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# Report of the 1985-86 National Survey of Science and Mathematics Education

by
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# Chapter 1
# INTRODUCTION

## A. Background and Purpose of the Study

In 1976 the National Science Foundation (NSF) commissioned a major assessment of science, mathematics, and social science education consisting of three studies:

1. A comprehensive review of the literature, conducted by the ERIC Center for Science, Mathematics, and Environmental Education at Ohio State University and the Social Sciences Education Consortium.
2. Case studies of eleven districts throughout the United States, coordinated by the University of Illinois.
3. A national survey of teachers, principals, district, and state personnel conducted by the Research Triangle Institute (RTI).

These three NSF research projects were widely quoted in reports of the status of science and mathematics education beginning with their publication in 1978.

As late as 1983, major reports on science and mathematics education, including those prepared by the National Science Board's Commission on Pre-College Education in Mathematics, Science, and Technology, continued to rely on 1977 data. RTI requested support from NSF for a second survey, to provide updated information about science and mathematics education as well as to identify trends since 1977. This project was funded in the spring of 1984.

While the second survey would be designed to be comparable to the earlier survey in order to detect trends, it would also differ in a number of ways from the 1977 survey. First, social science would no longer be a focus. While social science education is certainly important, the issues of interest differ markedly from those involved in science and mathematics education and would best be considered in a separate study. Second, while teachers would again be the primary source of data, and principals would again be included, the new survey would not include state or local supervisors or district superintendents. Based both on printed references to the 1977 survey and on the queries received by RTI, it appeared that data collected from teachers and principals were most useful in policy deliberations, and the decision was made to concentrate resources on these data sources.

The design and implementation of the 1985-86 National Survey of Science and Mathematics Education involved developing a sampling strategy and selecting samples of principals and teachers; developing and field testing survey instruments; collecting data from sample members; and preparing data files and analyzing the data. These activities are described in the following sections. The final section of this chapter outlines the contents of the remainder of the report.

## B. Sample Design and Sampling Error Considerations

The National Survey of Science and Mathematics Education involved a national probability sample of schools, principals, and teachers in grades K through 12. The sample was designed so that national estimates of teacher preparation, course offerings and enrollments, and classroom practices could be made from the sample data. The sample design also ensured that estimates could be made for various subpopulations such as those in a particular region or a particular type of community.

A probability sample requires that every member of the population being sampled have a positive chance of being selected. The sample design for this survey ensured that every principal or headmaster and teacher of mathematics and/or science in grades K-12 in the 50 states and the District of Columbia had a chance of being selected.

This study used a two-stage probability sampling design with schools as the first stage sampling units and teachers as the second stage units. In the first sampling stage, three independent grade-specific probability samples of 425 schools were selected with probability proportional to size. Schools were classified according to whether they contained grades K through 6, grades 7 through 9, or grades 10 through 12; schools containing grades spanning two or more of the grade ranges were eligible to be selected for multiple samples. The selection of sample schools required the construction of three grade range specific sampling frames, the computation of a size measure for each school and stratification of schools in each sampling frame. These activities are described in detail in Appendix A.

The second stage of sampling involved selecting a sample of science and mathematics teachers from the sample schools in each grade range. Many studies attempt to contact a sample of teachers by asking the principal to select one or more teachers at random. There is evidence, however, that this method often results in a biased sample. To avoid this problem, a list of names of all science and mathematics teachers in the appropriate grade range was obtained from the principal of each sample school. For schools selected for the K-6 and 7-9 samples, principals were asked to classify each teacher by teaching assignment: self-contained setting (responsible for teaching all or most academic subjects to a single group of students), mathematics only, science only, or both science and mathematics. Principals in schools selected for the 10-12 sample were asked to check the type(s) of science and mathematics courses taught by each teacher: biology/life sciences, chemistry, physics, earth/space science, "other science," calculus/advanced mathematics, and "other mathematics/computer science."

Since biology is by far the most common science course at the 10-12 level, selecting a random sample of science teachers would result in a much larger number of biology teachers than chemistry or physics teachers. In order to ensure that the sample would include a sufficient number of chemistry and physics teachers for separate analyses, information on teaching assignments was used to create separate domains, e.g., for teachers of "chemistry only" and "physics only," and sampling rates were adjusted by domain.

The study design included obtaining in-depth information from each teacher about curriculum and instruction in a single, randomly selected class. Most K-6 teachers were reported by their principals to teach in self-contained classrooms, i.e., they are responsible for teaching all academic subjects to a single group of students. Each such sample teacher was randomly assigned to one of two groups--science or mathematics--and received a questionnaire specific to that subject. Most 7-9 and 10-12 teachers and some K-6 teachers in the sample taught several classes of a single subject; some taught both science and mathematics. For each such teacher, one class was randomly selected. For example, a teacher who taught 2 classes of science and 3 classes of mathematics each day might have been asked to answer questions about his first or second science class or his first, second, or third mathematics class of the day.

Information about teaching assignments was used in constructing separate sampling frames for domains of interest within each sample grade range. For example, teachers who taught chemistry only were put in a single sampling frame. This system allowed RTI to "oversample" chemistry and physics teachers.

A total of 6,156 science and mathematics teachers were selected for this study, including 1,974 at the K-6 level, 1,882 at the 7-9 level, and 2,300 at the 10-12 level. Details about the construction of sampling frames and the selection of teachers in each frame are provided in Appendix A.

The results of any survey based on a sample of a population (rather than on the entire population) are subject to sampling variability. The sampling error (or standard error) provides a measure of the range within which a sample estimate can be expected to fall a certain proportion of the time. For example, it may be estimated that 10 percent of all K-6 mathematics classes use calculators. If it is determined that the sampling error for this estimate was 1 percent, then, according to the Central Limit Theorem, 95 percent of all possible samples of that same size selected in the same way would yield calculator usage estimates between 8 percent and 12 percent (that is, 10 percent ± 2 standard error units).

The decision to obtain information from a sample rather than from the entire population is made in the interest of reducing costs, both in terms of money and the burden on the population to be surveyed. The particular sample design chosen is the one which is expected to yield the most accurate information for the least cost.

It is important to realize that, other things being equal, estimates based on small sample sizes are subject to larger standard errors than those based on large samples. Also, for the same sample design and sample size, the closer a percentage is to 0 or 100, the smaller the sampling error.

In general, this report points out only those differences which are substantial as well as statistically significant as the .05 level or beyond. The reader who wishes to determine if particular percentages shown in the tables differ significantly should refer to Appendix B for instructions for using the genrealized tables of standard errors.

## C. Instrument Development

The 1985-86 National Survey of Science and Mathematics Education involved collecting data from a sample of principals and teachers throughout the United States. Since a primary purpose of the study was to identify recent trends in science and mathematics education, the process of developing survey instruments began with the questionnaires that had been used in the 1977 National Survey of Science, Mathematics, and Social Studies Education.[1] The project Advisory Panel, comprised of experienced researchers in science and mathematics education, reviewed the 1977 questionnaires and made recommendations about retaining or deleting particular items. Additional items needed to provide important information about the current status of science and mathematics education were also considered.

Preliminary drafts of the questionnaires were reviewed by representatives of The Association of State Supervisors of Mathematics and the Council of State Science Supervisors, to help ensure that the survey would meet the information needs of state-level personnel. Questionnaire drafts were also sent to numerous professional organizations including the American Association for the Advancement of Science, the National Science Teachers Association, the National Council of Teachers of Mathematics, the National Education Association, the American Federation of Teachers, The National Association of Elementary School Principals and the National Association of Secondary School Principals, for review and comment.

The Committee on Evaluation and Information Systems (CEIS) also played an important role in the instrument development process. This committee was established by the Council of Chief State School Officers to reduce the burden of data collection efforts on local education agencies; most state commissioners of education will not approve a survey unless it is first endorsed by CEIS. RTI worked with members of the CEIS committee throughout the

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1/ The instruments used in the 1977 survey are included in the project final report. (Weiss, I. R. Report of the 1977 National Survey of Science, Mathematics, and Social Studies Education. Research Triangle Park, NC: Research Triangle Institute, 1978.

planning stages of this project to make sure that the disruption to school activities and the burden on principals and teachers would be kept to a minimum. CEIS officially endorsed the survey in April, 1985.

The survey instruments were revised based on feedback from the various reviewers, field tested, and revised again. The instrument development process was a lengthy one, constantly compromising between information needs and data collection constraints. There were several iterations of field testing and revision, with frequent input from the project Advisory Panel, to help ensure that individual items were clear and unambiguous and that the survey as a whole would provide the necessary information with the least possible burden on participating principals and teachers. The survey was endorsed by more than 20 professional organizations, whose names were listed on the questionnaires.

D. Data Collection

Once the Committee on Evaluation and Information Systems had approved the study design, instruments, and data collection procedures, the Chief State School Officers were asked for permission to contact those districts in each state that included one or more sample schools. While in a few cases repeated contacts were necessary, eventually RTI obtained permission to contact all of these districts.

While the 1985-86 National Survey of Science and Mathematics Education did not involve collecting data from superintendents, protocol dictates that superintendents be informed prior to contact with any schools in their districts. Consequently, as state permission was obtained beginning in May 1985, a letter describing the study was sent to the district superintendents of the sample schools. Superintendents were asked to verify the name and address of the schools and to call a toll-free number if any of these schools were now closed or other corrections were needed, or if they had any concerns about the study. A number of districts, typically the larger ones, required that the study comply with their local procedures for approval of research efforts; in all such cases, RTI sent the requested information and completed the necessary forms. As a result of these contacts with districts, 18 sample schools were determined to be ineligible due to school closings and mergers. Five districts, representing 9 sample schools, refused to participate in the survey.

In September 1985, a description of the survey was sent to the principal of each sample school, along with a teacher listing form and a set of posters of "typical" scientists and mathematicians as a token of our appreciation for their participation. Telephone follow-ups were used to obtain lists from non-responding schools. In cases where principals would not release teacher names because of privacy concerns, coding systems were developed to ensure confidentiality. As a result of this process, 37 schools were identified as ineligible. Teacher lists were obtained from 1,166 of the remaining 1,248 sample schools, for a response rate of 93 percent.

As was described earlier, information from the teacher listing forms was used to select a sample of science and mathematics teachers at each of three grade ranges -- K-6, 7-9, and 10-12; these teachers were subsequently mailed questionnaires, as were the principals of the sample schools.

Questionnaires returned by mail were assigned to control batches and routed on a flow basis to a central check-in point for initial processing. Each respondent's 5-digit ID number and batch number were transmitted to the data processing section for entry into an automated survey support system, which allowed mail and telephone follow-ups to be focused on only those who had not yet returned their questionnaires.

It should be noted that while this study was planned as the "1985 National Survey of Science and Mathematics Education", due to delays in the approval process and difficulties in achieving acceptable response rates, survey data were actually collected during the period from November 1985 through May 1986. The final response rates, after repeated mail and telephone contacts with non-responding teachers and principals, and excluding ineligibles, were 75 percent for teachers and 86 percent for principals.

## E. File Preparation and Analysis

Once completed questionnaires were checked in by identification number and assigned to control batches, they were routed to the pre-machine editing and coding section at RTI. Manual editing was used to identify and, if possible, resolve multiple responses. For example, if an elementary teacher indicated spending approximately 40-50 minutes per day on mathematics instruction, the average value of 45 was used. On the other hand, if 1983-84 was written in as the year in which the respondent last took a course for college credit, the year 1984 was used. A number of questions called for non-numeric answers such as the title and author of a science or mathematics textbook or the name of a professional magazine or journal. These responses were coded into numeric form in preparation for data entry.

Following manual coding and editing, the questionnaires were transformed to machine-readable form using programmable terminals. Major advantages of this type of data transformation include higher speed, fewer processing steps, and lower transcription error rates. The terminals were programmed to accept only values within a specified range for most of the data fields, and only specific field widths for all data items. Responses which were outside the acceptable range for each item were coded as "bad data"; for example, if a teacher indicated that he had taken his last course for college credit in 1990 this response was considered uncodable. Similarly, if the number of minutes reportedly spent in a lesson exceeded the number of minutes in the school day, the response was considered uncodable.

The majority of the machine-editing checks involved routing questions, i.e., questions that either implicitly or explicitly directed respondents around questions that did not apply to them. A routing-check program was used to determine if the respondents correctly followed the routing patterns and to flag the responses of violators. Subsequent analyses could then easily exclude flagged records from the tabulations. For example, if a principal indicated that computers were not available for use in instruction and then proceeded to indicate how many computers were available for student use, the data are clearly inconsistent; in cases such as these the inconsistent data were omitted from the analyses of numbers of computers.

The final step in file preparation was the addition of weights to the file. The weight for each respondent was calculated as the inverse of the probability of selecting the individual into the sample multiplied by a non-response adjustment factor.[2] All population estimates presented in this report were computed using weighted data. In the case of data about a randomly selected class, the teacher weight was adjusted to reflect the number of classes taught, and therefore the probability of a particular class being selected.

F. Outline of This Report

This report of the 1985-86 National Survey of Science and Mathematics Education is organized into major topical areas. Chapter 2 presents information about science and mathematics course offerings at the secondary level and about the time spent on science and mathematics instruction in the elementary grades.

Issues related to textbook usage are examined in Chapter 3. This chapter includes a list of commonly used science and mathematics textbooks in each grade range as well as teacher perceptions about textbook quality.

Chapter 4 presents information about the objectives of science and mathematics instruction, and the instructional techniques used in science and mathematics classes. Data about use of calculators and computers and the amount of time spent on homework are also presented.

Chapter 5 focuses on science and mathematics teachers. Basic demographic data are presented along with information about certification status, degrees earned, and science and mathematics course background.

Teacher perceptions of their qualifications to teach science and mathematics are treated in Chapter 6; information is also provided about in-service education and other opportunities for professional development.

Finally, Chapter 7 presents data about a number of factors which are likely to affect science and mathematics instruction, including the availability of instructional resources and the supply of qualified teachers.

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2/ The aim of non-response adjustment is to reduce the possible bias by distributing the non-respondent weights among the respondents expected to be most similar to these non-respondents. In this study, adjustment was made by urbanicity of the school, and in the case of teachers, by subjects taught as well.

## Chapter 2

## SCIENCE AND MATHEMATICS COURSES

### A. Overview

The 1985-86 National Survey of Science and Mathematics Education collected data from principals on the science, mathematics, and computer science courses offered in their schools. Teachers provided information about class size and ability levels, the time spent in elementary science and mathematics instruction, and the titles and duration of secondary science and mathematics courses. These results, and comparisons to results of the 1977 survey when appropriate, are presented in the following sections.

### B. Time Spent in Elementary Science and Mathematics Instruction

Each teacher was asked to indicate the number of minutes spent in the most recent lesson in the selected subject and class. It was recognized that some subjects are not taught every day in some classes; for example some elementary classes have instruction in reading and mathematics every day and in science and social studies instruction only on alternate days. To avoid overestimating the number of minutes typically spent on science and mathematics, 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.

Table 1 shows the average number of minutes spent in K-3 and 4-6 science and mathematics instruction in both 1985-86 and 1977.[3] The time spent on science and mathematics instruction has remained essentially the same; there are no significant differences between the 1977 and 1985-86 estimates. At each grade level, substantially more time is spent on mathematics instruction than on science instruction.

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3/ The reader should exercise caution in interpreting these results since they are based on teacher estimates of time spent rather than on actual measurements.

Table 1

AVERAGE NUMBER OF MINUTES PER DAY SPENT
IN ELEMENTARY SCHOOL MATHEMATICS AND SCIENCE BY GRADE RANGE
1977 and 1985-86*

| | 1977 | | 1985-86 | |
|---|---|---|---|---|
| | Minutes | Standard Error | Minutes | Standard Error |
| Science | | | | |
| K-3 | 19 | 4.12 | 19 | .99 |
| 4-6 | 35 | 1.73 | 38 | 5.26 |
| Mathematics | | | | |
| K-3 | 38 | 2.53 | 38 | 1.15 |
| 4-6 | 44 | 2.09 | 49 | 1.49 |

*Classes in which the most recent lesson was not on the last day school was in session were assigned zeros for number of minutes spent in the lesson.

In addition to asking teachers about the number of minutes spent in their most recent lesson in a particular subject, each elementary teacher was asked to write in the approximate number of minutes typically spent teaching mathematics, science, social studies, and reading.[4] The average number of minutes per day typically spent in K-3 and 4-6 instruction in each subject is shown in Table 2; to facilitate comparisons among the subject areas only teachers who teach all 4 of these subjects to one class of students were included in these analyses. In each grade level the amount of time spent is greatest for reading, followed by mathematics, then social studies and science; the same was true in 1977. The only substantial difference between the 1977

4/ Again, it is essential to realize that the results are based on teacher estimates of time spent, not on actual measurements.

Table 2

AVERAGE NUMBER OF MINUTES PER DAY SPENT
TEACHING EACH SUBJECT TO SELF-CONTAINED CLASSES BY GRADE RANGE
1977 and 1985-86*

| | 1977 | | | | 1985-86 | | | |
|---|---|---|---|---|---|---|---|---|
| | K-3 | | 4-6 | | K-3 | | 4-6 | |
| Subject | Minutes | Standard Error | Minutes | Standard Error | Minutes | Standard Error | Minutes | Standard Error |
| Science | 17 | .24 | 26 | .64 | 18 | .38 | 29 | .59 |
| Social Studies | 21 | .62 | 34 | .71 | 18 | .40 | 33 | .54 |
| Mathematics | 41 | .61 | 51 | .43 | 43 | .67 | 52 | .60 |
| Reading | 95 | 1.60 | 66 | 1.34 | 77 | 1.58 | 83 | 1.27 |

* Only teachers who indicated they teach mathematics, science, social studies, and reading to one class of students were included in these analyses.

results and those for 1985-86 is the significantly less time now spent on reading instruction in grades K-3. The survey provided no information about where the additional time that used to be spent on reading instruction is now being spent, other than the fact that it is apparently something other than science, social studies, or mathematics instruction.

