Characteristics of Presidential Awardees

How do they compare with science and mathematics teachers nationally?

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Characteristics of Presidential Awardees

How do they compare with science and mathematics teachers nationally?

Introduction

The Presidential Awards for Excellence in Science and Mathematics Teaching program was established by the White House in 1983 to recognize outstanding science and mathematics teachers in the United States. Sponsored by the National Science Foundation (NSF), the Presidential Awards are given to teachers who demonstrate:

- Subject-matter competence and sustained professional growth in science or mathematics and in the art of teaching;
- An understanding of how students learn science or mathematics;
- The ability to engage students in direct hands-on science inquiry or mathematics-inquiry activities;
- The ability to foster curiosity and to generate excitement among students, colleagues, and parents about the uses of science and mathematics in everyday life;
- A conviction that all students can learn science and mathematics, and a sensitivity to the needs of all students' cultural, linguistic, learning, and social uniqueness;
- An understanding of the relationships of science and mathematics to each other and to the interconnectedness of all subject matter;
- An experimental and innovative attitude in their approach to teaching; and
- Professional involvement and leadership.

Nominations are typically sent to the state department of education, which then sends an application packet to the nominees. A selection committee reviews the applications and picks the three state finalists for each award category, and then NSF makes the final selection. Initially, Presidential Awards were restricted to secondary school teachers in the 50 states, District of Columbia, and Puerto Rico, with two science teachers and two mathematics teachers in each jurisdiction receiving awards each year. The program was expanded in 1986 to include U.S. territories and the Department of Defense Dependent Schools and in 1990 to include elementary teachers.

Each awardee is given an expense-paid trip for two to Washington, DC to attend an awards ceremony, receive a presidential citation, meet with leaders in government and education, and attend a number of special receptions. In addition, each awardee's school receives a grant (originally $5,000, later increased to $7,500) to be used under the direction of the awardee to improve the local science or mathematics program. Activities supported by these grants have included field trips, curriculum development, purchase of laboratory and instructional materials, and professional development for teachers. Finally, awardees and their schools often receive gifts from private sector donors in honor of their achievement and contributions.

In 1993, Horizon Research, Inc. administered a survey, with National Science Foundation support, to a national probability sample of approximately 6,000 teachers in grades 1–12 asking about teacher background and preparation, classroom practices, and professional activities. At the same time, questionnaires were sent to all teachers who had received the Presidential Award for Excellence in Science and Mathematics Teaching. The response rates were 84 percent for the national sample and 82 percent for the Presidential Awardees.

Based on the selection criteria used in evaluating the nominees, and the resources and opportunities made available to the recipients, it was expected that the groups would differ in teaching experience, in subject matter background, in classroom practices, and in roles in the professional community. The purpose of this monograph is to provide information about the nature and extent of these differences.*

Table 1 shows the amount of teaching experience of Presidential Awardees and science and mathematics teachers nationally. It is clear that Presidential Awardees are a much more experienced group than the national teaching force, generally. For example, in 1993, about 2 in 3 secondary-level Presidential Awardees had taught for at least 20 years, while only about 1 in 3 science and mathematics teachers nationally had that much experience. (It is not a coincidence that none of the awardees were in the 0–4 years experience category; only teachers with at least five years K–12 teaching experience in science and/or mathematics were eligible for these awards.)

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* The results of the national survey are reported in *A Profile of Science and Mathematics Education in the United States: 1993* and the *Report of the 1993 National Survey of Science and Mathematics Education*.

Table 1
Teaching Experience of Presidential Awardees and the National Science and Mathematics Teaching Force

	Percent of Teachers							
	Science				Mathematics			
	Grades 1–6		Grades 7–12		Grades 1–6		Grades 7–12	
Number of Years	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.
0–4 years	0	20	0	20	0	22	0	19
5–9 years	13	16	4	19	6	18	2	20
10–14 years	19	18	10	11	19	16	7	14
15–19 years	30	22	22	15	29	18	22	15
20+ years	39	26	64	35	46	27	69	33

To enable "fair" comparisons, the remaining tables in this monograph focus on teachers in each group with 15 or more years teaching experience. These analyses are based on 930 Presidential Awardees and 2,605 teachers nationally. (See Table 2.)

Table 2
Number of Presidential Awardees and Teachers Nationally Included in These Analyses

	Number of Teachers	
Grade and Subject Taught	P.A.	Nat.
Grades 1–6		
Science	97	374
Mathematics	104	391
Grades 7–12		
Science	367	881
Mathematics	362	959
TOTAL	**930**	**2,605**

Teacher Demographics

Nationally, roughly 9 out of 10 elementary teachers are female. While that holds true for Presidential Awardees in elementary mathematics, only about 8 out of 10 elementary science awardees are female. (See Table 3.) The pattern is reversed at the secondary level, with a disproportionately large representation of female awardees in both science and mathematics. In terms of race/ethnicity, both the national teaching force and the Presidential Awardees are a predominately white group, including 90 percent or more in each subject/grade combination.

Black teachers are even less well-represented among Presidential Awardees than in the national teaching force. For example, while roughly 12 percent of the United States population is Black, only 6 percent of secondary science teachers nationally and only 2 percent of secondary science Presidential Awardees are Black.

