their colleagues in schools, seeking ways to collaborate in improving school mathematics programs and in supporting professional development of mathematics teachers.