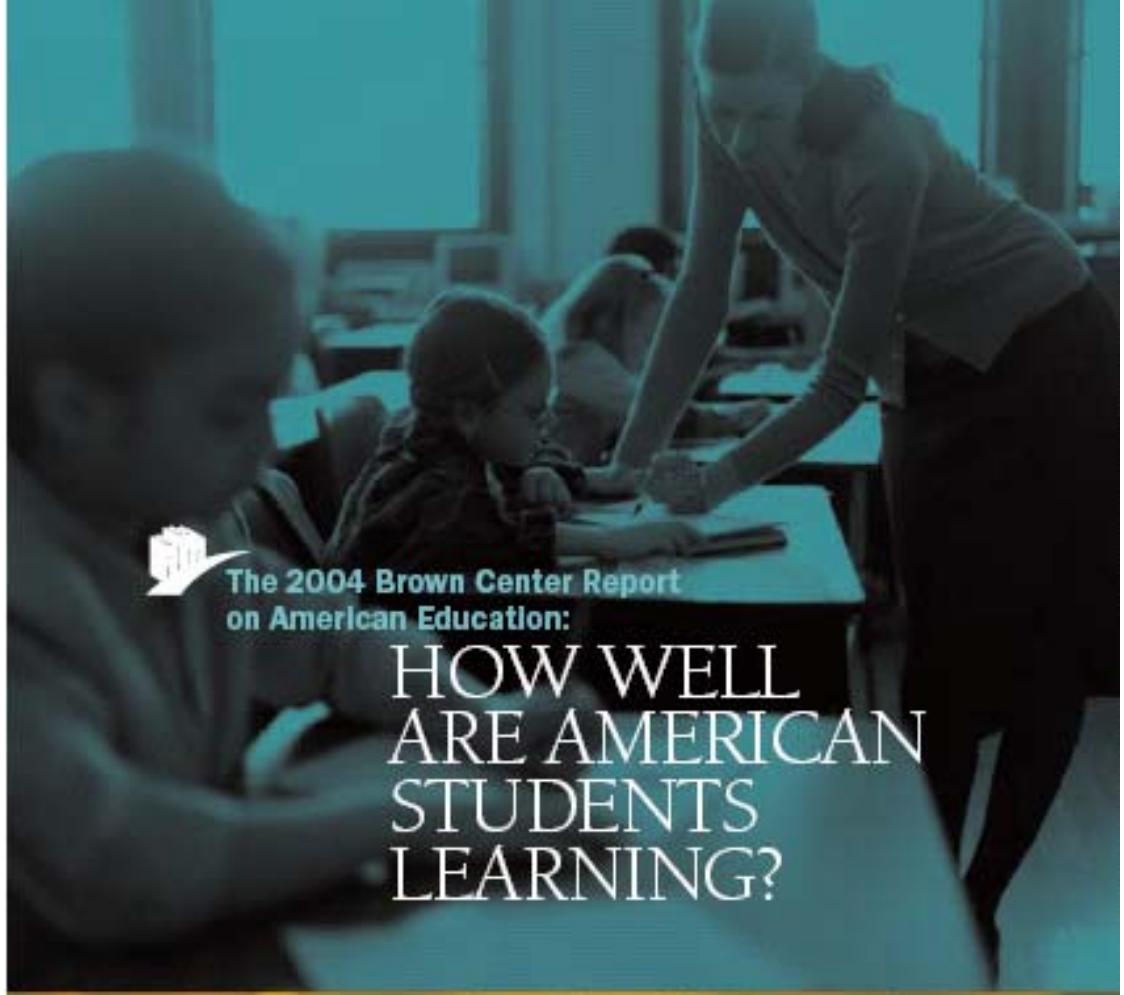


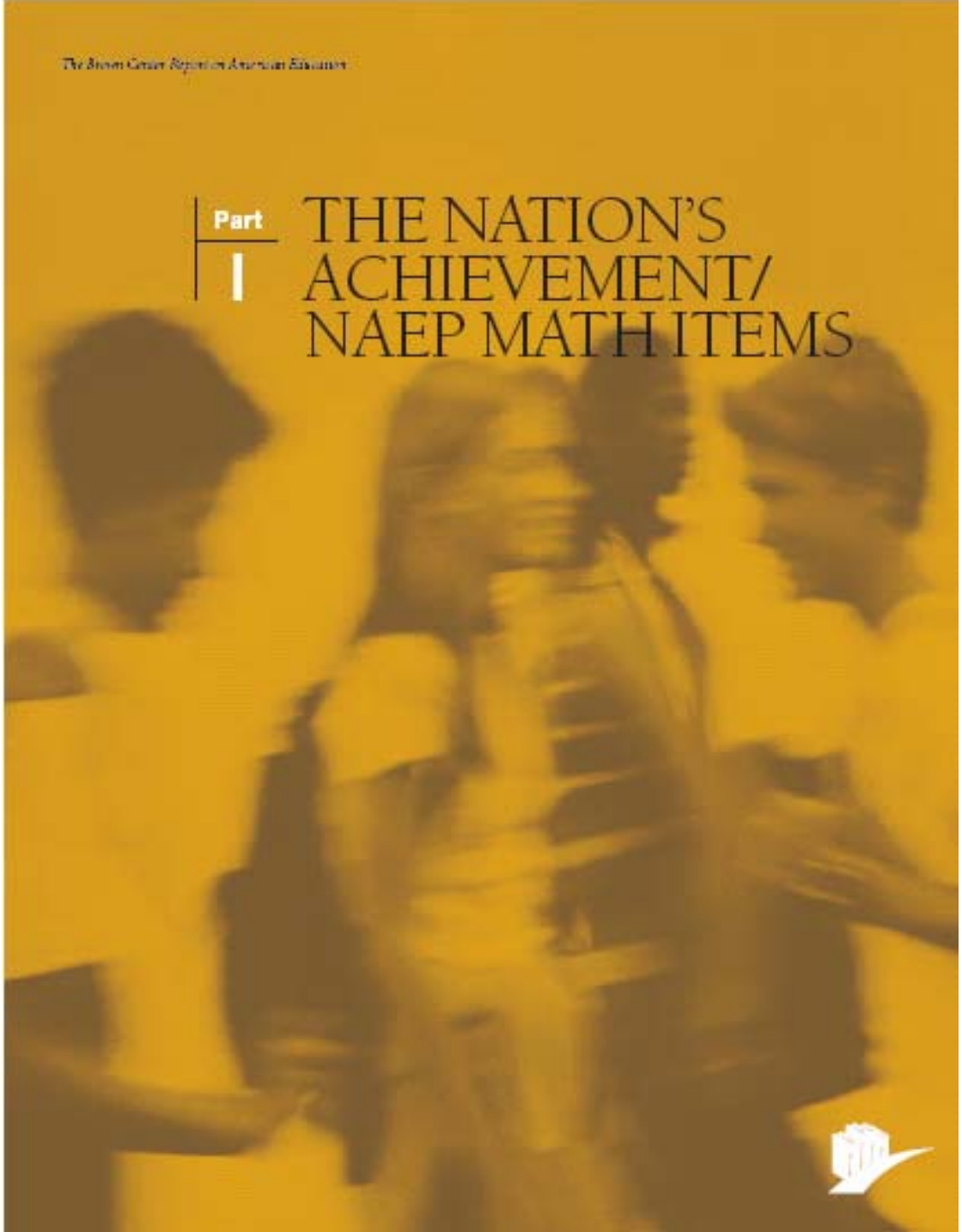
The 2004 Brown Center Report on American Education:

HOW WELL ARE AMERICAN STUDENTS LEARNING?

With studies of NAEP math items, middle school math teachers, and the revamped Blue Ribbon Schools awards

THE BROOKINGS INSTITUTION

Part I THE NATION'S ACHIEVEMENT/ NAEP MATH ITEMS



Sample rubric from Singapore math curriculum
(grade levels at which skills are taught)

Table 1-1

Operations on Whole Numbers	1A (1.0)	1B (1.5)	2A (2.0)	2B (2.5)	3A (3.0)	3B (3.5)
Addition/subtraction of 2-digit numbers within 20	X					
Addition/subtraction of 2-digit numbers within 100		X				
Addition/subtraction of 3-digit numbers			X			
Addition/subtraction of 4-digit numbers					X	

Source: Primary Mathematics U.S. Edition Scope and Sequence for Singapore Math Curriculum, http://www.singaporemath.com/scope_and_sequence_USedition_PriMath.htm

When are key skills taught?