Table 3
Characteristics of Presidential Awardees and the National Science and Mathematics Teaching Force

	Percent of Teachers							
	Science				Mathematics			
	Grades 1–6		Grades 7–12		Grades 1–6		Grades 7–12	
Characteristic	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.
Sex								
Male	21	9	57	73	9	11	35	54
Female	79	91	43	27	91	89	65	46
Race								
White	93	91	92	90	93	91	94	90
Black	1	6	2	6	4	6	2	7
Hispanic	2	1	3	1	0	3	2	1
American Indian	1	1	0	1	0	1	0	0
Asian	3	1	3	2	3	0	2	1

Teacher Preparation

Presidential Awardees are a much more educated group than their national counterparts. As can be seen in Table 4, for example, about 80 percent of elementary level Presidential Awardees, compared to fewer than 50 percent of the elementary teachers in the nation, have earned master's degrees.

Not surprisingly, Presidential Awardees are more likely than others to have extensive coursework in science and mathematics. For example, secondary science and mathematics awardees are much more likely to have undergraduate majors in field—72 percent in science compared to 54 percent nationally, and 55 percent in mathematics compared to 38 percent nationally.

At the elementary level, the contrast is most evident in the percentages having either a major or minor in field. For example, 36 percent of elementary mathematics awardees, compared to only 7 percent of elementary teachers nationally, had either an undergraduate or graduate major or minor in mathematics or mathematics education.

Table 4
Undergraduate Science/Mathematics Majors and Minors and Master's Degrees of Experienced Teachers

	Percent of Teachers							
	Science				Mathematics			
	Grades 1–6		Grades 7–12		Grades 1–6		Grades 7–12	
Degree/Area	**P.A.**	**Nat.**	**P.A.**	**Nat.**	**P.A.**	**Nat.**	**P.A.**	**Nat.**
Undergraduate major in science (mathematics)	12	2	72	54	5	1	55	38
Undergraduate or graduate major in science/science education (mathematics/mathematics education)	35	3	67	66	12	2	56	58
Undergraduate or graduate major or minor in science/science education (mathematics/mathematics education)	42	7	97	91	36	7	93	74
Master's degree (in any field)	77	46	90	69	81	46	91	67

In mathematics, there are large differences in the percentage of awardees and secondary teachers in the nation as a whole who have completed each of a number of different courses; the differences are most notable in some of the more advanced courses, such as abstract algebra, advanced calculus, and discrete mathematics. (See Table 5.) In science, the differences are generally small in the life and earth sciences, but substantial in the physical sciences, especially in coursework in analytical and organic chemistry. (See Table 6.)

Table 5
Grade 7–12 Experienced Mathematics Teachers Completing Various College Courses

	Percent of Teachers	
College Course	**P.A.**	**Nat.**
College algebra/trigonometry/elementary functions	90	86
Calculus	97	81
Advanced calculus	82	59
Differential equations	76	57
Geometry	89	81
Probability and statistics	86	75
Abstract algebra/number theory	90	69
Linear algebra	84	67
Applications of mathematics/problem solving	58	47
History of mathematics	54	45
Discrete mathematics	40	20
Other upper division mathematics	77	51

Table 6
Grade 7–12 Experienced Science Teachers Completing Various College Courses

College Course	Percent of Teachers	
	P.A.	Nat.
Introductory biology	82	81
Botany, plant physiology	70	66
Cell biology	46	40
Ecology	57	45
Genetics, evolution	57	51
Microbiology	49	46
Anatomy/physiology	56	61
Zoology, animal behavior	65	61
General chemistry	98	90
Analytical chemistry	60	37
Organic chemistry	76	51
Physical chemistry	41	27
Quantum chemistry	15	9
Biochemistry	45	28
General physics	88	71
Electricity and magnetism	43	32
Heat and thermodynamics	37	22
Mechanics	38	23
Modern or quantum physics	29	15
Nuclear physics	28	12
Solid-state physics	9	6
Optics	31	15
Astronomy	50	35
Geology	57	49
Meteorology	27	24
Oceanography	26	21
Physical geography	23	32
Environmental science	56	43

Similarly, as can be seen in Table 7, elementary mathematics Presidential Awardees are more likely than their peers nationally to have taken such college courses as geometry for teachers and introductory calculus. Likewise 79 percent of elementary science awardees, compared to only 52 percent nationally, meet or exceed NSTA recommendations for coursework in life science, earth science, physical science, and science education. (See Table 8.)

Table 7
Grade 1–6 Experienced Mathematics
Teachers Completing Various College Courses

	Percent of Teachers	
College Course	**P.A.**	**Nat.**
Mathematics education	97	99
Mathematics for elementary school teachers	94	99
College algebra/trigonometry/elementary functions	47	38
Geometry for elementary/middle school teachers	49	34
Probability and statistics	40	35
Applications of mathematics/problem solving	39	30
Introductory calculus	26	11

Table 8
Grade 1–6 Experienced Science Teachers
Meeting NSTA Course-Background Standards

	Percent of Teachers	
Course Background	**P.A.**	**Nat.**
Coursework in each science discipline plus science education	79	52
Lack coursework in science education only	8	14
Lack coursework in one science discipline	10	27
Lack coursework in two science disciplines	3	6
Lack coursework in three science disciplines	0	1

Professional Development

While differences in formal coursework are evident, they pale in comparison to differences in amount of in-service education between Presidential Awardees and science and mathematics teachers nationally. As can be seen in Table 9, roughly 8 out of 10 Presidential Awardees reported spending more than 35 hours on in-service education in their field in the past three years, compared to only about 1 in 10 in grades 1–6, and 4 in 10 in grades 7–12 nationally.