Each elementary teacher was asked how the amount of time spent in instruction in the selected subject and class compared to the amount of time spent in a similar class 3 years ago. The results are shown in Table 3; the approximately 25-30 percent of each subject/grade range category who either were not teaching 3 years previously or who taught another grade level were not included in the analyses. The majority of teachers who taught the same grade level 3 years ago are spending about the same time on science and mathematics now. Of the others, many more indicate they are spending more time now than indicate spending less time now.

C. Science, Mathematics and Computer Science Course Offerings

Each principal of a 7-9 or 10-12 sample school was given a list of science, mathematics, and computer science courses and asked to specify the number of sections of each course offered in the school. The principal was also asked to write in course names and indicate the number of sections of each for those science, mathematics, and computer science courses offered in the school which were not included on the printed list.

Table 4 shows the percent of schools in each sample grade range which offer each of the most common science, mathematics, and computer science courses. It is important to remember that a school which was selected as a 7-9 sample school or a 10-12 sample school may contain other grades as well. For example both the 7-9 and 10-12 samples include some 9-12 schools. Thus, the fact that 64 percent of all schools with grades 10-12 offer a course in grade 9 general mathematics is simply a reflection of the fact that so many schools which have grades 10-12 also include grade 9.

Table 3

TIME SPENT ON MATHEMATICS AND SCIENCE IN ELEMENTARY CLASSES RELATIVE TO THREE YEARS AGO*

| | Percent of Classes | | | |
|---|---|---|---|---|
| | Mathematics | | Science | |
| Amount of Time | K-3 | 4-6 | K-3 | 4-6 |
| More time spent now | 30 | 15 | 35 | 32 |
| About the same | 65 | 78 | 57 | 60 |
| Less time spent now | 4 | 6 | 7 | 6 |
| Unknown | 2 | 1 | 2 | 3 |
| Sample N | 312 | 179 | 316 | 209 |

* Teachers who indicated they did not teach a class of the same grade level three years ago were not included in the analyses.

Table 4

COMMON SCIENCE, MATHEMATICS, AND COMPUTER SCIENCE COURSES OFFERINGS

Percent of Schools Offering Course

| | School With Only Grades 7-9 | Schools With Grades 7-9 and Higher | All Schools With Grades 7-9 | Schools With Only Grades 10-12 | Schools With Grades 10-12 and Lower | All Schools With Grades 10-12 |
|---|---|---|---|---|---|---|
| I. Science Courses | | | | | | |
| Life Science | 63 | 46 | 57 | 24 | 48 | 46 |
| Earth Science | 54 | 62 | 57 | 10 | 54 | 52 |
| Physical Science | 38 | 86 | 53 | 45 | 70 | 68 |
| General Science, Grade 7 | 49 | 33 | 43 | 0 | 27 | 25 |
| General Science, Grade 8 | 46 | 32 | 41 | 0 | 28 | 26 |
| General Science, Grade 9 | 5 | 37 | 17 | 0 | 34 | 31 |
| General Science, Grades 10-12 | 0 | 15 | 6 | 24 | 18 | 18 |
| Biology, 1st year | 7 | 98 | 41 | 93 | 99 | 99 |
| Chemistry, 1st year | 1 | 91 | 34 | 98 | 90 | 91 |
| Physics, 1st year | 0 | 88 | 32 | 97 | 79 | 81 |
| Biology, 2nd year | 0 | 45 | 17 | 55 | 53 | 53 |
| Chemistry, 2nd year | 0 | 28 | 10 | 45 | 27 | 28 |
| Physics, 2nd year | 0 | 12 | 4 | 21 | 10 | 11 |
| Astronomy | 2 | 9 | 5 | 24 | 6 | 8 |
| Anatomy/Physiology | 2 | 31 | 13 | 45 | 31 | 32 |
| Ecology, Environmental Science | 3 | 24 | 11 | 45 | 12 | 15 |
| Zoology | 2 | 9 | 5 | 12 | 5 | 6 |
| Sample N | 232 | 116 | 348 | 66 | 294 | 360 |

COMMON SCIENCE, MATHEMATICS, AND COMPUTER SCIENCE COURSES OFFERINGS (continued)

Percent of Schools Offering Course

| | School With Only Grades 7-9 | Schools With Grades 7-9 and Higher | All Schools With Grades 7-9 | Schools With Only Grades 10-12 | Schools With Grades 10-12 and Lower | All Schools With Grades 10-12 |
|---|---|---|---|---|---|---|
| **II. Mathematics Courses** | | | | | | |
| Mathematics, Grade 7 | 96 | 45 | 79 | 0 | 51 | 46 |
| Mathematics, Grade 8 | 93 | 42 | 74 | 0 | 49 | 45 |
| General Mathematics, Grade 9 | 10 | 71 | 33 | 0 | 69 | 64 |
| General Mathematics, Grade 10 | 0 | 47 | 17 | 50 | 45 | 46 |
| Business Mathematics | 4 | 44 | 19 | 58 | 48 | 49 |
| Consumer Mathematics | 2 | 55 | 22 | 55 | 49 | 49 |
| Remedial Mathematics | 19 | 35 | 25 | 42 | 28 | 29 |
| Pre-Algebra/ Intro. to Algebra | 38 | 60 | 46 | 30 | 65 | 63 |
| Algebra, 1st year | 34 | 98 | 57 | 93 | 99 | 99 |
| Algebra, 2nd year | 2 | 92 | 36 | 96 | 92 | 92 |
| Geometry | 11 | 93 | 41 | 97 | 94 | 95 |
| Trigonometry | 0 | 63 | 23 | 79 | 57 | 59 |
| Probability/Statistics | 0 | 17 | 6 | 23 | 13 | 14 |
| Advanced Sr. Math, no Calculus | 0 | 34 | 12 | 49 | 35 | 36 |
| Advanced Sr. Math, with Calculus | 0 | 34 | 12 | 36 | 34 | 34 |
| Calculus | 0 | 38 | 14 | 63 | 28 | 31 |
| Advanced Placement Calculus | 0 | 16 | 6 | 35 | 17 | 18 |
| Any Calculus or Advanced Mathematics | 0 | 80 | 30 | 98 | 73 | 76 |
| Sample N | 232 | 116 | 348 | 66 | 294 | 360 |

COMMON SCIENCE, MATHEMATICS, AND COMPUTER SCIENCE COURSES OFFERINGS (continued)

Percent of Schools Offering Course

| | School With Only Grades 7-9 | Schools With Grades 7-9 and Higher | All Schools With Grades 7-9 | Schools With Only Grades 10-12 | Schools With Grades 10-12 and Lower | All Schools With Grades 10-12 |
|---|---|---|---|---|---|---|
| III. Computer Science Courses | | | | | | |
| Computer Awareness or Literacy | 51 | 65 | 56 | 37 | 64 | 62 |
| Applications and Implications of Computers | 9 | 36 | 20 | 24 | 23 | 24 |
| Introductory Computer Programming | 19 | 71 | 38 | 81 | 64 | 65 |
| Advanced Computer Programming | 6 | 31 | 15 | 59 | 36 | 38 |
| Advanced Placement Computer Science | 1 | 12 | 5 | 10 | 12 | 13 |
| Any Computer Science | 60 | 94 | 72 | 90 | 90 | 91 |
| Sample N | 232 | 116 | 348 | 66 | 294 | 360 |

To help in the interpretation of course offerings results, data are presented for six groups:

(1) schools which include one or more of the grades 7-9 but do not include any higher grades (typically middle and junior high schools);

(2) schools with one or more of the grades 7-9 and also one or more higher grades (typically 7-12 and 9-12 schools);

(3) all schools which contain one or more of the grades 7-9;

(4) schools which include one or more of the grades 10-12 but do not include any lower grades;

(5) schools which include one or more of the grades 10-12 and also one or more lower grades; and

(6) all schools which contain one or more of the grades 10-12.

For example, Table 4 shows that while an estimated 25 percent of all schools with one or more of the grades 10-12 offer grade 7 general science, none of the "schools with only grades 10-12" offers this course. It is reasonable to conclude that the grade 7 general science enrollment in schools with grades 10-12 is comprised of grade 7 students who attend these schools. Similarly, the substantial percentages of schools in grades 7-9 offering courses such as chemistry and physics is due to the many 7-9 schools that include higher grades as well.[5]

It was noted earlier that one of the major purposes of the 1985-86 National Survey of Science and Mathematics Education was to provide information about trends since 1977. For this reason, identical items were used whenever possible. In a few cases, however, item formats and/or instructions were modified in order to avoid problems encountered in the earlier administration. Course offerings was one of those cases.

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5/ The reader is cautioned that estimates for a subset of 7-9 or 10-12 schools may be based on extremely small samples. In particular, of the 360 responding sample schools with one or more of the grades 10-12 only 66 are "10-12 only" schools. Therefore, as can be seen in Appendix B, the standard errors associated with estimates of course offerings for "10-12 only" schools are quite large.

The 1977 survey asked principals for both the number of sections and the total enrollment of each science and mathematics course offered in their schools. A number of principals objected to the burden imposed by this task; non-response on these items was relatively high. In addition, there was evidence that some principals may not have followed the instruction: "Do not include courses or enrollments more than once." For example, a school with 26 eighth graders indicated that 26 students were enrolled in one section of general science, grade 8 and 26 students were enrolled in one section of earth science. While we could not be sure that this was a violation of the instructions, we considered it likely. This problem was more likely to have affected 7-9 science courses than 10-12 courses, since high school science courses tend to have specific titles.

Extensive field testing of various item formats and sets of instruction led us to make a number of changes:

(1) Principals would be asked to provide only the number of sections, not the total enrollment. This would reduce the response burden on principals but still allow us to calculate the percent of schools offering each course; enrollment estimates could later be derived from teacher-supplied data.

(2) The order of the major 7-9 courses would be reversed, listing life science, earth science, and physical science first, followed by the various grades of general science.

(3) The caution about listing enrollment only once would be printed in italics and underlined for emphasis, and an example would be added: For example, if 7th grade science in your school is actually life science, enter the number of sections as "Life Science," not "General Science, Grade 7."

Taken together, these changes had the desired effects. Response to this item was high, and we did not see evidence of counting the same section more than once. On the other hand, these changes tend to make comparisons with 1977 results more difficult. For example, the 1985-86 survey found that life science, earth science and physical science were the most commonly offered science courses in grades 7-9, while the 1977 survey had found that general science courses were more common. (See Table 5.) It may be that large numbers

Table 5

COMPARISON OF SELECTED MATHEMATICS AND SCIENCE
COURSE OFFERINGS IN 1977 AND 1985-86 BY SAMPLE GRADE RANGE*

| | Percent of Schools | | | |
|---|---|---|---|---|
| | 1977 | | 1985-86 | |
| A. Mathematics | 7-9 | 10-12 | 7-9 | 10-12 |
| Mathematics, Grade 7 | 82 | 34 | 79 | 46 |
| Mathematics, Grade 8 | 78 | 36 | 74 | 45 |
| General Math, Grade 9 | 36 | 59 | 33 | 64 |
| General Math, Grades 10-12 | 12 | 42 | 17 | 46 |
| Business Mathematics | 17 | 52 | 19 | 49 |
| Geometry | 33 | 97 | 41 | 95 |
| Trigonometry | 14 | 54 | 23 | 59 |
| Probability/Statistics | 3 | 7 | 6 | 14 |
| Calculus | 7 | 31 | 14 | 31 |
| B. Science | | | | |
| Life Science | 22 | 18 | 57 | 46 |
| Earth Science | 28 | 37 | 57 | 52 |
| Physical Science | 23 | 40 | 53 | 68 |
| General Science, Grade 7 | 65 | 23 | 43 | 25 |
| General Science, Grade 8 | 57 | 26 | 41 | 26 |
| General Science, Grade 9 | 21 | 46 | 17 | 31 |
| General Science, Grades 10-12 | 6 | 11 | 6 | 18 |
| Biology, 1st Year | 30 | 95 | 41 | 99 |
| Chemistry, 1st Year | 23 | 89 | 34 | 91 |
| Physics, 1st Year | 22 | 78 | 32 | 81 |
| Sample N | 291 | 253 | 348 | 360 |

* In both the 1977 and 1985-86 surveys 7-9 and 10-12 schools were defined as schools that contained at least one of those grades. The fact that many schools cut across those boundaries, e.g., 7-12 or 9-12 explains, for example, why 12 percent of 7-9 schools offer general mathematics, grades 10-12.

of schools have switched from general science to subject-specific courses, and in fact the teacher responses provide some evidence of this trend. On the other hand, these apparent differences may be due at least in part to changes in the item format and wording.

According to the 1985-86 results, life science, earth science and physical science are each offered by more than 50 percent of the schools with grades 7-9. General science is also frequently offered in grades 7 and 8, but relatively infrequently in grade 9.

At the 10-12 level, most schools offer courses in biology (99 percent), chemistry (91 percent) and physics (81 percent). Not surprisingly, small schools are considerably less likely to offer a wide variety of science courses, especially higher-level courses (see Table 6). For example, 26 percent of small high schools (defined as enrollment less than 800) do not offer a course in physics, compared to only 6 percent of schools with enrollments greater than 1400.

In addition, many schools that are able to offer courses in physics and chemistry typically have very few sections of each. As shown in Table 7, only 23 percent of the nation's high schools have 5 or more chemistry sections and only 5 percent have 5 or more physics sections. Even in biology, only 40 percent of the high schools have as many as 5 sections. Since a typical teacher teaches 5 or 6 classes each day, it is inevitable that many science teachers will be assigned to teach courses outside their primary area of specialty.

In mathematics, the most commonly offered courses in grades 7-9 are mathematics, grade 7 (79 percent) and grade 8 (74 percent), and 1st year algebra, offered by 57 percent of schools with grades 7-9. More than half of all 7-9 schools offer a course in computer awareness or literacy.

In grades 10-12, 99 percent of schools offer a course in first-year algebra, 95 percent offer a geometry course, 91 percent offer some type of computer science, but only 31 percent offer a course in calculus. Again, small high schools are considerably less likely to be able to offer higher level courses: 22 percent of small schools offer calculus compared to 57 percent of large schools.

Table 6

SELECTED COURSE OFFERINGS BY SCHOOL SIZE AND TYPE OF COMMUNITY

| | | Percent of High Schools | | |
|---|---|---|---|---|
| | Sample N | Chemistry | Physics | Calculus |
| Total | (360) | 91 | 81 | 31 |
| School Size | | | | |
| Small | (134) | 87 | 74 | 22 |
| Medium | (106) | 99 | 98 | 48 |
| Large | (120) | 98 | 94 | 57 |
| Type of Community | | | | |
| Rural | (128) | 88 | 75 | 18 |
| Urban | (106) | 90 | 85 | 39 |
| Suburban | (126) | 97 | 90 | 54 |

Table 7

PERCENT OF HIGH SCHOOLS OFFERING 0, 1, 2, 3, 4, AND 5
OR MORE SECTIONS OF SELECTED COURSES

| | Number of Sections | | | | | |
|---|---|---|---|---|---|---|
| Course | 0 | 1 | 2 | 3 | 4 | 5 or more |
| Biology | 1 | 23 | 16 | 14 | 6 | 40 |
| Chemistry | 9 | 35 | 18 | 9 | 6 | 23 |
| Physics | 19 | 52 | 13 | 6 | 5 | 5 |
| First-Year Algebra | 1 | 29 | 20 | 13 | 6 | 31 |
| Geometry | 5 | 33 | 15 | 7 | 11 | 29 |
| Calculus | 69 | 23 | 8 | 0 | 0 | 0 |

Sample N = 360

While most schools have only a small number of sections of each mathematics course--only 29 percent have 5 or more sections of geometry, 31 percent have 5 or more sections of first year algebra, and less than 1 percent have that many sections of calculus--the fact that teacher preparation programs are geared to producing "mathematics" teachers rather than algebra or calculus teachers makes this less of a problem than in science.

In addition to obtaining course titles from principals, the survey instruments requested that each sample secondary science and mathematics teacher provide the title of a randomly selected class. The results are shown in Table 8, along with comparable results from the 1977 survey. As was the case in 1977, general mathematics and algebra together continue to account for the overwhelming majority of 7-9 mathematics classes. There has, however, been a significant decrease in the percent of general mathematics classes in favor of more algebra classes. At the high school level, algebra and geometry continue to be the most commonly offered mathematics classes, accounting for half of all 10-12 mathematics/computer science classes.

The teacher-supplied data provides additional evidence of a trend away from general science toward discipline-specific science courses at the 7-9 level. (The change from 30 percent general science in 1977 to 20 percent in 1985-86 is statistically significant.) As was the case in 1977, biology, chemistry, and physics classes together represent roughly 70 percent of all 10-12 science classes; another 7 percent of classes are 2nd year biology. The remaining 24 percent of 10-12 science classes are scattered among a large number of course titles.