(comparing the study's rubric and state frameworks)

Table 1-2

	Study's Rubric	California	North Carolina	Massachusetts	Florida
Whole Numbers					
Addition/subtraction of whole numbers less than 100	1	1-2	1	1-2	1-2
Addition/subtraction of 3- and 4-digit numbers	2-3	2-3	2-3	2-3	3
Multiplication times tables and corresponding division facts	2-3	2-3	3	3	4
Multiplication/division of 3-digit number by 1-digit number	3	3	3-4	3-4	4
Division of up to a 4-digit number by a 2-digit number	5	5	4	5	5
Fractions					
Halves and quarters	1	2	2	1-2	1
Comparing and ordering unlike fractions	3	4	3	3-4	3
Addition/subtraction of related fractions	4	4	4	3-4	4
Addition/subtraction of unrelated fractions	5	5	5	5	4
Product of fractions	5	5	6	5-6	5
Division of a fraction by a whole number	5	5-6	6	5-6	5
Percentages					
Concepts and computing (with) percentages	5-6	5-6	6	5-7	5-6

Source: Data compiled from respective state department of education websites; Primary Mathematics U.S. Edition Scope and Sequence for Singapore Math Curriculum, http://www.singaporemath.com/scope_and_sequence_USedition_PriMath.htm

Problem solving items with arithmetic
(by grade level of item)

Table 1-3

4th Grade

Grade Level	N	Students Answering Correctly (%)	Standard Error	Minimum	Maximum
1st	6 (15.4%)	49.7	8.2	25	78
2nd	11 (28.2%)	41.7	4.9	9	66
3rd	8 (20.5%)	31.6	3.4	20	47
4th	11 (28.2%)	28.8	4.4	8	58
5th	3 (7.7%)	30.7	10.2	20	51

Note: N= 39, Mean grade level: 3.1, Mean percent of students answering correct: 36.4

8th Grade

Grade Level	N	Students Answering Correctly (%)	Standard Error	Minimum	Maximum
1st	7 (16.3%)	54.0	8.4	25	92
2nd	10 (23.3%)	45.4	8.3	5	82
3rd	8 (18.6%)	41.4	7.5	4	69
4th	8 (18.6%)	32.6	8.7	6	73
5th	6 (13.9%)	38.5	6.6	17	58
6th	1 (2.3%)	NA	NA	NA	NA
7th	3 (7.0%)	27.7	9.3	13	45

Notes: N= 43, Mean grade level: 3.4, Mean percent of students answering correct: 41.4
The single sixth grade item is constructed response.

Source: Author's work and NAEP question tool http://nces.ed.gov/nationsreportcard/ITMRLS/pickone.asp

Summary of achievement and grade level of problem solving items (by content strands)

Table 1-4

4th Grade

Content Strand	N	Items with Whole Numbers Only	Average Grade Level of Items	Students Answering Correctly (%)
Algebra	5	5 (100%)	2.3	24.4
Data analysis	3	2 (66.7%)	2.5	45.3
Geometry	0	NA	NA	NA
Measurement	6	4 (66.7%)	2.8	37.3
Number sense	25	17 (48.6%)	3.4	37.5
Total	39	28 (71.8%)	3.1	36.4

8th Grade

Content Strand	N	Items with Whole Numbers Only	Average Grade Level of Items	Students Answering Correctly (%)
Algebra	8	7 (87.5%)	2.4	37.0
Data analysis	2	1 (50.0%)	4.5	33.5
Geometry	5	5 (100%)	3.2	22.6
Measurement	10	5 (50.0%)	3.7	37.4
Number sense	18	12 (66.7%)	3.6	49.4
Total	43	30 (69.8%)	3.4	40.4

Source: Analysis of NAEP items in public release.
Data on items available at http://nces.ed.gov/nationsreportcard/ITMRLS

Comparison of algebra and number sense items

Table 1-5

4th Grade

Content Strand	N	Items with Whole Numbers Only	Average Grade Level of Items	Students Answering Correctly (%)
Algebra	**15**	**15** (100%)	**2.3**	**40.5**
Number sense	**66**	**47** (71.2%)	**3.4**	**48.1**

8th Grade

Content Strand	N	Items with Whole Numbers Only	Average Grade Level of Items	Students Answering Correctly (%)
Algebra	**25**	**23** (92.0%)	**2.6**	**45.6**
Number sense	**54**	**31** (57.4%)	**4.1**	**55.3**

Source: Analysis of NAEP items in public release.
Data on items available at http://nces.ed.gov/nationsreportcard/ITMRLS