Table 9
Time Spent by Experienced Teachers on In-Service Education in Science and Mathematics in Last Three Years

	Percent of Teachers							
	Science				Mathematics			
	Grades 1–6		Grades 7–12		Grades 1–6		Grades 7–12	
Number of Hours	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.
None	0	23	3	11	1	17	0	8
< 6 Hours	3	27	2	17	2	21	2	13
6–15 Hours	8	25	7	18	5	28	6	22
16–35 Hours	10	13	12	17	14	23	6	22
> 35 Hours	78	12	76	37	77	12	86	35

Similarly, Presidential Awardees were much more likely to participate in other science- and mathematics-related professional development activities. (See Table 10.) For example, 93 percent of secondary mathematics awardees reported attending a state or national mathematics teacher association meeting in the last 12 months, compared to only 44 percent nationally.

Table 10
Experienced Teacher Participation in Various Professional Activities in Last 12 Months

	Percent of Teachers							
	Science				Mathematics			
	Grades 1–6		Grades 7–12		Grades 1–6		Grades 7–12	
Professional Activity	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.
Served on school or district curriculum committee	83	18	70	42	77	21	75	46
Served on a school or district textbook selection committee	40	13	45	36	45	22	60	48
Attended any national or state teacher association meeting	98	11	92	35	89	10	93	44
Taught any in-service workshop or course in science/ mathematics or science/mathematics teaching	95	7	85	16	91	6	86	17

It is not at all surprising, therefore, that Presidential Awardees are much more likely to be familiar with the National Council of Teachers of Mathematics (NCTM) *Standards*. (See Table 11.) Where nationally only 14 percent of elementary mathematics teachers and 56 percent of secondary mathematics teachers reported being "well aware" of the NCTM *Curriculum and Evaluation Standards*, virtually all mathematics Presidential Awardees indicated that level of awareness.

Table 11
Experienced Mathematics Teachers' Familiarity with the NCTM *Standards*

NCTM Standards	Percent of Teachers			
	Grades 1–6		Grades 7–12	
	P.A.	Nat.	P.A.	Nat.
Curriculum and Evaluation Standards				
Well aware of	99	14	98	56
Heard of, but don't know much about them	1	42	2	32
Not aware of	0	31	0	9
Not sure	0	13	0	3
Professional Standards for Teaching				
Well aware of	93	10	92	42
Heard of, but don't know much about them	7	41	8	41
Not aware of	0	40	1	13
Not sure	0	10	0	4

Table 12 shows the percentages of science teachers nationally reporting that they are very well qualified to teach each of a number of science subjects. Note the very large differences at the elementary level, with, for example, 66 percent of Presidential Awardees compared to only 30 percent nationally indicating they felt very well qualified to teach the life sciences. Differences were much smaller in secondary science, with the largest disparity in perceived qualifications in physics (36 percent versus 21 percent) and chemistry (47 percent versus 33 percent).

Table 12
Experienced Science Teachers Reporting That They Are Well-Qualified to Teach Each of a Number of Subjects

Subject	Percent of Teachers			
	Grades 1–6		Grades 7–12	
	P.A.	Nat.	P.A.	Nat.
Life sciences	66	30	51	57
Chemistry	40	5	47	33
Physics	38	4	36	21
Earth sciences	54	28	27	34
Technology	25	6	16	12
Integrated science, drawing from various science disciplines	64	16	38	27

Similarly, as can be seen in Table 13, a larger proportion of elementary mathematics Presidential Awardees perceive themselves as very well qualified to teach a number of mathematics concepts. For example, 42 percent of awardees, compared to 12 percent of grades 1–6 teachers nationally, are confident in their ability to teach probability and statistics to elementary students. At the secondary level, differences are most marked in the more advanced mathematics topics. For example, 62 percent of awardees, compared to only 25 percent of 7–12 mathematics teachers nationally, perceive themselves as very well qualified to teach the conceptual underpinnings of calculus.

Table 13
Experienced Mathematics Teachers Reporting That They Are Well-Qualified to Teach Each of a Number of Topics

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Topic	P.A.	Nat.	P.A.	Nat.
Estimation	76	54	74	76
Number sense and numeration	86	71	85	84
Number systems and number theory	64	52	81	77
Measurement	79	59	80	81
Fractions and decimals	78	59	91	95
Geometry and spatial sense	73	45	86	75
Functions	47	46	92	71
Patterns and relationships	84	57	86	72
Algebra	41	18	97	88
Trigonometry	10	5	84	53
Probability and statistics	42	12	52	36
Discrete mathematics	11	5	33	18
Conceptual underpinnings of calculus	3	2	62	25
Mathematics structure	15	8	58	30

Teacher Attitudes Toward Curriculum and Instruction

Teachers were given a series of statements about science and mathematics education and asked to indicate the extent to which they agreed or disagreed with each. As can be seen in Tables 14 and 15, Presidential Awardees' views are more strongly aligned with current reform notions than are the views of science and mathematics teachers nationally. At both the elementary and secondary levels, Presidential Awardees were more likely than their national peers to agree that virtually all students can learn to think scientifically/mathematically; that laboratory-based science classes are more effective than others; and, especially, that students should be able to use calculators most of the time in their mathematics classes. In contrast, teachers nationally were more likely to support such non-reform ideas as homogeneous grouping; having students learn basic scientific terms and formulas before learning underlying concepts and principles; and the importance of students mastering arithmetic computation before going on to algebra.