Secondary science teachers were also asked to indicate whether the content of the randomly selected class was general science, biological sciences, physical sciences, or earth sciences. As can be seen in Table 9, 7-9 science courses are spread out across all of these categories. In contrast, at the 10-12 level half of all classes relate to the biological sciences while only 1 percent are general science and only 3 percent are in the earth/space sciences.

Table 8

MOST COMMONLY OFFERED SCIENCE AND MATHEMATICS COURSES, 1977 and 1985-86

| | | Percent of Classes 1977 | | 1985-86 |
|---|---|---|---|---|
| **7-9 Science Courses** | | | | |
| General Science | | 30 | | 20 |
| Life Science | | 16 | | 25 |
| Earth Science | | 25 | | 23 |
| Physical Science | | 15 | | 18 |
| Biology | | 6 | | 8 |
| Other Courses | | 8 | | 6 |
| | | 100% | | 100% |
| Sample N | (n=535) | | (n=658) | |
| **10-12 Science Courses** | | | | |
| Biology, 1st Year | | 40 | | 35 |
| Chemistry, 1st Year | | 19 | | 22 |
| Physics, 1st Year | | 15 | | 12 |
| Biology, 2nd Year | | 5 | | 7 |
| Other Courses | | 21 | | 24 |
| | | 100% | | 100% |
| Sample N | (n=586) | | (n=1050) | |
| **7-9 Mathematics/ Computer Science Courses** | | | | |
| General Mathematics | | 64 | | 52 |
| Algebra | | 23 | | 33 |
| Remedial Mathematics | | 4 | | 4 |
| Computer Science | | -- | | 4 |
| Other Courses | | 9 | | 7 |
| | | 100% | | 100% |
| Sample N | (n=550) | | (n=671) | |
| **10-12 Mathematics/ Computer Science Courses** | | | | |
| Algebra | | 38 | | 36 |
| Geometry | | 30 | | 21 |
| Advanced Math, Calculus | | 7 | | 13 |
| Consumer/Business | | 6 | | 7 |
| General Mathematics | | 5 | | 5 |
| Computer Science | | -- | | 10 |
| Other Courses | | 14 | | 8 |
| | | 100% | | 100% |
| Sample N | (n=548) | | (n=565) | |

Table 9

CONTENT OF SECONDARY SCIENCE CLASSES BY GRADE RANGE

| | Percent of Classes | |
|---|---|---|
| | 7-9 | 10-12 |
| General Science | 21 | 1 |
| Biology, life sciences, environmental science | 31 | 50 |
| Chemistry, physics, physical sciences | 20 | 42 |
| Earth/space sciences | 24 | 3 |
| Other | 4 | 1 |
| Sample N | (n=658) | (n=1050) |

D. <u>Other Characteristics of Science and Mathematics Classes</u>

As was the case in 1977, the overwhelming majority of secondary mathematics and science classes are one year in length (see Table 10). Average class size varies slightly by subject and grade range but is generally around 22 to 24, a decrease from the 1977 averages of 23 to 31, with the most substantial decreases in class size at the 4-6 and 7-9 levels (see Table 11).

Table 10

DURATION OF SECONDARY MATHEMATICS AND SCIENCE CLASSES
1977 and 1985-86

Percent of Classes

| | 1977 | | | | 1985-86 | | | |
|---|---|---|---|---|---|---|---|---|
| | Mathematics | | Science | | Mathematics | | Science | |
| Duration | 7-9 | 10-12 | 7-9 | 10-12 | 7-9 | 10-12 | 7-9 | 10-12 |
| Year | 96 | 86 | 86 | 88 | 94 | 82 | 91 | 91 |
| Semester | 2 | 9 | 7 | 6 | 3 | 15 | 6 | 8 |
| Quarter | 1 | 3 | 4 | 4 | 2 | 1 | 1 | 0 |
| Other | 1 | 1 | 2 | 0 | 1 | 1 | 2 | 0 |
| Missing | 0 | 1 | 2 | 3 | 1 | 1 | 0 | 0 |
| Sample N | 550 | 548 | 535 | 586 | 671 | 565 | 658 | 1050 |

Table 11

AVERAGE CLASS SIZE
1977 and 1985-86

| | 1977 | | 1985-86 | |
|---|---|---|---|---|
| | Class Size | Standard Error | Class Size | Standard Error |
| Science | | | | |
| K-3 | 23.5 | .36 | 23.9 | .37 |
| 4-6 | 26.6 | .65 | 24.6 | .45 |
| 7-9 | 30.6 | .74 | 23.7 | .40 |
| 10-12 | 22.8 | .36 | 22.1 | .34 |
| Mathematics | | | | |
| K-3 | 24.2 | .23 | 22.7 | .33 |
| 4-6 | 27.7 | .52 | 23.5 | .64 |
| 7-9 | 26.7 | .33 | 23.3 | .39 |
| 10-12 | 23.6 | .46 | 21.4 | .39 |

Teachers were also asked to indicate the ability make-up of the selected class compared to the average student in the grade. These results are shown in Table 12. Elementary classes tend to be composed primarily of average ability students or students of widely differing abilities. In grades 7-9 we see some evidence of homogeneous grouping, where roughly a third of science and mathematics classes are considered either high or low ability. And in 10-12 science a striking difference appears -- fully one-third of all science classes are composed primarily of high ability students, presumably because a disproportionate number of lower ability students have elected not to take science in the upper grades.

Table 12

ABILITY MAKE-UP OF MATHEMATICS AND SCIENCE CLASSES

| | Mathematics | | | Science | | |
|---|---|---|---|---|---|---|
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| High Ability | 8 | 16 | 11 | 10 | 19 | 34 |
| Low Ability | 10 | 16 | 12 | 10 | 17 | 10 |
| Average Ability | 44 | 49 | 46 | 43 | 34 | 33 |
| Widely Differing Levels | 37 | 19 | 30 | 37 | 30 | 21 |
| Missing | 1 | 1 | 1 | 0 | 0 | 1 |
| Sample N | 686 | 671 | 565 | 710 | 658 | 1050 |

In a related question, both teachers and principals were asked whether they considered science and mathematics difficult subjects for children to learn; these results are shown in Table 13. Note that elementary mathematics is more often perceived as difficult to learn than is elementary science. In addition, the percentages of teachers and principals viewing each subject as difficult to learn tends to increase with grade level.

Table 13

TEACHER AND PRINCIPAL OPINIONS ABOUT THE DIFFICULTY OF SCIENCE AND MATHEMATICS

| | | Percent of Respondents | | | | | |
|---|---|---|---|---|---|---|---|
| | Sample N | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree | Missing |
| **A. Science is a difficult subject for children to learn.** | | | | | | | |
| Science Teachers | | | | | | | |
| K-6 | (710) | 2 | 11 | 2 | 57 | 23 | 5 |
| 7-9 | (658) | 5 | 30 | 7 | 46 | 9 | 3 |
| 10-12 | (1050) | 4 | 30 | 3 | 47 | 13 | 3 |
| Principals | | | | | | | |
| K-6 | (365) | 1 | 15 | 2 | 60 | 22 | 0 |
| 7-9 | (348) | 1 | 21 | 1 | 60 | 18 | 0 |
| 10-12 | (360) | 1 | 25 | 4 | 62 | 8 | 1 |
| **B. Mathematics is a difficult subject for children to learn.** | | | | | | | |
| Mathematics Teachers | | | | | | | |
| K-6 | (686) | 1 | 19 | 3 | 54 | 15 | 7 |
| 7-9 | (671) | 7 | 27 | 5 | 47 | 10 | 3 |
| 10-12 | (565) | 6 | 34 | 6 | 46 | 7 | 2 |
| Principals | | | | | | | |
| K-6 | (365) | 1 | 23 | 1 | 54 | 21 | 1 |
| 7-9 | (348) | 2 | 24 | 3 | 55 | 15 | 2 |
| 10-12 | (360) | 1 | 32 | 5 | 49 | 13 | 1 |

## Chapter 3

## USE OF TEXTBOOKS IN SCIENCE AND MATHEMATICS CLASSES

### A. Overview

Textbooks play a central role in science and mathematics instruction. For this reason, both the 1977 and the 1985-86 surveys focused to a great extent on which textbooks were being used, how they were selected, and how well teachers liked them. The results of the analyses of the 1985-86 data are presented in the following sections, along with comparisons to the 1977 results when comparable data are available.

### B. Textbook Usage

Each teacher was asked if he or she was using one or more published textbooks or programs for teaching a randomly selected science or mathematics class. As shown in Table 14, the percentages of science and mathematics classes using textbooks at each grade level have remained essentially the same since 1977; with the exception of K-3 science where only about two-thirds of the classes use published textbooks/programs, roughly 90 percent of science and mathematics classes at each grade level use textbooks.

Table 14

USE OF PUBLISHED TEXTBOOKS/PROGRAMS BY
SUBJECT AND GRADE RANGE
1977 and 1985-86

| | Percent of Classes (Sample N) | | | |
|---|---|---|---|---|
| | Science | | Mathematics | |
| Grade Range | 1977 | 1985-86 | 1977 | 1985-86 |
| K-3 | 63 (287) | 69 (431) | 92 (297) | 90 (433) |
| 4-6 | 90 (271) | 89 (273) | 96 (277) | 94 (246) |
| 7-9 | 94 (535) | 93 (658) | 95 (550) | 93 (671) |
| 10-12 | 92 (586) | 93 (1050) | 95 (548) | 91 (565) |

Those teachers who reported using one or more textbooks in these randomly selected classes were asked for additional information about the one used most often by the students in that class. (Those who said they did not use a textbook were asked why they had made this choice, but the numbers were too small to permit meaningful analysis.)

In the 1977 study, teachers were provided with a list of commonly used textbooks/programs in the subject and grade range of the randomly selected class and asked to indicate the code numbers of the one or more textbooks they used; for textbooks not on the list, teachers were asked to write in the title, author, and copyright date. While these lists were lengthy, there were so many different textbooks in use that were not on the lists, including some that were quite old, that it was still necessary to do extensive manual coding of textbooks.

A number of changes were made in the data collection procedures to try and streamline this process. First, teachers were asked only about the <u>one</u> textbook/program used most often, not about multiple textbooks. Second, a list of publishers was provided for each subject/grade range combination; teachers could circle the appropriate number or write in the name of the publisher if it was not on the list. (Since there are a relatively small number of major publishers, compiling these lists was considerably easier than preparing the textbook lists had been for the 1977 survey.) Teachers were then asked to write in the title, author, and most recent copyright data of this particular textbook.

The most commonly used science and mathematics textbooks in each grade range are shown in Tables 15 and 16; the secondary textbooks are shown by major type of class within each subject. Tables C.1 and C.2 in the Appendix list all of the textbooks/programs which are being used by 2 percent or more of the classes in each subject/grade range category.

The share of the market held by each of the major science and mathematics textbook publishers is shown in Table 17. It is interesting to note that two textbook publishers (Merrill and Holt, Rinehart, Winston) account for more than half of the textbook usage in secondary science. The same type of dominance is seen in mathematics, where two publishers (Addison-Wesley and D.C. Heath) account for 43 percent of elementary textbook usage and one publisher (Merrill) has 37 percent of the 10-12 mathematics textbook market.

Table 18 shows the percent of science and mathematics classes using textbooks with copyright dates before 1980, 1980-1983, and 1984-1986. Sizable proportions of science and mathematics classes, especially at the secondary level, are using textbooks that are at least 6 years old. (Note that large numbers of teachers did not provide copyright information. If we assume proportional distribution of these across the three categories the number of classes using "old" textbooks would be roughly 1 in 5 at the elementary level and 1 in 4 at the secondary level.)

It is interesting to note that many of the science and mathematics classes that use textbooks do not "cover" the entire textbook. As can be seen in Table 19, while half of all elementary mathematics classes cover more than 90 percent of their textbooks, only 1 in 4 secondary mathematics classes does so. Similarly in science, 1 in 3 elementary classes but only about 1 in 5 secondary science classes cover more than 90 percent of their textbooks. Whether this finding is "good" or "bad" cannot be determined from these survey data. Many observers believe that science textbooks are much too long to be "covered" in any reasonable fashion. A class that uses a wide variety of quality resources and "covers" only a small part of the science textbook might well learn more science than one that rushes through the entire textbook. The survey data do point out, however, the need for more in-depth research on the science and mathematics curriculum. Knowing the title of a course gives some information; knowing the textbook that is used provides even more. But with so many classes not getting to much of the textbook, it becomes important to identify what is covered and what is not.

## C. Teacher Perceptions of Textbook Quality

As part of a series of questions about factors that affect instruction, teachers were asked the extent to which poor quality of textbooks causes problems in science and mathematics instruction on their school as a whole. The results, shown in Table 20, indicate that the majority of science and mathematics teachers do not consider textbook quality to be a significant problem in their schools.

Table 15

MOST COMMONLY USED SCIENCE TEXTBOOKS/PROGRAMS
BY GRADE RANGE AND SUBJECT

| | Publisher | Textbooks |
|---|---|---|
| K-6 Science | Silver Burdett | Science: Understanding Your Environment |
| | D. C. Heath | Science |
| | Merrill | Accent on Science |
| | Holt, Rinehart, Winston | Science |
| 7-9 General Science | | |
| | Merrill | Principles of Science |
| 7-9 Life Science/ Biology | | |
| | Merrill | Focus on Life Science |
| | Holt, Rinehart, Winston | Modern Biology |
| | Scott, Foresman | Life Science |
| 7-9 Earth Science | | |
| | Merrill | Focus on Earth Science |
| 7-9 Physical Science | | |
| | Merrill | Focus on Physical Science |
| | Prentice Hall | Introductory Physical Science |
| 10-12 Biology | | |
| | Holt, Rinehart, Winston | Modern Biology |
| | Merrill | Biology - Living Systems |
| | Holt | Modern Human Physiology |
| | Merrill | Biology Everyday Experience |

Table 15 (continued)

| | Publisher | Textbooks |
|---|---|---|
| 10-12 Chemistry | | |
| | Holt, Rinehart, Winston | Modern Chemistry |
| | Merrill | Chemistry: A Modern Course |
| 10-12 Physics | | |
| | Merrill | Physics: Principles and Problems |
| | Holt, Rinehart, Winston | Modern Physics |

Table 16

MOST COMMONLY USED MATHEMATICS TEXTBOOKS/PROGRAMS
BY GRADE RANGE AND SUBJECT

| | | |
|---|---|---|
| <u>K-6 Mathematics</u> | | |
| | Addison-Wesley | Mathematics in Our World |
| | D. C. Heath | Mathematics |
| | Scott, Foresman | Invitation to Mathematics |
| | Holt, Rinehart, Winston | Mathematics |
| | MacMillan | Mathematics |
| | Houghton Mifflin | Modern School Mathematics |
| <u>7-9 Mathematics</u> | | |
| | Houghton Mifflin | Algebra: Structure and Method |
| | D. C. Heath | Mathematics |
| | Scott, Foresman | Mathematics Around Us |
| | Holt, Rinehart, Winston | Mathematics |
| | Harcourt, Brace, Jovanovich | Mathematics Today |
| | Harcourt, Brace, Jovanovich | Mathematics |
| <u>10-12 Algebra</u> | | |
| | Houghton Mifflin | Algebra: Structure and Method |
| | Holt, Rinehart, Winston | Algebra with Trigonometry |
| <u>10-12 Geometry</u> | | |
| | Houghton Mifflin | Geometry |
| | Scott, Foresman | Geometry |
| | Holt, Rinehart, Winston | Geometry |
| <u>Advanced Mathematics</u> | | |
| | Merrill | Advanced Mathematical Concepts |

Table 17

MARKET SHARE OF MAJOR TEXTBOOK PUBLISHERS BY SUBJECT AND GRADE RANGE*

| | Percent of Classes | | |
|---|---|---|---|
| | K-6 | 7-9 | 10-12 |
| A. Mathematics | | | |
| Addison-Wesley | 23 | 9 | 9 |
| Harcourt Brace Jovanovich | 9 | 12 | 7 |
| D. C. Heath | 20 | 6 | 1 |
| Holt, Rinehart, Winston | 11 | 13 | 8 |
| Houghton Mifflin | 8 | 24 | 37 |
| Laidlaw | 1 | 4 | 2 |
| MacMillan | 9 | 2 | 1 |
| Merrill | 0 | 5 | 10 |
| Scott, Foresman | 12 | 10 | 10 |
| Sample N | 636 | 622 | 517 |
| B. Science | | | |
| D. C. Heath | 15 | 3 | 7 |
| Holt, Rinehart, Winston | 10 | 16 | 39 |
| Laidlaw | 2 | 5 | 0 |
| McGraw Hill | 7 | 1 | 1 |
| Merrill | 14 | 37 | 19 |
| Prentice Hall | 1 | 9 | 6 |
| Scott, Foresman | 4 | 7 | 4 |
| Silver Burdett | 26 | 8 | 2 |
| Sample N | 548 | 615 | 984 |

* Only classes which are using published textbooks/programs were included in these analyses

Table 18

TEXTBOOK COPYRIGHT DATE BY SUBJECT AND GRADE RANGE*

| | Percent of Classes | | | | | |
|---|---|---|---|---|---|---|
| | Science | | | Mathematics | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Before 1980 | 14 | 23 | 22 | 13 | 22 | 29 |
| 1980-1983 | 40 | 45 | 49 | 45 | 46 | 42 |
| 1984-1986 | 34 | 22 | 20 | 25 | 26 | 22 |
| Unknown | 12 | 11 | 10 | 17 | 6 | 7 |
| Sample N | 548 | 615 | 984 | 636 | 622 | 517 |

* Only classes which are using published textbooks/programs were included in these analyses

Table 19

PERCENT OF MATHEMATICS AND SCIENCE TEXTBOOKS COVERED*

| | Percent of Classes | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics | | | Science | | |
| Percent of Textbook "Covered" | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Less than 25% | 0 | 1 | 2 | 3 | 1 | 1 |
| 25-49% | 2 | 7 | 6 | 10 | 9 | 11 |
| 50-74% | 8 | 16 | 24 | 23 | 27 | 37 |
| 75-90% | 39 | 50 | 45 | 30 | 42 | 34 |
| More than 90% | 50 | 26 | 23 | 33 | 20 | 16 |
| Unknown | 0 | 1 | 1 | 1 | 1 | 1 |
| Sample N | 636 | 622 | 517 | 548 | 615 | 984 |

* Only classes which are using published textbooks/programs were included in these analyses

Table 20

TEACHER PERCEPTIONS OF PROBLEMS IN THEIR SCHOOL
CAUSED BY TEXTBOOK QUALITY

| | | Percent of Teachers | | | |
|---|---|---|---|---|---|
| | Sample N | Serious Problem | Somewhat of a Problem | Not a Significant Problem | Missing |
| **Science** | | | | | |
| K-6 | 710 | 11 | 20 | 62 | 7 |
| 7-9 | 658 | 5 | 18 | 75 | 2 |
| 10-12 | 1050 | 5 | 17 | 76 | 2 |
| **Mathematics** | | | | | |
| K-6 | 686 | 3 | 14 | 79 | 5 |
| 7-9 | 671 | 8 | 21 | 69 | 3 |
| 10-12 | 565 | 6 | 25 | 68 | 1 |

Each teacher who indicated that he or she uses a published textbook/program in a randomly selected science or mathematics class was also asked to rate the particular textbook used on a number of dimensions. These results are shown in Table 21. Overall, the most highly rated aspects of science and mathematics textbooks were their organization, clarity, and reading level. Teachers were generally less satisfied with the quality of supplementary materials and the adequacy of examples to reinforce concepts in science textbooks, and with the adequacy of examples of applications and suggestions for calculator and computer use in mathematics textbooks.

