Conclusion

Based on teacher responses to the national survey questionnaires, grade K–12 science and mathematics education was for the most part stable in the period from 1993 to 2000. Analysis of data from several items that were administered in the 1977 and/or 1985–86 national surveys reinforces the picture of overall stability in teaching practices.

One notable trend is that there has been an influx of females into the science and mathematics teaching force since 1977; for example, in 1977 only 25 percent of science teachers and 32 percent of mathematics teachers in grades 10–12 were female, compared to 48 and 57 percent, respectively in 2000. There has also been a trend toward a slightly more diverse teaching force, although minority groups continue to be underrepresented, with only 9–14 percent of teachers, compared to more than 30 percent of students, classified as non-white.

The newest teachers in 2000, those with five or fewer years of experience, are more likely to have completed a graduate degree than their counterparts in 1993. The number of semesters of college coursework of mathematics has increased for teachers in all three grade ranges. In contrast, the average number of semesters of college coursework in science completed by teachers did not increase, and in grades 5–8 actually fell between 1993 and 2000.

There appears to be little, if any, change in participation in subject-specific professional development among science and mathematics teachers; the amount of professional development for the average teacher remains strikingly low. Only 9–15 percent of grade 1–4 teachers, 17–23 percent of grade 5–8 teachers, and 31–45 percent of grade 9–12 teachers report participating in more than 35 hours of professional development in the last three years.

Survey data indicate some gains and some losses in teacher pedagogical preparedness. One prominent change is an increase in the percentage of grade 5–12 science teachers and grade 9–12 mathematics teachers indicating they are well prepared to have students work in cooperative learning groups. In contrast, in some groups of teachers (elementary science teachers and high school mathematics teachers), there was a trend toward feeling less prepared to include parents in the science/mathematics education of their children.

One of the most obvious differences between 1993 and 2000 is the amount of control science and mathematics teachers perceive themselves having over decisions related to curriculum, with fewer teachers reporting that they have strong control over determining course goals and objectives and over selecting the content, topics, and skills to be taught. In addition, teachers in both subjects and all grade ranges are more likely to report that the testing program in their state/district dictates what they teach.

Mathematics continues to be taught virtually every day in grades 1–12; in contrast, while the percent has increased since 1993, only about 70 percent of elementary classrooms receive science instruction every day. The amount of class time spent on mathematics instruction in the elementary grades has increased, and while time spent on science has increased slightly in grades 1–3, science still receives much less attention than mathematics in the elementary grades.

In terms of course offerings, there has been a decrease since 1993 in the percentage of high schools offering review mathematics courses, and an increase in the percentage of schools offering courses in probability and statistics. There has also been an increase in the percent of high schools offering advanced science courses (such as 2nd Year and Advanced Placement Chemistry). In middle schools, there has been a trend toward increased offering of general/integrated science courses.

In both science and mathematics there has been an increase in the percentage of classes containing LEP students in grades 1–4, a trend especially evident in the South and West. While the percentage of females in all science courses has remained roughly the same from 1993 to 2000, ranging from 46 to 56 percent, there has been an increase in the percentage of non-Asian minority students in science courses for grades 9–12, particularly in chemistry and physics courses.

Changes in science instruction are slight, but include reductions in students reading about science during class and doing textbook/worksheet problems. For the most part, the frequency of students doing hands-on/laboratory activities has not changed. The use of computers in science instruction is striking in its lack of change; in both 1993 and 2000, 10 percent or fewer science lessons included students using computers.

Mathematics instruction appears to have changed even less than science. Similar to science instruction, computer use in mathematics instruction has remained quite low, with well under 10 percent of the lessons in both 1993 and 2000 including computer use.

Access to technology generally appears to have improved since 1993, when as many as 41 percent of the schools rated access to computers as a serious problem. By 2000, this figure decreased to about 20 percent; apparently, the continued low levels of computer use are due to factors other than lack of access. Use of some other instructional technology has risen since 1993. The most dramatic change occurs across all levels and subjects with the rise in the use of CD-ROM, an increase from practically non-existent in 1993 to as much as 59 percent of the grade 5–8 science classes reporting their use in 2000.