Table 14
Experienced Science Teachers' Opinions on Curriculum and Instruction Issues

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Issue	P.A.	Nat.	P.A.	Nat.
Students learn best when they study science in the context of a personal or social application	98	92	93	83
Virtually all students can learn to think scientifically	98	77	87	77
Laboratory-based science classes are more effective than non-laboratory classes	92	81	97	88
It is important for students to learn basic scientific terms and formulas before learning underlying concepts and principles	5	37	18	57
Students learn science best in classes with students of similar abilities	22	30	60	65

Table 15
Experienced Mathematics Teachers' Opinions on Curriculum and Instruction Issues

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Issue	P.A.	Nat.	P.A.	Nat.
Students learn best when they study mathematics in the context of personal or social application	98	94	92	82
Virtually all students can learn to think mathematically	99	73	90	73
Students should be able to use calculators most of the time	83	22	93	68
Students need to master arithmetic computation before going on to algebra	28	75	37	76
Students learn mathematics best in classes with students of similar abilities	29	47	65	75

In another series of items, teachers were asked whether each of a number of strategies should be part of science/mathematics instruction. Tables 16 and 17 show the percentages of Presidential Awardees and science and mathematics teachers nationally who indicated that each strategy should definitely be part of instruction. Again, it is clear that Presidential Awardees' views are more closely aligned with the vision espoused in current reform documents.

Table 16
Experienced Mathematics Teachers Indicating That Various Strategies Definitely Should be a Part of Mathematics Instruction

Instructional Strategy	Percent of Teachers			
	Grades 1–6		Grades 7–12	
	P.A.	Nat.	P.A.	Nat.
Hands-on/manipulative activities	96	72	53	24
Concrete experience before abstract treatments	95	76	58	36
Applications of mathematics in daily life	91	79	62	55
Emphasis on solving real problems	89	81	70	59
Every student studying mathematics each year	87	75	65	48
Emphasis on mathematics reasoning	91	75	81	64
Emphasis on connections among concepts	92	64	81	50
Students working in cooperative learning groups	84	52	53	28
Use of computers	59	48	59	36
Emphasis on arithmetic computation	8	55	6	25
Coordination of mathematics with science	50	33	36	18
Taking students' prior conceptions about a topic into account when planning curriculum and instruction	51	30	37	21
Use of calculators	84	33	86	51
Inclusion of performance-based assessment	54	34	36	21
Deeper coverage of fewer mathematics ideas	39	34	35	14
Emphasis on writing about mathematics	77	30	50	19
Integration of mathematics subjects (e.g., algebra, probability, geometry, etc.) all taught together each year	63	24	41	21
Coordination of mathematics with vocational/technology education	39	27	29	19

Table 17
Experienced Science Teachers Indicating That Various Strategies Definitely Should be a Part of Science Instruction

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Instructional Strategy	P.A.	Nat.	P.A.	Nat.
Hands-on/laboratory activities	94	75	91	71
Applications of science in daily life	91	72	78	57
Concrete experience before abstract treatments	87	62	54	38
Every student studying science every year	92	58	55	41
Students working in cooperative learning groups	73	55	48	30
Emphasis on connections among concepts	82	54	74	45
Coordination of sciences with mathematics	69	40	59	40
Coordination of sciences with language arts	62	38	32	20
Coordination of sciences with social science	60	35	32	20
Taking students' prior conceptions about natural phenomena into account when planning curriculum and instruction	63	37	46	24
Coordination of sciences with vocational/technology education	53	38	38	27
Use of computers	52	31	53	37
Coordination of science disciplines	52	34	51	33
Revisiting science topics, each time in great depth	43	28	33	22
Deeper coverage of fewer science concepts	54	30	45	19
Applications of scientific methods in addressing societal issues	45	27	55	35
Inclusion of performance-based assessment	68	24	39	20

In both science and mathematics, at both the elementary and secondary levels, substantially larger percentages of Presidential Awardees than teachers nationally thought it important to include hands-on manipulative activities; concrete experiences before abstract treatments; taking students' prior conceptions into account when planning curriculum and instruction; deeper coverage of fewer concepts; emphasis on connections among concepts; coordination of science and mathematics; use of cooperative learning groups; use of computers; and performance-based assessment. Elementary and secondary mathematics awardees were also more likely than their national peers to favor the use of calculators; an emphasis in mathematical reasoning and writing about mathematics; and integration of mathematics subjects (e.g., algebra, probability, geometry, etc.) all taught together each year. Similarly in science, Presidential Awardees were more likely than their national counterparts to favor the coordination of science disciplines; the application of scientific methods in addressing societal issues; and revisiting science topics, each time in greater depth.

Teacher Decisionmaking

As can be seen in Table 18, Presidential Awardees perceive themselves as having more control over curriculum and instructional decisions than do their peers nationally. For example, about 7 out of 10 elementary awardees report having strong control in determining goals and objectives for their science and mathematics instruction, compared to only 3 out of 10 in the nation generally. Whether the decision at hand was selecting the content, topics, and skills to be taught; selecting the sequence in which topics are covered; selecting textbooks or other instructional materials; selecting teaching techniques; or even determining the amount of homework to be assigned, Presidential Awardees were considerably more likely than other teachers to indicate that they had strong control over the decision.