Table 21

TEACHER OPINIONS ABOUT TEXTBOOK QUALITY
BY SUBJECT AND GRADE RANGE[1]

| | Percent of Classes with Favorable Ratings[2] | | | | | |
|---|---|---|---|---|---|---|
| | Science | | | Mathematics | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Appropriate reading level | 82 | 83 | 87 | 90 | 90 | 87 |
| Interesting to students* | 73 | 56 | 52 | 70 | 42 | 43 |
| Clear and well-organized* | 86 | 83 | 85 | 85 | 81 | 82 |
| Develops problem-solving skills | 59 | 54 | 61 | 71 | 71 | 68 |
| Explains concepts clearly | 77 | 67 | 74 | 78 | 69 | 73 |
| Has goal suggestions for activities, assignments | 72 | 68 | 58 | 76 | 64 | 55 |
| Has high quality supplementary materials | 41 | 49 | 44 | 59 | 50 | 33 |
| Has adequate examples of reinforce concepts* | 45 | 39 | 43 | -- | -- | -- |
| Has adequate examples of use of science in daily life* | 64 | 51 | 53 | -- | -- | -- |
| Shows applications of science in careers | 49 | 65 | 50 | -- | -- | -- |
| Has exercises for practice of skills* | -- | -- | -- | 54 | 56 | 60 |
| Had adequate examples of applications of mathematics | -- | -- | -- | 45 | 33 | 40 |
| Has good suggestions for use of calculators | -- | -- | -- | 27 | 38 | 27 |
| Had good suggestions for use of computers | -- | -- | -- | 15 | 29 | 31 |
| Sample N | 548 | 615 | 984 | 636 | 622 | 517 |

[1] Only those classes which are using textbooks/programs were included in these analyses.

[2] Includes those who said "Strongly Agree" or "Agree" to positively worded statements and those who said "Strongly Disagree" or "Disagree" to negatively worded statements.

* Statements were worded negatively in the questionnaire, e.g., "Is not very interesting to my students."

In general, elementary teachers rated their science and mathematics textbooks more favorably than did their secondary school colleagues. For example, elementary teachers were much more likely to consider their textbooks "interesting to students;" they were also more satisfied with their textbooks' suggestions for activities and assignments. Elementary teachers were more satisfied than their junior high and high school counterparts with their science textbooks' treatment of the use of science in daily life and with the quality of their mathematics textbooks' supplementary materials. Is is also interesting to note that mathematics textbooks are considered more successful at developing problem-solving skills than are science textbooks.

## Chapter 4
## INSTRUCTIONAL OBJECTIVES AND ACTIVITIES

### A. Overview

While the textbook is an important determinant of the curriculum in a mathematics or science class, teachers typically have considerable latitude in the amount of time they spend on particular topics and the instructional activities they use with their classes. The survey asked teachers the degree to which they emphasized a number of objectives of science and mathematics instruction, such as learning basic concepts, becoming interested in the subject, and learning about its applications. Teachers were also asked about use of various instructional techniques as well as the use of calculators and computers. These results are presented in the following sections.

### B. Objectives of Mathematics and Science Instruction

Teachers were given a list of possible objectives of mathematics and science instruction and asked how much emphasis each would receive during the entire year (elementary) or course (secondary). Table 22 shows the percent of mathematics classes whose teachers indicated heavy emphasis for each objective; analogous data for science classes are shown in Table 23.

The two most heavily emphasized objectives in mathematics classes are to have students learn mathematical facts and principles and to have them develop a systematic approach to problem solving. It is noteworthy that while the majority of mathematics teachers at each level indicate they emphasize heavily preparing students for further study in mathematics, at the secondary level far fewer indicate that having the students become interested in mathematics is a heavily emphasized objective. Two other objectives that are heavily emphasized in mathematics at the elementary level appear to receive less emphasis at the secondary level: having students become aware of the importance of mathematics in daily life and having students learn to perform computations with speed and accuracy. Each is heavily emphasized in roughly 7 out of 10 K-6 mathematics classes, 6 out of 10 at the 7-9 level, and 4 out of 10 at the 10-12 level.

Table 22

OBJECTIVES OF MATHEMATICS INSTRUCTION BY GRADE RANGE

| Objective | Percent of Mathematics Classes With Heavy Emphasis* K-6 | 7-9 | 10-12 |
|---|---|---|---|
| Know mathematical facts, principles, algorithms, or procedures | 81 | 80 | 71 |
| Develop a systematic approach to solving problems | 72 | 76 | 75 |
| Prepare for further study in mathematics | 60 | 67 | 61 |
| Perform computations with speed and accuracy | 72 | 59 | 41 |
| Become aware of the importance of mathematics in daily life | 71 | 61 | 41 |
| Develop inquiry skills | 51 | 50 | 51 |
| Learn to effectively communicate ideas in mathematics | 49 | 54 | 42 |
| Become interested in mathematics | 60 | 40 | 31 |
| Learn about the applications of mathematics in technology | 20 | 27 | 31 |
| Learn about the career relevance of mathematics | 15 | 28 | 29 |
| Learn about the history of mathematics | 4 | 5 | 5 |
| Sample N | 686 | 671 | 565 |

* Teachers were given a 6-point scale for each objective, with 1 labeled "none," 2 "minimal emphasis," 4 "moderate emphasis" and 6 "very heavy emphasis." These numbers represent the total circling either 5 or 6.

Table 23

OBJECTIVES OF SCIENCE INSTRUCTION

| Objective | Percent of Science Classes With Heavy Emphasis* K-6 | 7-9 | 10-12 |
|---|---|---|---|
| Learn basic science concepts | 67 | 85 | 86 |
| Become aware of the importance of science in daily life | 68 | 68 | 59 |
| Develop a systematic approach to solving problems | 48 | 63 | 67 |
| Develop inquiry skills | 55 | 62 | 57 |
| Prepare for further study in science | 42 | 52 | 56 |
| Become interested in science | 54 | 51 | 45 |
| Learn to effectively communicate ideas in science | 45 | 46 | 47 |
| Develop awareness of safety issues in lab | 23 | 52 | 54 |
| Develop skills in lab techniques | 15 | 45 | 55 |
| Learn about applications of science in technology | 27 | 40 | 39 |
| Learn about the career relevance of science | 22 | 30 | 31 |
| Learn about the history of science | 9 | 12 | 12 |
| Sample N | 710 | 658 | 1050 |

* Teachers were given a 6-point scale for each objective, with 1 labeled "none," 2 "minimal emphasis," 4 "moderate emphasis" and 6 "very heavy emphasis." These numbers represent the total circling either 5 or 6.

At each grade level, roughly half of all mathematics classes give heavy emphasis to having students develop inquiry skills and learn to effectively communicate ideas in mathematics. About 2 in 10 elementary mathematics classes and 3 in 10 secondary mathematics classes give heavy emphasis to learning about the career relevance of mathematics and the applications of mathematics in technology. Only about 1 in 20 mathematics classes at each grade level has a heavy emphasis on learning about the history of mathematics.

In science, there is marked congruity between 7-9 and 10-12 classes objectives but substantial differences between these and K-6 classes. By far the most heavily emphasized objective of science instruction at the secondary level is having students learn basic science concepts, with roughly 85 percent of 7-9 and 10-12 science classes giving heavy emphasis to this objective. Several other objectives receive heavy emphasis by 60 percent or more of secondary science classes, including having students become aware of the importance of science in daily life, develop a systematic approach to solving problems, and develop inquiry skills. Roughly half of secondary science classes emphasize preparing students for further study in science, having students become interested in science, having them learn to effectively communicate ideas in science, and developing skills related to laboratory techniques and safety. Approximately 4 out of 10 secondary science classes emphasize having students learn about the applications of science in technology, 3 out of 10 emphasize the career relevance of science, and only 1 out of 10 emphasizes learning about the history of science.

At the elementary level, having students become aware of the importance of science in daily life and having them learn basic science concepts receive about the same emphasis; roughly 2 out of every 3 K-6 science classes heavily emphasize each of these objectives. Having students develop inquiry skills and become interested in science receive heavy emphasis in more than half of all K-6 science classes, and having them develop a systematic approach to problem-solving, learn to communicate ideas in science, and prepare for further study in science receive heavy emphasis in slightly less than half of the elementary science classes. As is the case in secondary science, objectives related to the history of science and the applications of science in technology and in careers are emphasized much less than are other objectives. In addition, developing awareness of safety issues in the lab and developing skill in lab techniques are much less heavily emphasized at the elementary level than at the secondary level.

C. Class Activities

The 1985-86 National Survey of Science and Mathematics Education provided a list of possible class activities and asked teachers to indicate those that took place during their most recent lesson in a randomly selected class. The results are shown in Table 24. Most science lessons included lecture and discussion. Use of hands-on activities was more common in elementary science (51 percent of lessons), than in secondary (43 percent 7-9, 39 percent 10-12). Computer usage in science classes was rare at all grade levels.

Most mathematics lessons included lecture, discussion, and seatwork assigned from the textbook; very few involved computers. Half of all elementary mathematics lessons involved manipulative materials, compared to only about 1 in 6 secondary mathematics lessons. Use of calculators increases with grade level, with 26 percent of the high school mathematics lessons involving the use of calculators. Homework assignments are relatively infrequent in K-6 mathematics lessons (39 percent) but quite common in secondary mathematics lessons (75 percent).

Selected comparisons with 1977 data are shown in Table 25. Note that in 1985-86, as in 1977, lecture and discussion were used considerably more frequently in science classes than were laboratory activities. Note also that the differences have become larger over time. For example, in 1977 72 percent of the junior high school science classes had lectures in their most recent science lesson and 59 percent used hands-on activities, a difference of 13 percent. In comparison, in 1985-86, 83 percent of the junior high school science lessons included lecture and 43 percent included hands-on activities, a difference of 40 percent.

In addition to indicating whether their most recent lesson included each of a list of activities, teachers were asked to estimate the number of minutes spent on each of a number of activities. For mathematics the categories were daily routines and other non-instructional activities, and the teacher working with the entire class as a group, working with small groups of students, and

Table 24

PERCENT OF SCIENCE AND MATHEMATICS CLASSES PARTICIPATING IN VARIOUS ACTIVITIES IN MOST RECENT LESSON

| | Science | | | Mathematics | | |
|---|---|---|---|---|---|---|
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Lecture | 74 | 83 | 84 | 73 | 89 | 89 |
| Discussion | 87 | 82 | 80 | 85 | 90 | 86 |
| Demonstrations | 52 | 42 | 44 | -- | -- | -- |
| Students use of hands-on, manipulatives, or laboratory materials | 51 | 43 | 39 | 50 | 20 | 12 |
| Student use of calculators | -- | 7 | 25 | 2 | 9 | 26 |
| Students use of computers | 2 | 5 | 5 | 7 | 6 | 10 |
| Students working in small groups | 33 | 35 | 36 | 59 | 45 | 34 |
| Students doing seatwork assigned from textbook | 31 | 45 | 35 | 76 | 76 | 66 |
| Students completing supplemental worksheets | 38 | 44 | 37 | 49 | 34 | 26 |
| Assigning homework | 28 | 54 | 52 | 39 | 75 | 75 |
| Test or Quiz | 23 | 23 | 19 | 18 | 11 | 6 |
| Sample N | 710 | 658 | 1050 | 686 | 671 | 565 |

Table 25

PERCENT OF CLASSES USING LECTURE, DISCUSSION AND HANDS-ON ACTIVITIES IN MOST RECENT LESSON, BY SUBJECT AND GRADE RANGE 1977 and 1985-86

A. Mathematics

| | 1977 | | | | 1985-86 | | | |
|---|---|---|---|---|---|---|---|---|
| | K-3 | 4-6 | 7-9 | 10-12 | K-3 | 4-6 | 7-9 | 10-12 |
| Lecture | 58 | 68 | 83 | 89 | 65 | 82 | 89 | 89 |
| Discussion | 88 | 89 | 83 | 91 | 81 | 92 | 90 | 86 |
| Hands-on | 58 | 38 | 23 | 24 | 63 | 31 | 20 | 12 |
| Sample N | 297 | 277 | 550 | 548 | 433 | 246 | 671 | 565 |

B. Science

| | 1977 | | | | 1985-86 | | | |
|---|---|---|---|---|---|---|---|---|
| | K-3 | 4-6 | 7-9 | 10-12 | K-3 | 4-6 | 7-9 | 10-12 |
| Lecture | 60 | 69 | 72 | 76 | 71 | 78 | 83 | 84 |
| Discussion | 87 | 90 | 82 | 77 | 88 | 86 | 82 | 80 |
| Hands-on | 67 | 54 | 59 | 53 | 57 | 45 | 43 | 39 |
| Sample N | 287 | 271 | 535 | 586 | 431 | 273 | 658 | 1050 |

supervising students working on individual activities. As shown in Table 26, teachers at the three grade levels estimate that about 10 to 12 percent of the time allocated for mathematics instruction is spent on daily routines, interruptions, and other non-instructional activities. The proportion of the allocated time that is spent on lecture and other "whole-class" activities increases with grade range, while the proportion of time spent on small-group activities decreases.

Table 26

PERCENT OF TIME SPENT ON VARIOUS ACTIVITIES IN MATHEMATICS CLASSES BY GRADE RANGE

| | K-6 | | 7-9 | | 10-12 | |
|---|---|---|---|---|---|---|
| | Mean | Standard Error | Mean | Standard Error | Mean | Standard Error |
| Daily Routines | 10 | .41 | 12 | .42 | 11 | .34 |
| Entire Class | 43 | 1.05 | 52 | 1.20 | 56 | 1.19 |
| Small Groups | 20 | 1.02 | 12 | .77 | 9 | .70 |
| Individual Activities | 27 | .86 | 24 | 1.00 | 25 | 1.11 |

For science, there were six categories: daily routines, lecture, hands-on, reading about science, test or quiz, and "other science instructional activities." These results are shown in Table 27. Teachers at each grade level estimate that about 10 to 12 percent of the time allocated for science instruction is spent on daily routines, interruptions, and other non-instructional activities, about 6 to 7 percent on tests and quizzes, and about 11 to 14 percent on "other science instructional activities" not specified in the questionnaire. Differences among grade levels were found mainly in the percent of time devoted to lecture, which increases from 25 percent of class time in K-6 science to 43 percent in grades 10-12, and reading about science, which decreases from 19 percent of K-6 class time to 6 percent at the 10-12 level. The proportion of time spent on hands-on activities is significantly greater at the K-6 level than at either the 7-9 or 10-12 levels.