The attention to science and mathematics education reform over the last decade begs the question: Why is widespread change not more evident? At the time of the survey, national standards documents for science and mathematics had been in the field for five and ten years, respectively; yet evidence of their impact on a national scale is not strong. One potential explanation lies in other data from this study, which show that the amount of subject-specific professional development for the average science and mathematics teacher is quite small, typically less than a few days over a three-year period. Without professional development opportunities, and the time and incentives to participate in them, teachers are not very likely to change their practice in ways envisioned by the reforms.

A second potential explanation concerns the context within which teachers work, much of which they have little control over. The standards documents make it clear that in order for change to occur, there must be a supportive policy context. As noted in this report, teachers are more likely today than several years ago to perceive high-stakes tests as dictating what they teach; the fact that many of these tests are not well-aligned with the reform vision would act as a deterrent to teachers for changing their practice.

Without opportunities for teachers to reform their practice or a context that supports such reforms, perhaps the lack of change is not so surprising after all.

Endnotes

1 Concerning race/ethnicity categories, in the 1993 survey, teachers were instructed to "circle one"; in the 2000 survey, teachers were instructed to "darken all that apply."

2 Concerning race/ethnicity categories, in the 1993 survey, teachers were instructed to "circle one"; in the 2000 survey, teachers were instructed to "darken all that apply."

3 The highest number of courses a teacher could indicate for each of the four categories—life science, chemistry, physics/physical science, and earth/space science—was ">8," and 9 was used as the number of courses in those cases. As a result, these figures underestimate the total for any teacher who completed more than nine courses in a particular category.

4 The highest number of courses a teacher could indicate for each of the four categories—calculus, statistics, advanced calculus, and "all other mathematics courses"—was ">8," and 9 was used as the number of courses in those cases. As a result, these figures underestimate the total for any teacher who completed more than nine courses in a particular category.

5 The standard errors are estimated using the average design effect.

6 The 1977 survey included Kindergarten teachers; estimates are for teachers of grades K–6, rather than 1–6.

7 The standard error is estimated using the average design effect.

8 The 1993 survey categories were "Discrete mathematics," "Number systems and number theory," and "Conceptual underpinnings of calculus."

9 The 2000 survey category was "Have students work in cooperative learning groups."

10 The 2000 survey category was "Have students work in cooperative learning groups."

11 The 1993 category was "Science teachers in this school regularly share ideas and materials."

12 The 1993 category was "Mathematics teachers in this school regularly share ideas and materials."

13 The 1993 category was "Selecting textbooks."

14 The 1993 category was "Selecting textbooks."

15 The standard errors are estimated using the average design effect.

16 To avoid overestimating the number of minutes typically spent on science instruction, if the most recent lesson did not take place on the last day school was in session, the number of minutes was treated as zero when the average was computed.

17 The 1993 survey did not include Kindergarten teachers; estimates are for teachers of grades 1–3, rather than K–3.

18 To avoid overestimating the number of minutes typically spent on mathematics instruction, if the most recent lesson did not take place on the last day school was in session, the number of minutes was treated as zero when the average was computed.

19 The 1993 survey did not include Kindergarten teachers; estimates are for teachers of grades 1–3, rather than K–3.

20 Only teachers who indicated they teach reading, mathematics, science, and social studies were included in these analyses.

[21] The 1977 survey included Kindergarten teachers; estimates are for teachers of grades K–3, rather than 1–3.

[22] Only teachers who indicated they teach reading, mathematics, science, and social studies were included in these analyses.

[23] The 1993 survey collected data for grades 7–8; the 2000 survey collected data for grades 6–8. To compensate, only schools containing grades 7 and/or 8 were included in these analyses.

[24] The 1993 data included coordinated science.

[25] The 1993 survey collected data for grades 7–8; the 2000 survey collected data for grades 6–8. To compensate, only classes with grade 7 and/or 8 students were used to calculate these numbers.

[26] The 1993 data included coordinated science.

[27] The standard error is estimated using the average design effect.

[28] The 1993 survey categories were “Use a computer,” “Watch the teacher demonstrate a scientific principle,” and “Work in small groups.”

[29] The standard error is estimated using the average design effect.

[30] The standard error is estimated using the average design effect.

[31] The 1993 survey categories were “Work in small groups” and “Use computers/calculators to develop an understanding of mathematics concepts.”

[32] The standard error is estimated using the average design effect.