Table 18
Classes Where Experienced Teachers Report Having Strong Control Over Various Curriculum and Instructional Decisions*

	Percent of Teachers							
	Science				Mathematics			
	Grades 1–6		Grades 7–12		Grades 1–6		Grades 7–12	
Decision	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.
Determining the amount of homework to be assigned	88	67	90	80	80	66	88	77
Selecting teaching techniques	94	61	94	78	89	67	92	75
Choosing criteria for grading students	78	59	84	69	70	53	79	66
Selecting the sequence in which topics are covered	85	51	87	70	78	51	80	58
Setting the pace for covering topics	80	53	87	72	78	58	81	61
Determining goals and objectives	72	30	81	55	68	29	74	42
Selecting other instructional materials	82	27	80	57	81	37	78	49
Selecting content, topics, and skills to be taught	68	27	80	52	57	24	65	40
Selecting textbooks	37	13	68	50	40	17	58	35

* Teachers were given a five-point scale for each decision, with 1 labeled "no control" and 5 labeled "strong control."

While the vast majority of all science and mathematics teachers, both Presidential Awardees and others, noted that their understanding of what motivates their students has a major influence on what they teach, there were marked differences in the extent to which other factors reportedly influenced these teachers. (See Table 19.) In science, Presidential Awardees were more likely than others to report being influenced by reform projects (both NSTA's Scope, Sequence and Coordination project and AAAS's Project 2061) and by parents and the community. In contrast, larger proportions of teachers nationally said their textbooks, tests, and state and district frameworks had a major influence on what they taught.

The differences were especially large in mathematics. For example, 97 percent of elementary awardees compared to only 24 percent nationally reported that NCTM's *Curriculum and Evaluation Standards* had a major influence on what they teach. In contrast, only 22 percent of elementary awardees, but 79 percent nationally, said the textbook was a major influence. Elementary and secondary mathematics teachers in the nation as a whole were also more likely to report that state and district curriculum frameworks and state and district tests had a major influence on what they teach.

Table 19
Classes Where Experienced Teachers Report That
Various Factors Have a Major Influence on What They Teach*

	Percent of Teachers							
	Science				Mathematics			
	Grades 1–6		Grades 7–12		Grades 1–6		Grades 7–12	
Curriculum Influence	**P.A.**	**Nat.**	**P.A.**	**Nat.**	**P.A.**	**Nat.**	**P.A.**	**Nat.**
Your own understanding of what motivates your students	98	94	99	90	99	97	99	93
Your own content background	92	80	96	88	89	90	94	89
Your district's curriculum framework/course of study	75	80	51	68	70	85	61	78
Available facilities, equipment, and supplies	84	72	94	90	81	88	86	78
Your state's curriculum framework/course of study	50	62	30	50	54	77	42	58
Textbook	17	59	43	72	22	79	64	80
Parents/community	56	38	48	38	55	56	43	45
State test	22	31	15	26	33	59	16	36
District test	14	25	11	17	32	48	13	25
Scope, Sequence and Coordination philosophy or *Content Core* (NSTA's SS&C project)	41	9	29	12	--	--	--	--
Science for All Americans (AAAS' Project 2061)	50	4	38	7	23	5	14	4
NCTM's *Curriculum and Evaluation Standards*	--	--	--	--	97	24	88	51
NCTM's *Professional Standards for Teaching Mathematics*	--	--	--	--	89	22	81	43

* Teachers were given a four-point scale for each factor, with 1 labeled "no influence" and 4 labeled "extensive influence." These percentages include the total choosing either 3 or 4.

Science and Mathematics Teaching

Overall, the composition of Presidential Awardees' classes is quite similar to that of science and mathematics classes nationally. For example, in grades 7–12, Presidential Awardees' classes and science and mathematics classes nationally have an average of 24 students. As can be seen in Table 20, race/ethnic distributions are also comparable, with both awardees' classes and those of their national counterparts including roughly 75–80 percent white students.

Table 20
Composition of Science and Mathematics Classes of Experienced Teachers

Class Composition	Science				Mathematics			
	Grades 1–6		Grades 7–12		Grades 1–6		Grades 7–12	
	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.
Average Classroom Size (number of students)	29	31	24	24	23	23	24	24
Race/Ethnic Composition (percent of students)								
White	79	73	76	79	74	77	77	77
Black	10	12	9	12	15	12	8	12
Hispanic	6	12	7	5	6	8	6	6
Asian-American	4	2	7	2	4	2	7	3
American Indian	2	1	1	1	2	1	1	1

However, Presidential Awardees have very different ideas about the appropriate objectives of science/mathematics instruction, and they use very different strategies to achieve their objectives. Table 21 shows the percentage of elementary and secondary Presidential Awardees and mathematics teachers nationally who reported giving heavy emphasis to each of a number of instructional objectives. Awardees are more likely than their national peers to emphasize increased interest in mathematics, and learning to explain ideas in mathematics effectively, while mathematics teachers nationally are more likely than awardees to emphasize learning to perform computations with speed and accuracy, learning mathematical algorithms, and preparing for standardized tests.