Table 27

TIME SPENT ON VARIOUS ACTIVITIES
IN SCIENCE CLASSES BY GRADE RANGE

| | Mean Percent of Lesson | | | | | |
|---|---|---|---|---|---|---|
| | K-6 | | 7-9 | | 10-12 | |
| | Mean | Standard Error | Mean | Standard Error | Mean | Standard Error |
| Daily Routines | 10 | .76 | 12 | .44 | 11 | .26 |
| Lecture | 25 | .89 | 34 | 1.12 | 43 | 1.11 |
| Hands-on or Laboratory | 28 | 1.32 | 23 | 1.27 | 21 | 1.12 |
| Reading about Science | 19 | .88 | 11 | .91 | 6 | .53 |
| Test or Quiz | 7 | .96 | 7 | .70 | 6 | .68 |
| Other | 11 | .71 | 14 | 1.11 | 13 | .76 |

Statements about what science education "should be" typically advocate heavy reliance on hands-on instruction in science. As shown in Table 28, the 1985-86 survey provides evidence that teachers agree. Approximately two-thirds of elementary science teachers and more than three-fourths of secondary science teachers indicated that laboratory-based science classes are more effective than non-laboratory classes. Fewer than 5 percent of each group of teachers agreed with the statement that "Hands-on science experiences are not worth the time and expense." Principals had very similar opinions. Why, then, are hands-on activities not used more extensively? The survey responses provide some clues. Hands-on science activities often require special materials and equipment. However, at the elementary level, only 6 percent of science classes are conducted in laboratories or special science rooms; 55 percent use classrooms with portable science kits or materials and 38 percent use classrooms with no science facilities or materials. These figures are quite similar to those in 1977 (see Table 29).

Recent research has pointed to the importance of homework as a means of increasing instructional time. Accordingly, science and mathematics teachers in this survey were asked to estimate the average amount of time a typical student in a randomly selected class spends on homework. These results are shown in Table 30. Not surprisingly, the amount of time spent on homework increases with grade level. In addition, at each grade level significantly more time is spent on mathematics homework than on science homework.

## D. Use of Calculators and Computers

A great deal of attention has been paid to the potential of technology for changing the way students learn. The 1985-86 National Survey of Science and Mathematics Education looked at the extent to which two of these tools--hand-held calculators and computers--are used in science and mathematics instruction.

Secondary science teachers, and both elementary and secondary mathematics teachers, were asked whether they use calculators in the randomly selected science or mathematics class, and if so, how they were used. As can be seen in

Table 28

TEACHER AND PRINCIPAL OPINIONS ABOUT HANDS-ON SCIENCE INSTRUCTION

Percent of Respondents

A. Laboratory-based science classes are more effective.

| | Sample N | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree | Missing |
|---|---|---|---|---|---|---|---|
| Science Teachers | | | | | | | |
| K-6 | 710 | 25 | 41 | 20 | 7 | 1 | 5 |
| 7-9 | 658 | 39 | 38 | 6 | 12 | 3 | 2 |
| 10-12 | 1050 | 47 | 33 | 8 | 7 | 2 | 3 |
| Principals | | | | | | | |
| K-6 | 365 | 22 | 54 | 13 | 8 | 2 | 1 |
| 7-9 | 348 | 26 | 52 | 9 | 9 | 3 | 1 |
| 10-12 | 360 | 31 | 54 | 8 | 4 | 2 | 1 |

B. Hands-on science experiences are not worth the time and expense.

| | Sample N | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree | Missing |
|---|---|---|---|---|---|---|---|
| Science Teachers | | | | | | | |
| K-6 | 710 | 3 | 1 | 3 | 33 | 56 | 5 |
| 7-9 | 658 | 1 | 2 | 4 | 37 | 52 | 4 |
| 10-12 | 1050 | 1 | 2 | 3 | 33 | 58 | 3 |
| Principals | | | | | | | |
| K-6 | 365 | 2 | 3 | 3 | 34 | 58 | 1 |
| 7-9 | 348 | 0 | 0 | 3 | 40 | 56 | 0 |
| 10-12 | 360 | 2 | 2 | 3 | 35 | 57 | 1 |

Table 29

TYPES OF ELEMENTARY SCIENCE CLASSROOMS
1977 AND 1985-86

| | Percent of Classes | | | |
|---|---|---|---|---|
| | 1977 | | 1985-86 | |
| | K-3 | 4-6 | K-3 | 4-6 |
| Laboratory or special science room | 0 | 9 | 0 | 14 |
| Classroom with portable science materials | 54 | 54 | 57 | 53 |
| Classroom with no science facilities | 38 | 34 | 42 | 33 |
| Missing | 8 | 3 | 1 | 0 |
| Sample N | 287 | 271 | 431 | 273 |

Table 30

TIME SPENT ON SCIENCE AND MATHEMATICS
HOMEWORK BY SUBJECT AND GRADE RANGE

| | Number of minutes/day* | | | |
|---|---|---|---|---|
| | Science | | Mathematics | |
| | Mean | Standard Error | Mean | Standard Error |
| K-3 | 3 | .24 | 8 | .56 |
| 4-6 | 11 | .72 | 20 | .84 |
| 7-9 | 23 | .72 | 28 | .68 |
| 10-12 | 28 | .53 | 32 | .72 |

* K-6 teachers were asked to estimate the number of minutes spent on homework each week; this number was divided by 5 to get minutes per day.

Table 31, only 1 in 7 K-6 mathematics classes uses calculators. Calculator usage increases with increasing grade range, with slightly more than half of all 10-12 science and mathematics classes using calculators. At each grade level, most of the classes that use calculators at all use them for doing computations and for solving problems. Many also use calculators for checking answers. Those 7-9 and 10-12 science classes and 10-12 mathematics classes that use calculators are likely to use them for taking tests; in contrast, relatively few K-6 and 7-9 mathematics classes use calculators for test taking.

Table 31

CALCULATOR USAGE IN MATHEMATICS AND SCIENCE CLASSES

| | Percent of Classes | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics | | | Science | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Use calculators for: | | | | | | |
| Checking answers | 11 | 23 | 29 | -- | 14 | 32 |
| Doing computations | 9 | 27 | 47 | -- | 21 | 51 |
| Solving problems | 9 | 22 | 37 | -- | 18 | 47 |
| Taking tests | 1 | 10 | 35 | -- | 18 | 42 |
| One or more uses | 14 | 35 | 51 | -- | 24 | 54 |
| Sample N | 686 | 671 | 565 | | 658 | 1050 |

Computer usage was examined in a number of ways. Teachers who indicated there were computers available for use in the randomly selected class were asked whether they in fact used them. If so, they were asked to identify the ways in which computers were used, e.g., for writing programs, drill and practice, or using simulations. They were also asked to indicate how many minutes a typical student spent working with computers in that class during the last week of instruction. Finally, teachers were asked to indicate if students in that class used computers during their most recent lesson.

Table 32 shows the percent of mathematics and science classes at each grade level that use computers as part of their instruction, and those that did so during a particular week and a particular day. Approximately 1 out of every 2 K-6 mathematics classes uses computers at least some of the time, a larger proportion than in any other subject/grade range combination; at this level computers are typically used for drill and practice and for computer games. Computer usage in secondary school mathematics is more evenly dispersed among several categories.

In science, overall computer usage tends to increase with increasing grade level, with 25 percent of K-6 science classes and 36 percent of 10-12 science classes using computers. (The difference between K-6 and 7-9 classes is not statistically significant.) Particular uses that increase with grade level are using computers as a laboratory tool and using computers for simulations.

The question about computer usage in a given week yielded similar results: mathematics classes, especially K-6 mathematics classes, were more likely than science classes to have used computers in the previous week's instruction. As shown in Tables 32 and 33, fewer than 1 in 10 science classes used computers at all during the "last week," and in most of those the typical students spent fewer than 15 minutes working with computers. In mathematics, elementary classes were more likely to use computers in a given week than were their secondary counterparts, but students typically spent less than half an hour using computers during that week. In contrast, if a high school mathematics class used computers, the typical student spent more than 45 minutes working with computers during that week.

Table 32

COMPUTER USAGE IN MATHEMATICS AND SCIENCE CLASSES

| | Percent of Classes | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics | | | Science | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Used in this class | 49 | 40 | 34 | 25 | 28 | 36 |
| Used last week | 29 | 19 | 18 | 9 | 6 | 9 |
| Used last lesson | 7 | 6 | 10 | 2 | 5 | 5 |
| Use computers for: | | | | | | |
| Teacher demonstrating computer use | 18 | 17 | 15 | 9 | 7 | 13 |
| Writing programs | 5 | 12 | 14 | 2 | 4 | 5 |
| Learning content | 14 | 16 | 9 | 7 | 15 | 15 |
| Laboratory tool | -- | -- | -- | 3 | 8 | 15 |
| Drill and practice | 40 | 24 | 12 | 12 | 13 | 18 |
| Using simulations | 7 | 8 | 9 | 6 | 11 | 17 |
| Problem solving | 19 | 14 | 13 | 7 | 10 | 11 |
| Using computer graphics | 8 | 10 | 11 | 4 | 7 | 8 |
| Games | 33 | 19 | 6 | 12 | 8 | 7 |
| Testing and evaluation | 3 | 5 | 5 | 3 | 8 | 7 |
| Sample N | 686 | 671 | 565 | 710 | 658 | 1050 |

Table 33

TIME SPENT WORKING WITH COMPUTERS "LAST WEEK"

| | Percent of Classes | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics | | | Science | | |
| Number of Minutes | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| None[1] | 67 | 78 | 81 | 85 | 92 | 89 |
| 1-14 | 12 | 5 | 4 | 5 | 3 | 6 |
| 15-29 | 10 | 6 | 2 | 2 | 0 | 1 |
| 30-44 | 3 | 4 | 1 | 2 | 1 | 1 |
| 45-60 | 2 | 1 | 4 | 0 | 1 | 1 |
| More than 60 | 2 | 3 | 7 | 0 | 1 | 0 |
| Missing/ Inconsistent[2] | 4 | 2 | 3 | 6 | 2 | 2 |
| Sample N | 686 | 671 | 565 | 710 | 658 | 1050 |

[1] Includes those classes that never use computers.

[2] Inconsistent includes those classes in which the teacher indicated that computers are not used but went on to describe how they were used.

## Chapter 5

## SCIENCE AND MATHEMATICS TEACHERS

### A. Overview

The quality of science and mathematics education depends to a very large extent on the capabilities of science and mathematics teachers. The 1985-86 Survey of Science and Mathematics Education collected a variety of types of information about science and mathematics teachers -- e.g., their sex, race/ethnicity, ages, number of years teaching, course backgrounds, degrees earned, and certification status. These data are presented in the following sections.[6]

### B. Teacher Characteristics

Table 34 shows the breakdown of teacher sex by subject and grade range, in both the 1985-86 survey and the 1977 survey. As expected, most elementary teachers are female, and the proportion of male teachers increases with grade. Since 1977, however, there has been an overall decrease in the proportion of male science and mathematics teachers. For example, in 1977 68 percent of 10-12 mathematics teachers were male, while in 1985-86 only 53 percent of 10-12 mathematics teachers were male.

The breakdown of teacher race by subject and grade range is shown in Table 35. Note that the percentage of minority teachers is generally greater in the lower grades: 92 percent of 10-12 science teachers are white compared to 82 percent of K-3 science teachers. Since race/ethnicity data from earlier years are not available, it is not possible to identify trends in the numbers of minority science and mathematics teachers. However, given the changing demographics of the student population and of the teaching force in general,

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6/ These types of data enable us to present a basic description of the science and mathematics teaching force; we know a lot now that we did not know before this survey. However, it is important to recognize the limitations of this description; a survey such as this cannot determine whether these teachers have a deep understanding of their subjects or how many are capable of sparking their students' interest in these fields.

Table 34

TEACHER SEX BY SUBJECT AND GRADE RANGE
1977 and 1985-86

| | Percent of Teachers | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1977 | | | | 1985-86 | | | |
| | Male | Female | Missing | Sample N | Male | Female | Missing | Sample N |
| Mathematics | | | | | | | | |
| K-3 | 6 | 94 | 0 | 297 | 4 | 93 | 3 | 433 |
| 4-6 | 21 | 76 | 2 | 277 | 20 | 79 | 1 | 246 |
| 7-9 | 54 | 46 | 0 | 550 | 45 | 51 | 4 | 671 |
| 10-12 | 68 | 32 | 0 | 548 | 53 | 46 | 1 | 565 |
| Science | | | | | | | | |
| K-3 | 2 | 98 | 0 | 287 | 3 | 94 | 3 | 431 |
| 4-6 | 33 | 67 | 0 | 271 | 23 | 76 | 1 | 273 |
| 7-9 | 62 | 38 | 0 | 535 | 56 | 41 | 3 | 658 |
| 10-12 | 74 | 24 | 2 | 586 | 68 | 31 | 1 | 1050 |

Table 35

TEACHER RACE BY SUBJECT AND GRADE RANGE

| | Sample N | White | Black | Hispanic | American Indian/ Alaskan Native | Asian/ Pacific Islander | Unknown |
|---|---|---|---|---|---|---|---|
| | | Percent of Teachers | | | | | |
| **Mathematics** | | | | | | | |
| K-3 | 433 | 84 | 10 | 1 | 0 | 0 | 4 |
| 4-6 | 246 | 84 | 12 | 2 | 0 | 0 | 2 |
| 7-9 | 671 | 90 | 6 | 1 | 0 | 1 | 3 |
| 10-12 | 565 | 94 | 3 | 1 | 0 | 1 | 1 |
| **Science** | | | | | | | |
| K-3 | 431 | 82 | 9 | 4 | 0 | 1 | 4 |
| 4-6 | 273 | 86 | 8 | 4 | 0 | 1 | 1 |
| 7-9 | 658 | 88 | 6 | 1 | 0 | 1 | 4 |
| 10-12 | 1050 | 92 | 5 | 1 | 1 | 1 | 1 |

there is reason for concern that the underrepresentation of minority science and mathematics teachers at the secondary level will become more severe, with a resulting scarcity of role models for scientifically talented minority youth.

The average age and numbers of years teaching experience of science and mathematics teachers at each grade level are shown in Table 36. In recent years considerable concern has been expressed about the likely need to replace large numbers of retiring teachers. The 1985-86 survey found some evidence that the science and mathematics teaching force is "aging." For example, while the typical 1977 high school science teacher had 11 years prior teaching experience, the average for a 1985-86 high school science teacher was 14 years. However, as shown in Table 37, data from this survey do not support the prediction of huge numbers of retirees in the next decade; roughly 4 out of 5 science and mathematics teachers at each grade level are age 50 or younger.

Table 38 shows the percent of teachers in each subject/grade range combination who have earned degrees beyond the bachelor's. As was the case in 1977, the percent of teachers with higher degrees increases with grade level taught. In addition, the percent of 10-12 science teachers with degrees beyond the bachelor's has increased significantly since 1977 (to 63 percent) which is significantly greater than the corresponding percent for 10-12 mathematics (55 percent, unchanged since 1977).

C. <u>Teacher Preparation</u>

The 1985-86 National Survey of Science and Mathematics Education focused to a considerable extent on teacher preparation as indicated by their course background and degrees earned. Information about certification status was also collected. Table 39 shows the percent of K-3 and 4-6 science teachers who have completed particular types of courses. While 85 percent of elementary school science teachers have had a college biology course, only about 1 in 3 have had a college chemistry course and 1 in 5 a college physics course. The National Science Teachers Association (NSTA) has recommended that elementary science teachers have at least one course in the biological sciences, one course in the physical sciences and one course in the earth/space sciences; 31 percent of K-3 science teachers and 42 percent of 4-6 science teachers meet that standard.

Table 36

AVERAGE TEACHER AGE AND TEACHING EXPERIENCE
BY SUBJECT AND GRADE RANGE

| Mathematics | Average Age | Standard Error | No. of Years Teaching | Standard Error |
|---|---|---|---|---|
| K-6 | 40.1 | .41 | 13.0 | .33 |
| 7-9 | 39.3 | .58 | 12.6 | .85 |
| 10-12 | 40.2 | .53 | 14.2 | .39 |
| Science | | | | |
| K-6 | 39.9 | .42 | 13.0 | .36 |
| 7-9 | 39.2 | .76 | 13.1 | .65 |
| 10-12 | 40.3 | .38 | 14.4 | .50 |

Table 37

TEACHER AGE DISTRIBUTION BY SUBJECT AND GRADE RANGE

| | | Percent of Teachers | | | | | |
|---|---|---|---|---|---|---|---|
| | Sample N | 30 or under | 31-40 | 41-50 | 51-60 | >60 | unknown |
| Mathematics | | | | | | | |
| K-6 | 686 | 17 | 36 | 24 | 15 | 2 | 6 |
| 7-9 | 671 | 16 | 41 | 23 | 13 | 1 | 5 |
| 10-12 | 565 | 17 | 35 | 31 | 13 | 1 | 2 |
| Science | | | | | | | |
| K-6 | 710 | 16 | 38 | 26 | 12 | 3 | 6 |
| 7-9 | 658 | 18 | 41 | 25 | 11 | 2 | 4 |
| 10-12 | 1050 | 15 | 38 | 30 | 15 | 1 | 1 |

Table 38

TEACHER EARNED DEGREES BEYOND THE BACHELOR'S
BY SUBJECT AND GRADE RANGE
1977 and 1985-86

| | 1977 | | 1985-86 | |
|---|---|---|---|---|
| | Percent of Teachers | Sample N | Percent of Teachers | Sample N |
| Mathematics | | | | |
| K-6 | 34 | 558 | 36 | 686 |
| 7-9 | 45 | 535 | 44 | 671 |
| 10-12 | 55 | 586 | 55 | 565 |
| Science | | | | |
| K-6 | 29 | 574 | 39 | 710 |
| 7-9 | 50 | 550 | 47 | 658 |
| 10-12 | 54 | 548 | 63 | 1050 |

Table 39

ELEMENTARY SCIENCE TEACHER COURSE BACKGROUND

| Course | Percent of Teachers Completing One or More College Courses K-3 | 4-6 |
|---|---|---|
| General methods of teaching | 95 | 95 |
| Methods of teaching elementary school science | 87 | 88 |
| Methods of teaching middle school science | 7 | 20 |
| Supervised student teaching | 77 | 87 |
| Psychology, human development | 83 | 88 |
| Instructional uses of computers | 31 | 37 |
| Computer Programming | 11 | 21 |
| Biology, environmental, life sciences | 83 | 87 |
| Chemistry | 30 | 37 |
| Physics | 17 | 21 |
| Physical Science | 58 | 61 |
| Earth/Space Science | 39 | 51 |
| | | |
| No science courses | 5 | 5 |
| One type of science course | 18 | 12 |
| Biology | (15) 16 | ( 8) |
| Physical Science | ( 2) | ( 3) |
| Earth/Space Science | ( 1) | ( 1) |
| Two types of science courses | 40 | 40 |
| Biology and Physical Science | (34) 30 | (31) |
| Biology and Earth/Space Science | ( 5) | ( 6) |
| Physical Science and Earth/Space Science | ( 1) | ( 3) |
| | | |
| All three categories of science courses | 31 32 | 42 |
| Unknown | 4 | 2 |
| Sample N | 431 | 273 |

Table 40 shows the percent of K-3 and 4-6 mathematics teachers who have completed particular types of courses. While 9 out of 10 elementary mathematics teachers have had a course in mathematics specifically for elementary school teachers, only about 1 in 5 has had a course in geometry for teachers, 1 in 4 a course in probability and statistics, and 1 in 10 a college calculus course.