Comparison of algebra and number sense items
(by calculator use)

Table 1-6

4th Grade

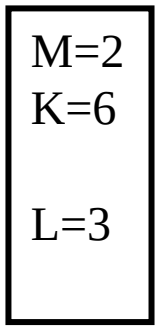
Content Strand	Calculator?	N	Items with Whole Numbers Only	Average Grade Level
Algebra	Y	8	100%	2.9
	N	7	100%	1.6
Number sense	Y	27	70.4%	3.8
	N	39	71.8%	3.1

8th Grade

Content Strand	Calculator?	N	Items with Whole Numbers Only	Average Grade Level
Algebra	Y	10	80.0%	3.4
	N	15	100%	2.1
Number sense	Y	21	42.9%	4.7
	N	33	66.7%	3.6

Source: Analysis of NAEP items in public release.
Data on items available at http://nces.ed.gov/nationsreportcard/ITMRLS

Grade 4 Item Block: 2003-4M10 No. 8:



8. What is K + L – M?

A) 1
B) 5
C) 7
D) 11

Grade 4 Block: 2003-4M6 No. 8

8. Peter wrote down a pattern of A's and B's that repeats in groups of 3. Here is the beginning of his pattern with some of the letters erased. Fill in the missing letters.

A B _ A _ B _ _ _

Grade 8 Item Block: 1990-8M9 No. 8:

(2,5), (4,9), (6,13)

Which of the following describes what to do to the first number in each ordered pair shown above to obtain the corresponding second number?