Table 21
Mathematics Classes of Experienced Teachers with Heavy Emphasis on Various Instructional Objectives*

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Objective	**P.A.**	**Nat.**	**P.A.**	**Nat.**
Learn mathematical concepts	96	94	97	90
Learn how to solve problems	95	94	96	89
Learn to reason mathematically	98	90	96	90
Increase awareness of importance of mathematics in daily life	90	84	75	67
Learn how mathematical ideas connect with one another	92	84	95	81
Increase interest in mathematics	92	77	78	64
Prepare for further study in mathematics	62	67	87	76
Learn to perform computations with speed and accuracy	20	75	22	49
Understand logical structure of mathematics	59	62	72	70
Learn to explain ideas in mathematics effectively	80	58	78	52
Prepare for standardized tests	16	49	22	37
Learn mathematical algorithms	27	50	50	56
Learn about applications of mathematics in science	51	41	55	39
Learn about applications of mathematics in business and industry	31	29	49	42
Learn about the history of mathematics	10	4	21	6

* Teachers were given a six-point scale for each objective, with O labeled "none"; 1, "minimal emphasis"; 3, "moderate emphasis"; and 5, "very heavy emphasis." These percentages are the total of 4 and 5.

Similarly, science awardees are more likely than their national peers to emphasize increasing interest in science, developing problem solving/inquiry skills, learning to explain science ideas, and learning to evaluate arguments based on scientific evidence. In contrast, the general population of science teachers is more likely than the awardees to emphasize learning important terms and facts of science and preparing students for standardized tests. (See Table 22.)

Table 22
Science Classes of Experienced Teachers
with Heavy Emphasis on Various Instructional Objectives*

Objective	Percent of Teachers			
	Grades 1–6		Grades 7–12	
	P.A.	Nat.	P.A.	Nat.
Increase awareness of the importance of science in daily life	94	77	85	76
Learn basic science concepts	89	77	88	85
Increase interest in science	91	74	81	64
Develop problem-solving/inquiry skills	92	71	95	78
Learn important terms and facts of science	28	53	37	63
Learn scientific methods	85	52	83	75
Prepare for further study in science	63	44	69	65
Learn to explain ideas in science effectively	79	49	77	61
Learn about the relationship between science, technology, and society	62	30	65	52
Learn to evaluate arguments based on scientific evidence	60	30	76	52
Learn about the applications of science in business and industry	51	26	62	47
Prepare for standardized tests	7	21	17	24
Learn about the history of science	19	10	24	16

* Teachers were given a six-point scale for each objective, with O labeled “none”; 1, “minimal emphasis”; 3, “moderate emphasis”; and 5, “very heavy emphasis.” These percentages are the total of 4 and 5.

The same pattern can be seen in class activities. Table 23 shows that students in Presidential Awardees’ mathematics classes are more likely than others to make conjectures and explore possible methods to solve a mathematical problem; participate in dialogue with the teacher to develop an idea; learn about mathematics through real-life applications; use computers, calculators and manipulatives to learn mathematics; and write their reasoning about how to solve a problem. They are less likely than classes nationally to do mathematics problems from textbooks or worksheets.

Similarly, students in Presidential Awardees’ science classes are more likely than others to do hands-on science activities, work in small groups, and prepare written science reports; they are less likely to read a science textbook in class. (See Table 24.)

Table 23
Mathematics Classes of Experienced Teachers
Participating in Various Instructional Activities at Least Once a Week

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Activity	**P.A.**	**Nat.**	**P.A.**	**Nat.**
Work in small groups	99	85	86	61
Use manipulative materials or models	98	76	46	21
Do mathematics problems from textbooks	40	84	92	97
Do mathematics problems from worksheets	34	76	50	62
Participate in dialogue with the teacher to develop an idea	92	68	90	71
Learn about mathematics through real-life applications	83	62	62	44
Use computers/calculators to do computations	71	49	94	72
Use computers/calculators to explore problems	74	54	80	55
Make conjectures and explore possible methods to solve a mathematical problem	82	46	71	41
Use computers/calculators to develop an understanding of mathematics concepts	58	39	68	41
Write their reasoning about how to solve a problem	68	31	58	30
Listen and take notes during presentation by teacher	23	27	89	85
Watch films, filmstrips, or videotapes	7	4	1	2
Watch television programs	6	2	2	2

Table 24
Science Classes of Experienced Teachers
Participating in Various Instructional Activities at Least Once a Week

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Activity	**P.A.**	**Nat.**	**P.A.**	**Nat.**
Participate in dialogue with the teacher to develop an idea	91	75	86	76
Work in small groups	97	62	88	71
Read a science textbook in class	16	55	16	46
Do hands-on/laboratory science activities	94	42	92	63
Use a computer	42	35	22	6
Watch the teacher demonstrate a scientific principle	46	29	62	47
Listen and take notes during presentation by teacher	32	34	80	82
Watch films, filmstrips, or videotapes	17	20	16	23
Watch television programs	6	12	4	7
Prepare written science reports	17	8	47	25

Tables 25 and 26 show that grading practices of Presidential Awardees also differ from those of their peers. In mathematics, Presidential Awardees are more likely than other teachers to base grades on hands-on/performance tasks, contributions to small group work, projects, and essay tests, while teachers nationally are more likely than awardees to use class attendance, behavior, objective tests, and homework assignments in assigning grades.