The percentages of 7-9 and 10-12 science teachers completing specific science courses are shown in Table 41, while Table 42 shows the numbers of courses of a particular type that were completed. Only 3 percent of 7-9 science teachers and 7 percent of 10-12 science teachers have never had a college biology course, and 46 percent of 7-9 science teachers and 59 percent of 10-12 science teachers have had 8 or more life science courses. In contrast, 24 percent of 7-9 science teachers and 27 percent of 10-12 science teachers have never had a college-level course in the earth/space sciences, and only 12 percent of the former and 6 percent of the latter have had 8 or more courses in this area. More than half of all secondary science teachers have never had a college computer science course and almost half have had no college calculus.

Table 43 shows the percentages of 7-9 and 10-12 science teachers who have completed various numbers of science courses. NSTA has recommended that junior high school science teachers have at least 36 credit hours in science, and senior high school science teachers at least 50 credit hours. Assuming that each science course is an average of 3.5 credit hours, 68 percent of 7-9 science teachers and 83 percent of 10-12 science teachers meet or exceed the 36 credit hour standard (11 courses); 43 percent of 7-9 science teachers and 57 percent of 10-12 science teachers meet or exceed the 50 credit hour standard (15 courses).

Table 44 shows the percent of 7-9 and 10-12 mathematics teachers who have completed each of a number of particular types of courses. Typically, larger percentages of 10-12 teachers than 7-9 mathematics teachers have taken each specific mathematics course. While 67 percent of 7-9 mathematics teachers and 80 percent of 10-12 mathematics teachers have had a college-level geometry course, and nearly that many have had a course in probability and statistics,

Table 40

ELEMENTARY MATHEMATICS TEACHER COURSE BACKGROUND

| Course | Percent of Teachers Completing One or More College Courses | |
|---|---|---|
| | K-3 | 4-6 |
| General methods of teaching | 94 | 93 |
| Methods of teaching elementary school mathematics | 90 | 90 |
| Methods of teaching middle school mathematics | 14 | 27 |
| Supervised student teaching | 82 | 83 |
| Psychology, human development | 83 | 87 |
| Instructional uses of computers | 30 | 34 |
| Computer Programming | 17 | 24 |
| Mathematics for elementary school teachers | 89 | 90 |
| Mathematics for secondary school teachers | 11 | 21 |
| Geometry for elementary or middle school teachers | 17 | 21 |
| College algebra, trigonometry, elementary functions | 30 | 37 |
| Calculus | 8 | 12 |
| Upper division geometry | 5 | 7 |
| Probability and statistics | 21 | 27 |
| Sample N | 433 | 246 |

Table 41

SECONDARY SCIENCE TEACHER COURSE BACKGROUND

| | Percent of Teachers Completing One or More College Courses | |
|---|---|---|
| | 7-9 | 10-12 |
| **EDUCATION** | | |
| General Methods of Teaching | 94 | 94 |
| Methods of Teaching Secondary School Science | 61 | 82 |
| Methods of Teaching Middle School Science | 30 | 20 |
| Supervised Student Teaching | 83 | 79 |
| Psychology, Human Development | 85 | 87 |
| Instructional Uses of Computers | 33 | 30 |
| **MATHEMATICS/COMPUTER SCIENCE** | | |
| College Algebra, Trigonometry, Elementary Functions | 75 | 78 |
| Calculus | 41 | 53 |
| Differential Equations | 16 | 25 |
| Probability and Statistics | 44 | 44 |
| Computer Programming | 33 | 33 |
| **LIFE SCIENCES** | | |
| Introductory Biology | 91 | 85 |
| Botany, Plant Physiology, etc. | 70 | 73 |
| Cell Biology | 54 | 58 |
| Ecology, Environmental Science | 62 | 63 |
| Genetics, Evolution | 55 | 64 |
| Microbiology | 48 | 53 |
| Physiology | 63 | 65 |
| Zoology, Animal Behavior, etc. | 64 | 71 |
| **CHEMISTRY** | | |
| General Chemistry | 76 | 92 |
| Analytical Chemistry | 30 | 47 |
| Organic Chemistry | 51 | 70 |
| Physical Chemistry | 21 | 32 |
| Biochemistry | 25 | 34 |
| Sample N | 658 | 1050 |

Table 41 (continued)

| | Percent of Teachers Completing One or More College Courses | |
|---|---|---|
| | 7-9 | 10-12 |
| **PHYSICS** | | |
| General Physics | 73 | 81 |
| Electricity and Magnetism | 18 | 28 |
| Heat and Thermodynamics | 16 | 24 |
| Mechanics | 15 | 26 |
| Modern or Nuclear Physics | 12 | 23 |
| Optics | 11 | 18 |
| **EARTH/SPACE SCIENCES** | | |
| Astronomy | 40 | 36 |
| Geology | 56 | 49 |
| Meteorology | 27 | 20 |
| Oceanography | 26 | 19 |
| Physical Geography | 39 | 25 |
| **OTHER** | | |
| History of Science | 21 | 23 |
| Science and Society | 18 | 16 |
| Engineering | 8 | 12 |
| Sample N | 658 | 1050 |

Table 42

SECONDARY SCIENCE TEACHER COURSE BACKGROUND:

NUMBER OF LIFE SCIENCE, CHEMISTRY, PHYSICS, EARTH SCIENCE, CALCULUS, AND COMPUTER SCIENCE COURSES

| Number of Courses Completed | Life Science | | Chemistry | | Physics | | Earth Science | | Calculus | | Computer Science | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7-9 | 10-12 | 7-9 | 10-12 | 7-9 | 10-12 | 7-9 | 10-12 | 7-9 | 10-12 | 7-9 | 10-12 |
| 0 | 3 | 7 | 18 | 6 | 16 | 13 | 24 | 27 | 53 | 44 | 52 | 57 |
| 1 | 5 | 5 | 11 | 8 | 26 | 17 | 15 | 20 | 17 | 16 | 18 | 18 |
| 2 | 11 | 5 | 15 | 14 | 18 | 23 | 14 | 15 | 12 | 16 | 12 | 10 |
| 3 | 5 | 5 | 13 | 14 | 15 | 12 | 9 | 9 | 7 | 9 | 4 | 5 |
| 4 | 9 | 5 | 12 | 14 | 7 | 9 | 6 | 6 | 2 | 5 | 2 | 3 |
| 5 | 7 | 3 | 6 | 9 | 3 | 4 | 4 | 2 | 1 | 2 | 1 | 1 |
| 6 | 5 | 3 | 6 | 7 | 4 | 5 | 3 | 3 | 0 | 0 | 6 | 0 |
| 7 | 4 | 3 | 2 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 8 | 46 | 59 | 11 | 26 | 6 | 15 | 12 | 6 | 0 | 0 | 1 | 2 |
| Unknown | 5 | 5 | 6 | 1 | 10 | 5 | 11 | 13 | 7 | 8 | 8 | 5 |
| Sample N | 658 | 1050 | 658 | 1050 | 658 | 1050 | 658 | 1050 | 658 | 1050 | 658 | 1050 |

Table 43

TOTAL NUMBER OF SCIENCE COURSES COMPLETED BY SECONDARY SCIENCE TEACHERS

| Total Number of Science Courses[1] | Percent of Teachers 7-9 | 10-12 |
|---|---|---|
| 0-5 | 12 | 4 |
| 6-10 | 19 | 12 |
| 11-14 | 25 | 26 |
| 15-20 | 29 | 42 |
| ≥ 21 | 14 | 15 |
| Unknown | 1 | 1 |
| Sample N | 658 | 1050 |

1/ Since the highest number of courses a teacher could indicate for each of the 4 categories--life science, chemistry, physics/physical science, and earth/space science--was "≥ 8", these figures underestimate the totals for any teachers who completed more than 8 courses in a particular category.

Table 44

SECONDARY MATHEMATICS TEACHER COURSE BACKGROUND

| | Percent of Teachers Completing One or More College Courses | |
|---|---|---|
| | 7-9 | 10-12 |
| EDUCATION | | |
| General Methods of Teaching | 90 | 93 |
| Methods of Teaching Secondary School Mathematics | 53 | 80 |
| Methods of Teaching Middle School Mathematics | 37 | 25 |
| Supervised Student Teaching | 79 | 81 |
| Psychology, Human Development | 84 | 87 |
| Instructional Uses of Computers | 40 | 42 |
| MATHEMATICS/COMPUTER SCIENCE | | |
| College Algebra, Trigonometry, Elementary Functions | 80 | 87 |
| Calculus | 67 | 89 1 |
| Advanced Calculus | 39 | 63 6 |
| Differential Equations | 39 | 61 8 |
| Geometry | 67 | 80 2 |
| Probability and Statistics | 59 | 76 3 |
| Abstract Algebra/Number Theory | 48 | 69 4 |
| Linear Algebra | 48 | 69 5 |
| Applications of Mathematics/ Problem Solving | 34 | 39 ~~8~~ 9 |
| History of Mathematics | 26 | 37 ~~9~~ 10 |
| Other Upper Division Mathematics | 37 | 63 7 |
| Computer Programming | 46 | 64 |
| Sample N | 671 | 565 |

fewer than 40 percent of each group has had a course in the applications of mathematics and only about a third has had a course in the history of mathematics.

The percentages of 7-9 and 10-12 mathematics teachers who have had various numbers of calculus, computer science, and methods of teaching mathematics courses are shown in Table 45. Roughly 7 out of 10 grade 7-9 mathematics teachers meet or exceed the National Council of Teachers of Mathematics' (NCTM) recommendation for a course in calculus; 58 percent have had a course in computer science and 80 percent have had 1 or more courses in methods of teaching mathematics as recommended by NCTM. At the 10-12 level, 64 percent of the teachers have had at least 3 calculus courses as suggested by NCTM; 72 percent have had a course in computer science, but only 54 percent have had 2 or more courses devoted specifically to methods of teaching mathematics as recommended by NCTM.

As shown in Table 46, most science and mathematics teachers at each grade level are certified to teach in their states, although roughly 5 percent are only provisionally certified (defined for this survey as lacking some requirements). Not surprisingly, very few K-6 teachers are specifically certified in mathematics or science (roughly 90 percent are certified in elementary education); even fewer have degrees in mathematics, science, or mathematics or science education.

While 62 percent of those teachers who are teaching 1 or more classes of mathematics in grades 7-9 are certified by their states to teach mathematics, only 48 percent have at least one degree in mathematics or mathematics education. In contrast, 84 percent of 10-12 mathematics teachers are state-certified in mathematics and 76 percent have degrees in mathematics and/or mathematics education.

Most teachers of science in grades 7-12 are certified by their states to teach one or more science subjects (73 percent of 7-9 science teachers and 89 percent of 10-12 science teachers). Sixty-eight percent of 7-9 science teachers and 84 percent of 10-12 science teachers have one or more degrees in science or science education.[7]

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7/ Many science teachers hold degrees in a single science discipline, e.g., biology or chemistry, but are assigned to teach several different science subjects. Future analyses will focus on the relationship between certification/degrees held and teaching assignments.

Table 45

SECONDARY MATHEMATICS TEACHER COURSE BACKGROUND:

NUMBER OF COURSES IN CALCULUS, COMPUTER SCIENCE AND METHODS OF TEACHING MATHEMATICS

| Number of Courses | Percent of Teachers 7-9 | Percent of Teachers 10-12 |
|---|---|---|
| A. Calculus | | |
| 0 | 29 | 6 |
| 1 | 15 | 7 |
| 2 | 15 | 16 |
| 3 | 18 | 24 |
| 4 | 9 | 20 |
| ≥ 5 | 10 | 20 |
| Unknown | 5 | 6 |
| B. Computer Science | | |
| 0 | 38 | 23 |
| 1 | 24 | 25 |
| 2 | 16 | 16 |
| 3 | 7 | 12 |
| 4 | 4 | 6 |
| ≥ 5 | 8 | 14 |
| Unknown | 4 | 5 |
| C. Methods of Teaching Mathematics | | |
| 0 | 14 | 11 |
| 1 | 24 | 29 |
| 2 | 21 | 24 |
| 3 | 16 | 12 |
| ≥ 4 | 20 | 18 |
| Unknown | 6 | 5 |
| Sample N | 671 | 565 |

Table 46

TEACHER DEGREE AND CERTIFICATION STATUS

A. Mathematics Teachers

| | Percent of Teachers | | |
|---|---|---|---|
| | K-6 | 7-9 | 10-12 |
| **Type of Certification** | | | |
| Not certified | 1 | 5 | 4 |
| Provisional | 4 | 5 | 4 |
| Regular | 87 | 83 | 90 |
| Missing/Inconsistent[1] | 8 | 6 | 3 |
| **Field of Certification** | | | |
| Not certified | 1 | 5 | 4 |
| Mathematics[2] | 9 | 62 | 84 |
| Other field | 86 | 28 | 10 |
| Missing/Inconsistent[1] | 5 | 5 | 1 |
| **Teaching Courses Uncertified to Teach** | | | |
| Yes | NA | 18 | 14 |
| No | NA | 78 | 83 |
| Missing/Inconsistent[1] | NA | 4 | 3 |
| **Degree Fields** | | | |
| Mathematics[3] | 1 | 24 | 40 |
| Mathematics and Mathematics Education[3] | 0 | 6 | 12 |
| Mathematics Education[3] | 1 | 18 | 24 |
| Other Field | 97 | 52 | 25 |
| Missing | 1 | 0 | 0 |
| Sample N | 686 | 671 | 565 |

1/ Inconsistent includes those who said they are certified but did not indicate the field(s) of certification and those who said they are not certified but indicated one or more fields of certification.

2/ These teachers may have been certified in other fields as well.

3/ These teachers may have degrees in other fields as well.

Table 46 (continued)

B. Science Teachers

| | Percent of Teachers | | |
|---|---|---|---|
| | K-6 | 7-9 | 10-12 |
| **Type of Certification** | | | |
| Not certified | 1 | 6 | 4 |
| Provisional | 4 | 7 | 6 |
| Regular | 87 | 83 | 89 |
| Missing/Inconsistent[1] | 7 | 3 | 2 |
| **Field of Certification** | | | |
| Not certified | 1 | 6 | 4 |
| Science | 9 | 73 | 89 |
| Other field | 86 | 17 | 5 |
| Missing/Inconsistent[1] | 4 | 4 | 2 |
| **Teaching Courses Uncertified to Teach** | | | |
| Yes | NA | 25 | 20 |
| No | NA | 71 | 75 |
| Missing/Inconsistent[1] | NA | 4 | 5 |
| **Degree Fields** | | | |
| Any Science[3] | 2 | 49 | 60 |
| Any Science and Science Education[3] | 0 | 10 | 16 |
| Science Education[3] | 2 | 9 | 8 |
| Other Field | 95 | 32 | 16 |
| Missing | 1 | 0 | 1 |
| Sample N | 710 | 658 | 1050 |

1/ Inconsistent includes those who said they are certified but did not indicate the field(s) of certification and those who said they are not certified but indicated one or more fields of certification.

2/ These teachers may have been certified in other fields as well.

3/ These teachers may have degrees in other fields as well.

Chapter 6

# PROFESSIONAL DEVELOPMENT

## A. Overview

Chapter 5 described the status of the science and mathematics teaching force in terms of objective measures such as percent of mathematics teachers with degrees in mathematics. This chapter focuses on teachers' perceptions of their qualifications, and on the opportunities they have for professional development to address their needs. The following sections include data on teachers' perceptions of their qualifications to (1) teach various subjects, (2) use computers as an instructional tool, and (3) teach special needs students. Data about professional development activities are also provided.