A) Add 3

B) Subtract 3

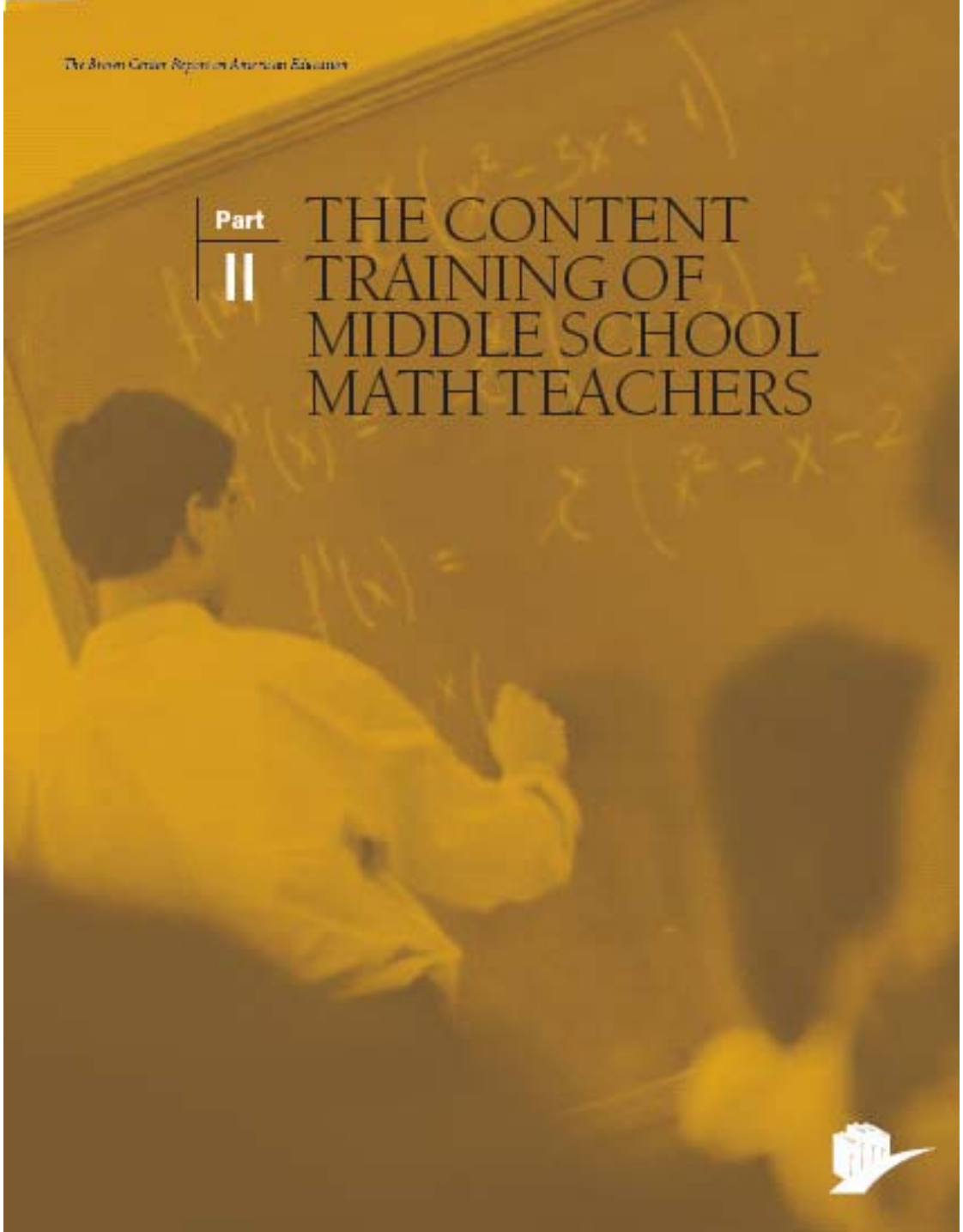
C) Multiply by 2

D) Multiply by 2 and subtract 1

E) Multiply by 2 and add 1

Part II

THE CONTENT TRAINING OF MIDDLE SCHOOL MATH TEACHERS



Middle school math teacher backgrounds

Table 2-1

Background	Percent
Undergraduate major in mathematics	22%
Undergraduate minor in mathematics	19%
Teaching credential or certificate in mathematics	41%

Middle school math teachers were asked:

Table 2-2

"In college, how many math courses did you complete that were offered by the mathematics department—not offered by the education school/department?"

Completed Courses	Percent
Four or more	77%
Three	7%
Two	7%
One	5%
None	4%

Middle school math teachers were asked:

Table 2-3

"In college, how many math courses did you complete that were offered by the education school/department—not offered by the mathematics department?"

Completed Courses	Percent
Four or more	17%
Three	9%
Two	26%
One	22%
None	24%

Percent of middle school mathematics teachers completing various college courses

Table 2-4

Completed Courses	Percent
General methods of teaching	92%
Methods of teaching mathematics	78%
Supervised student teaching in mathematics	47%
Mathematics for middle school teachers	45%
Instructional uses of computers/other technologies	43%
Geometry for elementary/ middle school teachers	36%
College algebra/trigonometry/ elementary functions	66%
Probability and statistics	56%
Geometry	47%
Computer programming or other computer science	45%
Calculus	43%

Percent of middle school mathematics teachers completing various college courses

Table 2-4

Completed Courses	Percent
Linear algebra	28%
Number theory	27%
Applications of mathematics/ problem solving	27%
Other upper division mathematics	25%
Abstract algebra	22%
Advanced calculus	21%
Differential equations	19%
History of mathematics	16%
Discrete mathematics	12%
Real analysis	11%
Engineering (any)	6%

Source: Dawayne Whittington, "Status of Middle School Mathematics Teaching," (Horizon Research, Inc., December 2002), p. 4.

Middle school math teachers were asked to describe their teaching responsibilities in a single day

Table 2-5

Responsibilities	Percent
All math courses	75%
Mostly math courses	17%
Some math courses	8%
No math courses	0%

Amount of professional development reported during the past two school years

Table 2-6

	No time	Less than 1 hour	1-2 hours	3-5 hours	More than 5 hours
Geometry	43%	15%	15%	9%	17%
Algebra	29%	10%	18%	10%	32%
Fractions and arithmetic	44%	14%	17%	9%	17%
Use of hands-on materials	23%	10%	23%	16%	28%
Integrating math topics	32%	13%	21%	12%	21%
Use of calculators	43%	12%	16%	11%	18%
Writing in math	33%	19%	23%	11%	13%
Math projects	47%	13%	20%	9%	11%
State standards	15%	9%	19%	13%	44%

Number of topics on which teachers received professional development

Table 2-7

Number of Topics	Percent of Teachers
None	3%
1-3 topics	16%
4-7 topics	44%
8 or more topics	36%

Teachers were asked to evaluate professional development they've received during the past two years.