Similarly, science awardees are more likely than other science teachers to use systematic observation of students, hands-on/performance tasks, projects, laboratory reports, and essay tests. In contrast, science teachers nationally are more likely than awardees to grade students based on class attendance, behavior, and objective tests.

Table 25
Mathematics Classes Where Experienced Teachers Report
Various Types of Activities Are Important in Determining Student Grades*

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Activity	P.A.	Nat.	P.A.	Nat.
Individual improvement or progress over past performance	93	91	61	66
Systematic observations of students	93	87	61	60
Participation in whole class discussion	87	85	59	60
Effort	80	82	49	67
Hands-on/performance tasks	96	80	62	49
Contribution to small group work	87	80	64	48
Interviewing students about what they understand	85	72	45	42
Objective tests (e.g., multiple choice, true/false)	23	56	44	63
Class attendance	48	62	36	46
Behavior	37	51	17	30
Homework assignments	32	47	63	77
Mathematics projects	62	40	51	25
Essay tests	34	16	54	20

* Teachers were given a four-point scale for each activity, with 1 labeled "not important" and 4 labeled "very important." These percentages are the total of 3 and 4.

Table 26
Science Classes Where Experienced Teachers Report
Various Types of Activities Are Important in Determining Student Grades*

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Activity	**P.A.**	**Nat.**	**P.A.**	**Nat.**
Participation in whole class discussion	91	88	54	56
Effort	90	92	57	65
Individual improvement or progress over past performance	90	88	59	60
Contribution to small group work	95	87	64	56
Systematic observations of students	96	79	66	58
Hands-on/performance tasks	96	81	83	67
Interviewing students about what they understand	85	70	44	43
Class attendance	57	65	39	47
Behavior	50	58	23	37
Objective tests (e.g., multiple choice, true/false)	29	56	62	87
Science projects	75	55	53	42
Homework assignments	33	35	49	61
Laboratory reports	69	35	84	66
Essay tests	46	30	68	50

* Teachers were given a four-point scale for each activity, with 1 labeled “not important” and 4 labeled “very important.” These percentages are the total of 3 and 4.

While the vast majority of secondary science and mathematics classes, both Presidential Awardees’ classes and those nationally, use commercially published textbooks/programs, there are large differences in textbook usage at the elementary level between awardees’ classes and others. For example, only 49 percent of elementary science awardees use textbooks in their classes, compared to 82 percent of those nationally. (See Table 27.) In addition, Presidential Awardees who do use textbooks, tend to “cover” less of the text. For example, only 1 in 2 elementary mathematics awardees cover as much as 75 percent of their textbooks, compared to 3 in 4 nationally.

Table 27
Classes of Experienced Teachers Using Commercially-Published Textbooks/Programs and Percentage Covered During the Year

	Percent of Teachers							
	Science				Mathematics			
	Grades 1–6		Grades 7–12		Grades 1–6		Grades 7–12	
Textbook/Program	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.
Use Commercially Published Textbooks/Programs	49	82	90	96	70	97	93	95
Percentage Covered During the Year*								
< 25 percent	29	12	6	4	13	1	3	0
25–49 percent	25	17	22	17	13	4	7	5
50–74 percent	23	28	36	38	23	20	28	23
75–90 percent	10	25	28	34	35	48	43	51
> 90 percent	13	18	9	7	17	27	18	22

* Only classes using commercially published textbooks/programs were included in these analyses.

Tables 28, 29, 30, and 31 provide data on equipment usage in Presidential Awardees' and national elementary and secondary science and mathematics classes. In elementary science, awardees are more likely than teachers nationally to report using laboratory facilities and such technologies as computers, videodisc players, and CD-ROM players. In addition, elementary science awardees who do not use instructional technologies report that they would use them if they were available, while most other teachers say they are not needed.

Similarly, at the secondary level, science awardees are more likely than others to report use of calculators, computers, computer/lab interfacing devices, videodisc players, and CD-ROM players, while many teachers nationally say they do not need these kinds of equipment.

The differences in equipment usage between Presidential Awardees and teachers nationally are smaller in mathematics than in science. At both the elementary and secondary level, mathematics awardees are more likely than their national peers to use overhead projectors and videotape players. Elementary awardees are more likely to use calculators—40 percent use fraction calculators and 80 percent use four-function calculators, compared to 4 percent and 56 percent, respectively, of teachers nationally. And at the secondary level, awardees are much more likely than others to use graphing calculators, scientific calculators, and computers, while secondary mathematics teachers nationally are more likely than awardees to use four-function calculators.

Table 28
Equipment Usage in Grade 1–6
Science Classes of Experienced Teachers

	Percent of Classes					
	Used		Not Needed		Needed, but not available	
Equipment	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.
Videotape player	91	89	5	10	4	1
Overhead projector	89	75	7	21	4	4
Videodisc player	33	16	26	60	42	24
CD-ROM player	21	9	32	63	47	28
Four-function calculators	50	41	42	47	8	12
Fraction calculators	9	3	78	82	13	15
Graphing calculators	2	0	87	85	11	14
Scientific calculators	4	1	87	84	9	15
Electrical outlets in laboratories	81	52	10	30	9	18
Running water in laboratories	85	51	5	27	10	23
Gas for burners in laboratories	10	6	66	69	24	25
Hoods or air hoses in laboratories	2	3	77	78	21	19
Computers	72	53	8	29	19	18
Computer/lab interfacing devices	20	11	30	61	51	28