## B. Perceptions of Teacher Qualifications

In both the 1977 and 1985-86 surveys, elementary teachers were asked to rate their qualifications for teaching mathematics, science, social studies, and reading; these results are shown in Table 47. In 1977, most elementary teachers indicated they felt very well qualified to teach reading (63 percent); corresponding figures were 49 percent for mathematics, 39 percent for social studies, but only 22 percent for science. By 1985-86, the differences in teacher perceptions about science and other subjects were even more marked. While 82 percent of the teachers indicated they felt very well qualified to teach reading, 67 percent to teach mathematics, and 47 percent to teach social studies, only 27 percent felt very well qualified to teach life sciences, 15 percent physical sciences, and 15 percent earth/space sciences. Science subjects were the only ones in which more than 4 percent of the teachers indicated they felt "not well qualified." The percentages were larger for the physical and earth sciences (23 and 22 percent respectively), than for life sciences (11 percent). Similarly, when asked to name a specific science topic they would find difficult to teach, the most commonly listed topics were physics, chemistry, and, to a lesser extent, earth/space science topics.

As shown in Table 48, relatively few K-6 teachers (12 percent) consider themselves to be "master" science teachers, in contrast to 38 percent in mathematics. Nevertheless, most elementary science and mathematics teachers

Table 47

ELEMENTARY TEACHERS' PERCEPTIONS OF THEIR QUALIFICATIONS TO TEACH VARIOUS SUBJECTS
1977 and 1985-86

| | 1977 | | | | 1985-86 | | | |
|---|---|---|---|---|---|---|---|---|
| | Percent of Teachers | | | | Percent of Teachers | | | |
| | Not Well Qualified | Adequately Qualified | Very Well Qualified | Missing | Not Well Qualified | Adequately Qualified | Very Well Qualified | Missing |
| Mathematics | 4 | 46 | 49 | 1 | 1 | 30 | 67 | 2 |
| Social Studies | 6 | 54 | 39 | 1 | 4 | 47 | 47 | 2 |
| Reading | 3 | 32 | 63 | 2 | 1 | 15 | 82 | 2 |
| Science | 16 | 60 | 22 | 2 | -- | -- | -- | -- |
| Life Science | -- | -- | -- | -- | 11 | 60 | 27 | 2 |
| Physical Science | -- | -- | -- | -- | 23 | 59 | 15 | 3 |
| Earth/Space Sciences | -- | -- | -- | -- | 22 | 59 | 15 | 4 |
| Sample N | | | 1667 | | | | 1396 | |

Table 48

TEACHER OPINIONS ABOUT THEIR SCIENCE AND MATHEMATICS TEACHING BY SUBJECT AND GRADE RANGE

A. I consider myself a "master" mathematics (science) teacher.

| | Sample N | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree | Missing |
|---|---|---|---|---|---|---|---|
| Mathematics | | | | | | | |
| K-6 | 686 | 7 | 31 | 25 | 27 | 3 | 7 |
| 7-9 | 671 | 23 | 34 | 22 | 15 | 2 | 4 |
| 10-12 | 565 | 29 | 37 | 17 | 11 | 3 | 2 |
| Science | | | | | | | |
| K-6 | 710 | 2 | 10 | 24 | 45 | 13 | 5 |
| 7-9 | 658 | 16 | 31 | 23 | 22 | 4 | 4 |
| 10-12 | 1050 | 26 | 35 | 24 | 11 | 1 | 3 |

B. I enjoy teaching mathematics (science).

| | Sample N | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree | Missing |
|---|---|---|---|---|---|---|---|
| Mathematics | | | | | | | |
| K-6 | 686 | 40 | 47 | 2 | 2 | 2 | 7 |
| 7-9 | 671 | 61 | 32 | 1 | 1 | 1 | 4 |
| 10-12 | 565 | 67 | 28 | 1 | 1 | 1 | 2 |
| Science | | | | | | | |
| K-6 | 710 | 25 | 41 | 20 | 7 | 1 | 5 |
| 7-9 | 658 | 53 | 39 | 0 | 2 | 2 | 4 |
| 10-12 | 1050 | 64 | 29 | 1 | 2 | 1 | 3 |

Table 48 (continued)

C. My principal really does not understand the problems of teaching mathematics (science).

| | Sample N | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree | Missing |
|---|---|---|---|---|---|---|---|
| Mathematics | | | | | | | |
| K-6 | 686 | 2 | 6 | 24 | 40 | 21 | 7 |
| 7-9 | 671 | 4 | 16 | 19 | 40 | 17 | 6 |
| 10-12 | 565 | 9 | 20 | 22 | 36 | 12 | 1 |
| Science | | | | | | | |
| K-6 | 710 | 5 | 11 | 25 | 33 | 20 | 6 |
| 7-9 | 658 | 6 | 16 | 19 | 39 | 14 | 6 |
| 10-12 | 1050 | 13 | 19 | 14 | 39 | 13 | 2 |

indicated they enjoy teaching these subjects; 79 percent for science and 87 percent for mathematics. While 7-9 teachers were not as likely as their 10-12 counterparts to consider themselves "master" science or mathematics teachers, (47 percent for 7-9 science, 61 percent for 10-12 science, 57 percent for 7-9 mathematics, and 66 percent for 10-12 mathematics) more than 90 percent of each group indicated they enjoy teaching their subjects.

Secondary teachers were also asked if they were teaching any courses that they do not feel adequately qualified to teach and, if so, to specify the courses. The percentages of science and mathematics teachers in 1977 and in 1985-86 who indicated they felt inadequately qualified to teach one or more of their courses are shown in Table 49; the change from 13 percent to 6 percent of high school science teachers feeling inadequately qualified is statistically significant.

Table 49

PERCENT OF SECONDARY SCIENCE AND MATHEMATICS TEACHERS
WHO FEEL INADEQUATELY QUALIFIED TO TEACH ONE OR MORE OF THEIR COURSES
1977 AND 1985-86

| | Percent of Teachers | | | |
|---|---|---|---|---|
| | 1977 | Sample N | 1985-86 | Sample N |
| Science | | | | |
| 7-9 | 13 | 535 | 11 | 658 |
| 10-12 | 13 | 586 | 6 | 1050 |
| Mathematics | | | | |
| 7-9 | 11 | 550 | 9 | 671 |
| 10-12 | 5 | 548 | 4 | 569 |

Principals were also asked to rate the competence of science, mathematics, and for purposes of comparison, social studies teachers, by indicating how many teachers in their schools taught each of these subjects, and how many of these they consider highly competent, competent, and not adequately prepared to teach the subject. As can be seen in Table 50, principals are generally quite pleased with the abilities of their science, mathematics and social studies teachers, especially at the high school level. Overall, only about 3 percent of teachers in each subject are considered inadequately prepared.

It is particularly interesting to note the similarity in overall ratings of science and mathematics teacher competence between those provided by the principals and those provided by the teachers themselves. For example, 57 percent of 7-9 mathematics teachers agreed or strongly agreed with the statement "I consider myself a master mathematics teacher;" principals rated 59 percent highly competent. At the other end of the scale, roughly 3 percent of secondary science and mathematics teachers strongly disagreed with that statement, and principals rated roughly 3 percent of these teachers inadequately prepared.

It is important to note that while most principals consider most of their science and mathematics teachers to be well-prepared, averages tend to obscure differences among schools. For example, while 31 percent of high school principals consider <u>all</u> of their mathematics teachers to be highly competent, 12 percent of the schools have at least 1 inadequately prepared mathematics teacher. And in small schools, 1 or 2 underprepared teachers will constitute a substantial portion of the mathematics faculty.

In addition to questions about science and mathematics instruction in general, teachers were asked specifically about the adequacy of their preparation for using computers as an instructional tool. As shown in Table 51, half or more of science and mathematics teachers at each grade level feel totally or somewhat unprepared to use computers as an instructional tool. While secondary teachers are somewhat more likely than elementary teachers to perceive themselves as well prepared to use computers, fewer than 1 in 5 secondary science teachers and 1 in 4 secondary mathematics teachers rated themselves well or very well prepared in this regard.

Table 52 shows the percent of teachers who have received various types of training in the instructional uses of computers. Roughly 1 in 5 mathematics teachers and 1 in 4 science teachers have had <u>no</u> training in computer use. While approximately half of all science and mathematics teachers have had some in-service education in the use of computers, in many cases this education was limited to a total of less than 3 days. Secondary mathematics teachers are

Table 50

SECONDARY PRINCIPAL RATINGS OF TEACHER COMPETENCE
BY SUBJECT AND GRADE RANGE

| | Mean Percent of Teachers | | | |
|---|---|---|---|---|
| | 7-9 | | 10-12 | |
| | Average Percent | Standard Error | Average Percent | Standard Error |
| Mathematics | | | | |
| Highly competent | 59 | 3.93 | 67 | 1.97 |
| Competent | 38 | 3.96 | 30 | 1.94 |
| Not adequately prepared | 3 | 0.89 | 3 | .48 |
| | 100% | | 100% | |
| Science | | | | |
| Highly competent | 51 | 4.02 | 72 | 1.85 |
| Competent | 43 | 3.98 | 25 | 1.80 |
| Not adequately prepared | 6 | 1.99 | 3 | .47 |
| | 100% | | 100% | |
| Social Studies/History | | | | |
| Highly competent | 55 | 3.63 | 72 | 1.97 |
| Competent | 43 | 3.65 | 25 | 1.83 |
| Not adequately prepared | 2 | .63 | 3 | .54 |
| | 100% | | 100% | |

Table 51

TEACHER PERCEPTIONS OF THEIR PREPARATION TO USE COMPUTERS AS AN INSTRUCTIONAL TOOL

| | Sample N | Percent of Teachers: Totally Unprepared | Somewhat Unprepared | Adequately Prepared | Well Prepared | Very Well Prepared | Missing |
|---|---|---|---|---|---|---|---|
| **Mathematics** | | | | | | | |
| K-6 | 686 | 18 | 41 | 26 | 6 | 5 | 5 |
| 7-9 | 671 | 19 | 32 | 25 | 10 | 10 | 5 |
| 10-12 | 565 | 14 | 36 | 21 | 11 | 17 | 1 |
| **Science** | | | | | | | |
| K-6 | 710 | 29 | 38 | 20 | 5 | 3 | 5 |
| 7-9 | 658 | 21 | 41 | 19 | 11 | 6 | 2 |
| 10-12 | 1050 | 20 | 37 | 25 | 10 | 6 | 2 |

Table 52

TEACHER TRAINING IN THE
INSTRUCTIONAL USES OF COMPUTERS

Percent of Teachers

| | Mathematics | | | Science | | |
|---|---|---|---|---|---|---|
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| None | 19 | 22 | 19 | 21 | 30 | 26 |
| College Coursework | 22 | 41 | 48 | 21 | 24 | 26 |
| Less than 3 days' in-service education | 30 | 20 | 20 | 24 | 20 | 23 |
| Three or more days' in-service education | 31 | 26 | 30 | 35 | 21 | 25 |
| Self-taught | 26 | 32 | 43 | 24 | 32 | 36 |
| Other | 8 | 5 | 6 | 5 | 7 | 5 |
| Sample N | 686 | 671 | 565 | 710 | 658 | 1050 |

more likely than elementary teachers or secondary science teachers to have had college coursework related to computer use.

Federal law requires that children with handicapping conditions be educated in the least restrictive environment, and as a result many children with special needs are now "mainstreamed" into regular classes. It is of considerable concern, therefore, that relatively few science and mathematics teachers have received any training in educating handicapped children in the regular classroom (see Table 53). While elementary teachers are more likely than their secondary counterparts to have had college courses and in-service

Table 53

TEACHER TRAINING IN EDUCATING HANDICAPPED CHILDREN IN THE REGULAR CLASSROOM

| | Percent of Teachers | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics | | | Science | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| None | 48 | 60 | 66 | 59 | 62 | 66 |
| College Courses | 32 | 21 | 17 | 27 | 23 | 18 |
| In-Service Workshops | 21 | 16 | 18 | 15 | 19 | 18 |
| Other | 9 | 5 | 6 | 7 | 4 | 4 |
| Sample N | 686 | 671 | 565 | 710 | 658 | 1050 |

workshops in this area, overall more than half of all science and mathematics teachers have had no training related to mainstreaming. Given the paucity of training, it is not at all surprising that teachers feel inadequately prepared to teach classes that include students with special needs--physically handicapped, mentally retarded and learning disabled. As shown in Table 54, half or more of all science and mathematics teachers in each grade range consider themselves to be totally or somewhat unprepared to teach a class that

Table 54

TEACHER PERCEPTIONS OF THEIR PREPARATION TO TEACH IN A CLASS THAT INCLUDES CHILDREN WITH SPECIAL NEEDS

Percent of Teachers

| | Sample N | Totally Unprepared | Somewhat Unprepared | Adequately Prepared | Well Prepared | Very Well Prepared | Missing |
|---|---|---|---|---|---|---|---|
| **A. Physically Handicapped** | | | | | | | |
| **Mathematics** | | | | | | | |
| K-6 | 886 | 16 | 32 | 25 | 12 | 6 | 6 |
| 7-9 | 671 | 25 | 27 | 28 | 8 | 8 | 5 |
| 10-12 | 565 | 20 | 34 | 29 | 13 | 4 | 1 |
| **Science** | | | | | | | |
| K-6 | 710 | 26 | 34 | 24 | 7 | 4 | 5 |
| 7-9 | 658 | 22 | 34 | 28 | 9 | 4 | 3 |
| 10-12 | 1050 | 19 | 38 | 26 | 10 | 5 | 2 |
| **B. Mentally Retarded** | | | | | | | |
| **Mathematics** | | | | | | | |
| K-6 | 886 | 40 | 33 | 12 | 5 | 5 | 6 |
| 7-9 | 671 | 57 | 25 | 8 | 2 | 4 | 5 |
| 10-12 | 565 | 61 | 26 | 8 | 2 | 2 | 1 |
| **Science** | | | | | | | |
| K-6 | 710 | 53 | 27 | 10 | 3 | 2 | 6 |
| 7-9 | 658 | 54 | 30 | 9 | 2 | 2 | 3 |
| 10-12 | 1050 | 61 | 28 | 8 | 1 | 1 | 1 |

Table 54 (continued)

| | Sample N | Totally Unprepared | Somewhat Unprepared | Adequately Prepared | Well Prepared | Very Well Prepared | Missing |
|---|---|---|---|---|---|---|---|
| | | | | Percent of Teachers | | | |
| **C. Learning Disabled** | | | | | | | |
| **Mathematics** | | | | | | | |
| K-8 | 686 | 11 | 34 | 28 | 14 | 7 | 6 |
| 7-9 | 671 | 21 | 37 | 23 | 8 | 6 | 5 |
| 10-12 | 565 | 28 | 42 | 19 | 7 | 3 | 1 |
| **Science** | | | | | | | |
| K-6 | 710 | 19 | 32 | 27 | 9 | 6 | 8 |
| 7-9 | 658 | 25 | 38 | 24 | 8 | 4 | 1 |
| 10-12 | 1050 | 28 | 41 | 21 | 5 | 3 | 2 |

includes physically handicapped students. Even larger percentages feel inadequately prepared to teach classes that include mentally retarded students, ranging from 73 percent for elementary mathematics to 89 percent for 10-12 science. While the percentages of teachers feeling inadequately prepared to teach learning disabled students are markedly lower than those for the mentally retarded, they are never the less substantial (ranging from 45 to 70 percent); again secondary teachers are more likely to feel unprepared than are elementary teachers.

B. <u>In-service Education and Other Sources of Assistance for Teachers</u>

One way to help remedy any inadequacies in teachers' pre-service preparation as well as to help teachers keep up with changes in their fields is to provide opportunities for in-service education. However, as shown in Table 55, sizable proportions of science and mathematics teachers have not taken a course for college credit in their subject for the last 10 years. While many teachers have participated in professional meetings, workshops, and conferences related to science (or mathematics) teaching, the amount of time devoted to these in-service education activities was typically less than 6 hours during the previous year. (See Table 56.) Fewer than 1 in 10 elementary teachers and only about 1 in 5 secondary science and mathematics teachers spent as many as 16 hours on in-service education in the selected subject.

Teachers were also asked about their preferences for scheduling in-service programs. These results are shown in Table 57. Roughly 60 percent of science and mathematics teachers indicated they would be "very likely" to attend an in-service program that interested them if it were offered on a teacher workday. Summer programs and those offered after school would be somewhat less popular (roughly a third of teachers would be very likely to attend), while only about 1 in 5 secondary science and mathematics teachers and 1 in 7 elementary teachers would be very likely to attend in-service programs in the evenings or on Saturdays.