Table 2-8

	Not helpful	Somewhat helpful	Very helpful
Geometry	14%	57%	29%
Algebra	5%	54%	41%
Fractions and arithmetic	11%	56%	33%
Use of hands-on materials	8%	52%	40%
Integrating math topics	21%	52%	27%
Use of calculators	15%	44%	41%
Writing in math	17%	54%	29%
Math projects	29%	53%	18%
State standards	12%	48%	39%

Responses from teachers who have participated in professional development

Education and teaching assignments of teachers with high, middle, and low levels of content training

Table 2-11

	Low (n=56)	Middle (n=133)	High (n=53)
4 or more education courses	23.6	18.3	9.3
Math credential	17.9	60.3	61.1
Full time	53.6	83.8	77.8

Percentage of teachers reporting 5 or more hours of professional development on various topics during the past two years, by level of content knowledge

Table 2-12

	Low	Medium	High
Geometry	18%	18%	11%
Algebra	33%	33%	30%
Fractions and arithmetic	18%	17%	9%
Use of hands-on materials	31%	27%	23%
Integrating math topics	25%	20%	17%
Use of calculators	13%	20%	19%
Writing in math	9%	14%	11%
Math projects	13%	7%	15%
State standards	42%	48%	38%

Percentage of teachers who would find professional development on the following topics "Very helpful," by level of content knowledge

Table 2-13

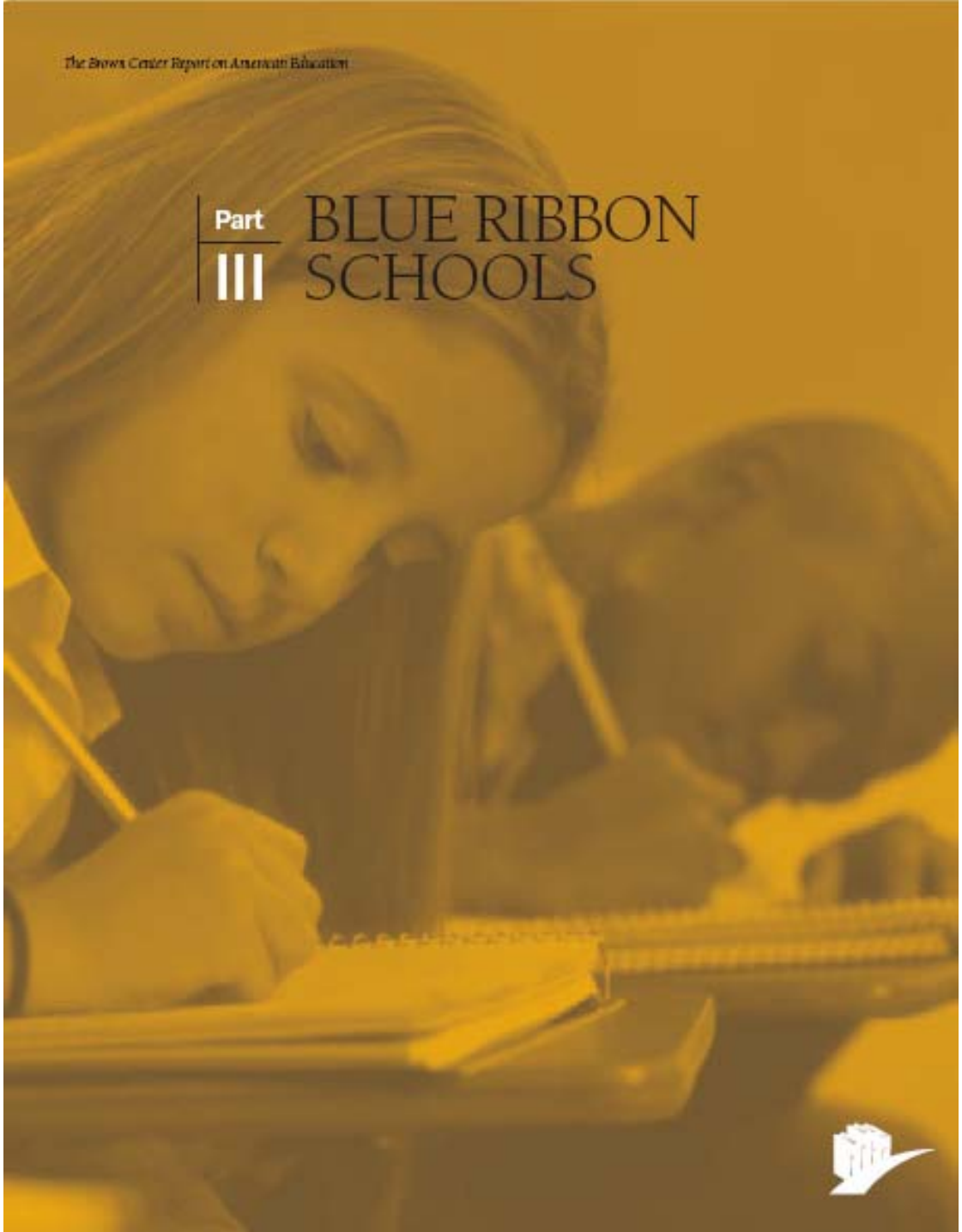
	Low	Medium	High
Geometry	51%	40%	26%
Algebra	60%	47%	34%
Fractions and arithmetic	45%	33%	19%
Use of hands-on materials	47%	45%	30%
Integrating math topics	52%	46%	32%
Use of calculators	51%	38%	26%
Writing in math	44%	39%	25%
Math projects	45%	45%	36%
State standards	38%	41%	23%