Table 29
Equipment Usage in Grade 7–12
Science Classes of Experienced Teachers

	Percent of Classes					
	Used		Not Needed		Needed, but not available	
Equipment	P.A.	Nat.	P.A.	Nat.	P.A.	Nat.
Videotape player	96	94	3	5	1	1
Overhead projector	91	84	8	14	1	2
Videodisc player	52	31	17	46	32	24
CD-ROM player	18	9	31	62	51	29
Four-function calculators	50	36	45	59	5	5
Fraction calculators	16	9	78	86	7	5
Graphing calculators	18	5	67	85	15	10
Scientific calculators	56	24	37	67	7	10
Electrical outlets in laboratories	98	89	1	6	1	5
Running water in laboratories	94	85	3	4	3	12
Gas for burners in laboratories	72	57	20	30	8	14
Hoods or air hoses in laboratories	48	27	31	42	21	31
Computers	74	43	4	27	21	30
Computer/lab interfacing devices	49	17	10	42	41	41

Table 30
Equipment Usage in Grade 1–6
Mathematics Classes of Experienced Teachers

	Percent of Classes					
	Used		Not Needed		Needed, but not available	
Equipment	**P.A.**	**Nat.**	**P.A.**	**Nat.**	**P.A.**	**Nat.**
Videotape player	53	41	44	56	3	3
Overhead projector	90	77	8	21	2	3
Videodisc player	13	8	64	79	23	12
CD-ROM player	8	3	55	84	37	14
Four-function calculators	80	56	19	31	1	13
Fraction calculators	40	4	44	75	15	21
Graphing calculators	2	0	92	84	6	15
Scientific calculators	5	1	89	89	6	10
Computers	81	75	7	13	12	13
Computer/lab interfacing devices	25	33	35	47	40	19

Table 31
Equipment Usage in Grade 7–12
Mathematics Classes of Experienced Teachers

	Percent of Classes					
	Used		Not Needed		Needed, but not available	
Equipment	**P.A.**	**Nat.**	**P.A.**	**Nat.**	**P.A.**	**Nat.**
Videotape player	64	38	33	58	3	5
Overhead projector	93	74	6	23	2	3
Videodisc player	6	3	72	87	22	10
CD-ROM player	3	1	68	87	29	12
Four-function calculators	47	71	52	24	1	5
Fraction calculators	27	30	63	46	9	24
Graphing calculators	71	29	15	49	14	22
Scientific calculators	76	50	19	42	5	8
Computers	75	46	9	27	16	27
Computer/lab interfacing devices	30	24	28	43	42	34

Finally, Presidential Awardees stand out from their peers in the amount of money they spend out of their own pockets to support science and mathematics instruction. Whereas secondary teachers nationally spent a median of $50 per class on science supplies and $25 per class on mathematics supplies, Presidential Awardees spent about twice that amount. Even more dramatically, where elementary teachers spent a median of $25 on science supplies, and $50 on mathematics supplies per class, the medians for Presidential Awardees are $250 and $188, respectively. (See Table 32.)

Table 32
Annual Amount of Own Money Experienced Science and Mathematics Teachers Spend on Supplies Per Class

	Percent of Teachers			
	Grades 1–6		Grades 7–12	
Subject	**P.A.**	**Nat.**	**P.A.**	**Nat.**
Science	$250	$ 25	$120	$ 50
Mathematics	$188	$ 50	$ 50	$ 25

Conclusion

The eligibility criteria and the process of selecting Presidential Awardees for Science and Mathematics Teaching make differences between the two groups highly likely. It is not surprising that Presidential Awardees tend to be more highly educated than their national counterparts, with a larger proportion having extensive science and mathematics coursework and master's degrees. Moreover, as a consequence of the award, Presidential Awardees have more resources to devote to their teaching and more opportunities to serve in leadership roles. Thus one would expect differences in views on science and mathematics teaching, in classroom practices, and in professional activity.

What was unexpected, however, was the magnitude of the differences. For example, 84 percent of Presidential Awardees, but only 33 percent of their national counterparts endorsed the use of calculators in elementary mathematics instruction. Similarly, 77 percent of the awardees, but only 30 percent nationally supported an emphasis on writing about mathematics. In contrast, Presidential Awardees were much less likely to be in favor of emphasizing arithmetic computation (8 percent vs. 55 percent).

The differences in attitudes are translated into differences in instruction, with Presidential Awardees' classes considerably more likely to work in small groups and use manipulative materials, and considerably less likely to read a textbook in class or do worksheet problems. Similarly, Presidential Awardees are more likely than others to use projects and performance tasks in determining student grades and much less likely to use multiple choice and other objective texts.

Finally, differences in level of involvement in professional activities were enormous. Presidential Awardees were much more likely to be active professionally—whether serving on school or district committees, attending state or national teacher association meetings, or teaching in-service workshops for their colleagues. And while in 1993, only 1 in 7 of the nation's elementary mathematics teachers said they were "well aware" of the NCTM *Curriculum and Evaluation Standards* (published in 1989), the comparable figure for elementary mathematics Presidential Awardees was 99 percent.

In summary, the process of selecting Presidential Awardees seems to be effective in recognizing teachers whose backgrounds, beliefs, teaching styles, and professional involvement are consistent with the recommendations of professional associations and state and national standards.

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