Middle school math teachers were asked: "Which of the following incentives do you think would be effective in persuading teachers to attend a summer institute?"

Table 2-14

	Not effective	Somewhat effective	Very effective
Extra pay or stipend	0%	13%	87%
Salary schedule advancement	2%	18%	80%
Credits toward a degree	7%	36%	58%
Credit for leave or release time	22%	38%	40%

Part III BLUE RIBBON SCHOOLS



Achievement of 1999 Blue Ribbon Schools
(1999 test scores)

Table 3-1

State	Number	Percentile 99th-90th	Percentile 89th-50th	Percentile 49th-1st
California	**39**	**12** (31%)	**18** (46%)	**9** (23%)
Illinois	**3**	**1** (33%)	**1** (33%)	**1** (33%)
Indiana	**4**	**0** (0%)	**2** (50%)	**2** (50%)
Michigan	**9**	**1** (11%)	**5** (56%)	**3** (33%)
Pennsylvania	**10**	**4** (40%)	**6** (60%)	**0** (0%)
New Mexico	**1**	**0** (0%)	**0** (0%)	**1** (100%)
Washington	**4**	**1** (25%)	**2** (50%)	**1** (25%)
Total	**70**	**19** (27%)	**34** (49%)	**17** (24%)

Note: Test scores from 1998-1999 school year, adjusted for socioeconomic status (SES). Public schools only. Blue Ribbon awards given in 1999.

Source: Tom Loveless. *The Brown Center Report on American Education: How Well Are American Students Learning?* (2000)

Achievement of 1999 Blue Ribbon Schools
(2003 test scores)

Table 3-2

State	Number	Percentile 99th-90th	Percentile 89th-50th	Percentile 49th-1st
California	**38**	**2** (5%)	**30** (79%)	**6** (16%)
Illinois	**3**	**0** (0%)	**3** (100%)	**0** (0%)
Indiana	**4**	**0** (0%)	**3** (75%)	**1** (25%)
Michigan	**9**	**0** (0%)	**6** (67%)	**3** (33%)
Pennsylvania	**10**	**2** (20%)	**7** (70%)	**1** (10%)
Washington	**4**	**0** (0%)	**3** (75%)	**1** (25%)
Total	**68**	**4** (6%)	**52** (76%)	**12** (18%)

Note: Test scores from 2002-2003 school year, adjusted for socioeconomic status (SES). Public schools only. Blue Ribbon awards given in 1999.

Source: Data compiled from respective state department of education websites.

Achievement of 2003 Blue Ribbon Schools
(2003 test scores)

Table 3-3

State	Number	Percentile 99th-90th	Percentile 89th-50th	Percentile 49th-1st
California	**24**	**2** (8%)	**18** (75%)	**4** (17%)
Illinois	**6**	**1** (17%)	**4** (66%)	**1** (17%)
Indiana	**3**	**2** (67%)	**1** (33%)	**0** (0%)
Missouri	**8**	**5** (63%)	**3** (37%)	**0** (0%)
Pennsylvania	**3**	**1** (33%)	**2** (67%)	**0** (0%)
Ohio	**10**	**7** (70%)	**3** (30%)	**0** (0%)
Washington	**3**	**0** (0%)	**3** (100%)	**0** (0%)
Total	**57**	**18** (31%)	**34** (60%)	**5** (9%)

Note: Test scores from 2002-2003 school year, adjusted for socioeconomic status (SES). Public schools only. Blue Ribbon awards given in 2003.

Source: Data compiled from respective state department of education websites.