While in-service education is often a good way to help teachers stay current, there are other ways that teachers learn about new developments in their fields. A major concern in education in general, and in science and mathematics education in particular, is the dissemination of research findings. For this reason, teachers were asked how likely they would be to use each of a

Table 55

LAST COURSE FOR COLLEGE CREDIT IN SUBJECT

| | Percent of Teachers | | | | | |
|---|---|---|---|---|---|---|
| | Science | | | Mathematics | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Prior to 1975 | 39 | 18 | 20 | 36 | 27 | 25 |
| 1975 to 1982 | 31 | 28 | 31 | 29 | 31 | 32 |
| 1983 or later | 16 | 47 | 46 | 24 | 34 | 38 |
| Unknown | 13 | 7 | 3 | 10 | 8 | 5 |
| Sample N | 710 | 658 | 1050 | 686 | 671 | 565 |

Table 56

TOTAL AMOUNT OF TIME SPENT ON IN-SERVICE EDUCATION IN SUBJECT IN LAST 12 MONTHS

| | Percent of Teachers | | | | | |
|---|---|---|---|---|---|---|
| | Science | | | Mathematics | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| None | 50 | 30 | 27 | 41 | 31 | 35 |
| Less than 6 hours | 22 | 22 | 23 | 29 | 25 | 18 |
| 6-15 hours | 13 | 22 | 25 | 15 | 22 | 21 |
| 16-35 hours | 4 | 12 | 12 | 5 | 11 | 13 |
| More than 35 hours | 3 | 10 | 12 | 3 | 8 | 10 |
| Unknown | 8 | 4 | 1 | 7 | 4 | 3 |
| Sample N | 710 | 658 | 1050 | 686 | 671 | 565 |

Table 57

TEACHER PREFERENCES FOR SCHEDULING IN-SERVICE PROGRAMS

| | Percent of Teachers "Very Likely to Attend" Program of Interest | | | | | |
|---|---|---|---|---|---|---|
| | Science | | | Mathematics | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| After School | 30 | 33 | 28 | 33 | 33 | 34 |
| Evenings | 15 | 21 | 23 | 14 | 24 | 19 |
| Saturdays | 12 | 20 | 21 | 11 | 17 | 18 |
| Summers | 32 | 43 | 46 | 39 | 33 | 40 |
| Teacher workdays | 60 | 57 | 62 | 64 | 58 | 61 |
| Sample N | 710 | 658 | 1050 | 686 | 671 | 565 |

number of information sources if they wanted to find out about the research related to a topic such as science/mathematics anxiety or sex differences in learning; these results are shown in Table 58. In each subject/grade range combination teachers are likely to depend on in-service programs and other teachers as sources of information. Elementary science and mathematics teachers are more likely than their secondary counterparts to use local subject specialists, principals, and consultants as information sources, while secondary science and mathematics teachers are more likely to make use of meetings of professional organizations. Science teachers, especially at the elementary level, are more likely than mathematics teachers to use newspapers, magazines, television and radio, while secondary science teachers are more likely than the others to use journals and research reviews. Relatively few science and mathematics teachers make use of state department personnel or publishers and sales representatives as information sources.

Teachers were also asked if there were any professional magazines or journals that they find particularly helpful in teaching a selected science/mathematics class. As shown in Table 59, science teachers, especially secondary science teachers, are more likely than mathematics teachers to find professional journals helpful in their teaching. Also, as shown in Table 60, science teachers appear to have a much larger variety of magazines/journals available for use as instructional resources. For example, only 2 journals were listed by as many as 3 percent of the 7-9 mathematics teachers, and only one, the Mathematics Teacher, by that many 10-12 mathematics teachers, while 10 journals were named by at least 3 percent of the 10-12 science teachers.

Recent national reports, emphasizing the importance of excellence in education to the economic well-being of the United States, have encouraged business and industry to help schools in whatever ways they can. The 1985-86 National Survey of Science and Mathematics Education asked teachers if they had received any assistance from private industry in the last year, and if so, to indicate the types of assistance they had received. These results are presented in Table 61. Roughly 1 in 3 elementary teachers and secondary science teachers received assistance from private industry in the last year, compared to fewer than 1 in 5 secondary mathematics teachers. The most common types of assistance were curriculum materials and guest speakers.

Table 58

TEACHER SOURCES OF INFORMATION ABOUT EDUCATIONAL RESEARCH
BY SUBJECT AND GRADE RANGE

| | Percent of Teachers "Very Likely" to Use Each Source | | | | | |
|---|---|---|---|---|---|---|
| | Science | | | Mathematics | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Other teachers | 44 | 37 | 43 | 41 | 37 | 40 |
| Principals | 20 | 9 | 7 | 22 | 15 | 9 |
| Local subject specialists/coordinators | 37 | 32 | 26 | 36 | 30 | 25 |
| State Department personnel | 9 | 10 | 8 | 8 | 9 | 8 |
| Consultants | 23 | 16 | 13 | 21 | 16 | 13 |
| College courses | 27 | 46 | 41 | 34 | 33 | 32 |
| In-service programs | 53 | 41 | 33 | 46 | 37 | 36 |
| Meetings of professional organizations | 14 | 20 | 25 | 17 | 27 | 29 |
| Journals | 34 | 52 | 54 | 36 | 40 | 41 |
| Research reviews | 27 | 39 | 40 | 32 | 32 | 34 |
| Newspapers/magazines | 45 | 39 | 39 | 28 | 24 | 20 |
| Television/radio | 35 | 22 | 26 | 15 | 14 | 9 |
| Publishers and sales representatives | 8 | 6 | 4 | 7 | 5 | 3 |
| Sample N | 710 | 658 | 1050 | 686 | 671 | 565 |

Table 59

USE OF PROFESSIONAL MAGAZINES/JOURNALS
IN TEACHING SELECTED CLASS

Percent of Classes

| | 1985-86 | | | | 1977 | | | |
|---|---|---|---|---|---|---|---|---|
| | Yes | No | Missing or Inconsistent* | Sample N | Yes | No | Missing or Inconsistent* | Sample N |
| **Science** | | | | | | | | |
| K-6 | 30 | 65 | 5 | 710 | 22 | 68 | 10 | 558 |
| 7-9 | 44 | 52 | 4 | 658 | 37 | 52 | 11 | 535 |
| 10-12 | 51 | 45 | 4 | 1050 | 61 | 31 | 8 | 586 |
| **Mathematics** | | | | | | | | |
| K-6 | 15 | 79 | 6 | 686 | 19 | 74 | 7 | 574 |
| 7-9 | 22 | 75 | 3 | 671 | 32 | 64 | 4 | 550 |
| 10-12 | 20 | 76 | 4 | 565 | 35 | 62 | 3 | 548 |

* Inconsistent includes cases where teachers indicated they are not using journals but went on to list journals used and cases where they said they use particular journals but omitted the names.

Table 60

PROFESSIONAL MAGAZINES/JOURNALS LISTED
AS "PARTICULARLY HELPFUL" BY SUBJECT AND GRADE RANGE*

| A. Mathematics | Journal | Percent of Classes |
|---|---|---|
| K-6 (N=686) | Arithmetic Teacher | 4 |
| | Instructor | 4 |
| 7-9 (N=671) | Mathematics Teacher | 9 |
| | Arithmetic Teacher | 8 |
| 10-12 (N=565) | Mathematics Teacher | 13 |
| **B. Science** | | |
| K-6 (N=710) | Ranger Rick | 7 |
| | National Geographic | 6 |
| | Science and Children | 3 |
| 7-9 (N=658) | Disçover | 9 |
| | The Science Teacher | 7 |
| | National Geographic | 7 |
| | Science Digest | 6 |
| | Current Science | 5 |
| | Science and Children | 4 |
| 10-12 (N=1050) | Science 85/86 | 10 |
| | The Science Teacher | 8 |
| | Scientific American | 8 |
| | Discover | 6 |
| | Journal of Chemical Education | 6 |
| | Science Digest | 6 |
| | The Physics Teacher | 5 |
| | Science News | 5 |
| | National Geographic | 4 |
| | 3-2-1 Contact | 4 |

* Any journal used by 3 percent or more of the classes at a particular grade level is included in this table.

Table 68

AVAILABILITY OF COMPUTERS FOR SCIENCE AND MATHEMATICS INSTRUCTION

| | Percent of Classes | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics | | | Science | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Not available | 27 | 28 | 24 | 33 | 32 | 24 |
| Available but quite difficult to access | 20 | 22 | 23 | 18 | 25 | 28 |
| Available but somewhat difficult to access | 24 | 23 | 23 | 21 | 25 | 27 |
| Readily available | 25 | 26 | 29 | 25 | 16 | 20 |
| Missing/inconsistent | 4 | 1 | 2 | 4 | 2 | 2 |
| Sample N | 686 | 671 | 565 | 710 | 658 | 1050 |

Research on effective schools has highlighted the importance of the principal as instructional leader in the schools. The typical principal in U.S. schools is a 46-year-old white male, with 10 years of teaching experience before becoming principal and 9 years of experience as a principal, including 6 years at his current school. (See Tables 62 and 63.)

While having an experienced cadre of principals can contribute greatly to the smooth functioning of schools, it is important that principals, like teachers, be given the opportunity to up-grade their skills. For this reason, principals were asked if they had attended any workshops or conferences in the last 3 years on a series of topics, including science and mathematics teaching. As shown in Table 64, more than 90 percent of principals in each grade range have attended workshops on instructional leadership and almost that many on school organization and management. Roughly 3 out of 4 have attended workshops related to the instructional uses of computers, and many, especially high school principals, have had in-service work on the administrative uses of computers.

Since principals are responsible for instructional leadership across the curriculum, it is not surprising that the percentages participating in workshops on a particular subject area are generally lower than those for school-wide concerns. At each grade range principals were more likely to have attended workshops related to reading/language arts/English teaching than any other subject, with 76 percent of elementary principals and roughly half of secondary principals participating.

The need for the principal to be able to assist teachers in improving instruction in individual subject areas is particularly important at the elementary level. While approximately 60 percent of high schools and more than half of all schools with grades 7, 8, or 9 have persons other than the principal specifically designated to coordinate science and mathematics instructions, only about a third of elementary schools have such persons, (see Table 65).

Earlier it was noted that elementary teachers are in fact more likely than secondary teachers to consult their principals for information about educational research, probably due at least in part to the fact that they do not have department chairpersons to help in this way. The survey also provides evidence that elementary teachers feel that their principals have a good idea

Table 62

PRINCIPAL EXPERIENCE BY SAMPLE GRADE RANGE

| | Number of Years | | | | | |
|---|---|---|---|---|---|---|
| | K-6 | | 7-9 | | 10-12 | |
| | Mean | Standard Error | Mean | Standard Error | Mean | Standard Error |
| Age | 46.3 | .52 | 46.7 | .99 | 44.8 | .58 |
| Teaching Experience | 11.0 | .50 | 10.1 | .74 | 9.8 | .38 |
| Principal | 9.7 | .57 | 9.1 | .76 | 8.6 | .47 |
| Principal at this school | 5.9 | .37 | 6.4 | .43 | 5.9 | .45 |

Table 63

PRINCIPAL CHARACTERISTICS BY SAMPLE GRADE RANGE

| | Percent of Principals | | |
|---|---|---|---|
| | K-6 | 7-9 | 10-12 |
| **Sex** | | | |
| Male | 68 | 74 | 91 |
| Female | 32 | 25 | 9 |
| Missing | 0 | 1 | 0 |
| **Race** | | | |
| White (not of Hispanic origin) | 90 | 94 | 95 |
| Black (not of Hispanic Origin) | 6 | 5 | 3 |
| Hispanic | 3 | 1 | 1 |
| American Indian or Alaskan Native | 0 | 0 | 0 |
| Asian or Pacific Islander | 1 | 0 | 0 |
| Missing | 0 | 1 | 1 |
| **Age** | | | |
| Less than 30 | 0 | 4 | 1 |
| 31-40 | 24 | 25 | 29 |
| 41-50 | 45 | 35 | 46 |
| 51-60 | 25 | 28 | 20 |
| Greater than 60 | 2 | 7 | 3 |
| Missing | 3 | 2 | 2 |
| **Undergraduate Major** | | | |
| Mathematics/Math Education | 11 | 11 | 13 |
| Science/Science Education | 7 | 7 | 13 |
| Both science and math | 1 | 2 | 1 |
| Other | 81 | 80 | 74 |
| Sample N | 365 | 348 | 360 |

Table 64

PRINCIPAL ATTENDANCE AT WORKSHOPS/CONFERENCES ON A NUMBER OF TOPICS BY GRADE RANGE

| | Percent of Principals | | |
|---|---|---|---|
| | K-6 | 7-9 | 10-12 |
| Instructional Leadership | 94 | 91 | 95 |
| School Organization/Management | 88 | 87 | 93 |
| Instructional Uses of Computers | 82 | 72 | 81 |
| Administrative Uses of Computers | 55 | 54 | 71 |
| Reading/Language Arts/English Teaching | 76 | 55 | 46 |
| Mathematics Teaching | 51 | 39 | 30 |
| Science Teaching | 42 | 35 | 28 |
| Social Studies/History Teaching | 34 | 36 | 26 |
| Sample N | 365 | 348 | 360 |

Table 65

DESIGNATED COORDINATORS OF SCIENCE AND MATHEMATICS INSTRUCTION BY SAMPLE GRADE RANGE

| | Percent of Schools | | |
|---|---|---|---|
| | K-6 | 7-9 | 10-12 |
| Mathematics Instruction | 35 | 56 | 60 |
| Science Instruction | 37 | 51 | 59 |
| Instructional Uses of Computers | 53 | 62 | 70 |
| Sample N | 365 | 348 | 360 |

of the challenges they face, perhaps because elementary schools tend to be smaller than secondary schools, thus allowing more interaction between principals and individual teachers. For example, as was shown in Table 48, only 8 percent of K-6 teachers agreed with the statement, "My principal really does not understand the problems of teaching mathematics," compared to 20 percent of 7-9 and 29 percent of 10-12 mathematics teachers. The climate appears right for elementary teachers to get help from their principals.

Unfortunately, there is evidence that elementary principals are often not adequately prepared to provide this assistance in the areas of science and mathematics education. Table 66 shows the percent of principals who indicated they were not well qualified, adequately qualified, and very well qualified to supervise each of a number of subjects. Sizable numbers of principals feel inadequately qualified to supervise science instruction, especially the physical and earth/space sciences, precisely those areas in which large numbers of elementary teachers are most likely to need help. Only about 1 in 4 principals feels very well qualified to supervise each science area, and about 1 in 3 in mathematics, compared to about 1 in 2 for social studies and English.

Table 66

PRINCIPALS' PERCEPTIONS OF THEIR QUALIFICATION TO SUPERVISE EACH SUBJECT BY SAMPLE GRADE RANGE

| | Percent of Principals | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics | Life Science | Physical Science | Earth/ Space Science | Social Studies/ History | Reading/ Language Arts/ English |
| K-6 | | | | | | |
| Not well qualified | 9 | 15 | 20 | 23 | 4 | 4 |
| Adequately qualified | 50 | 55 | 56 | 55 | 43 | 39 |
| Very well qualified | 41 | 29 | 23 | 27 | 52 | 57 |
| (Sample N = 365) | | | | | | |
| 7-9 | | | | | | |
| Not well qualified | 15 | 13 | 18 | 15 | 4 | 10 |
| Adequately qualified | 60 | 57 | 57 | 62 | 41 | 43 |
| Very well qualified | 26 | 28 | 24 | 22 | 55 | 46 |
| (Sample N = 348) | | | | | | |
| 10-12 | | | | | | |
| Not well qualified | 16 | 13 | 21 | 24 | 4 | 8 |
| Adequately qualified | 52 | 58 | 54 | 54 | 43 | 47 |
| Very well qualified | 30 | 23 | 24 | 20 | 52 | 44 |
| (Sample N = 360) | | | | | | |

Chapter 7

# FACTORS WHICH AFFECT INSTRUCTION IN SCIENCE AND MATHEMATICS EDUCATION

## A. Overview

In both the 1977 and 1985-86 surveys, principals were asked about the availability of various instructional resources in their schools, and both teachers and principals were asked about problems in science and mathematics instruction in their schools. Due to current concern about the impending shortages of science and mathematics teachers, the 1985-86 survey also included questions about teacher supply and demand. These results are presented in the following sections.

## B. Availability of Instructional Resources

Table 67 shows the percent of schools that have each of a number of instructional resources available to students. Not surprisingly, there has been a very large increase since 1977 in the number of schools with computers. For example, 90 percent of schools with one or more of the grades 7-9 now have computers compared to 16 percent in 1977. There has also been a marked increase in the number of schools with hand-held calculators, with, for example, 83 percent of junior high schools now having calculators compared to 49 percent in 1977. Otherwise, changes in percentages since 1977 were generally not statistically significant.

In addition to computers and calculators, instructional resources found in most schools include microscopes, videocassette recorders, cameras, models (e.g., the solar system, parts of organisms, mathematical figures), learning resource centers, and small group meeting rooms, and at the secondary level science laboratories and darkrooms. Less than one-third of schools have telescopes, greenhouses, outdoor study areas, or mathematics laboratories, and fewer than 1 in 10 have such resources as a weather station, a vivarium or a portable planetarium.

The fact that most schools have computers does not necessarily mean that computers are heavily used in science and mathematics instruction. As shown in Table 68, roughly half of all science and mathematics teachers at each grade

Table 67

AVAILABILITY OF SELECTED INSTRUCTIONAL RESOURCES BY SAMPLE GRADE RANGE 1977 and 1985-86

| Equipment | 1977 K-6 | 1977 7-9 | 1977 10-12 | 1985-86 K-6 | 1985-86 7-9 | 1985-86 10-12 |
|---|---|---|---|---|---|---|
| Computers or computer terminals | 7 | 16 | 36 | 90 | 90 | 98 |
| Greenhouse | 6 | 15 | 26 | 5 | 12 | 30 |
| Telescope | 18 | 25 | 29 | 26 | 29 | 29 |
| Darkroom | 14 | 37 | 75 | 13 | 42 | 73 |
| Weather Station | 9 | 14 | 22 | 9 | 10 | 7 |
| Hand-held calculators | 32 | 49 | 77 | 71 | 83 | 94 |
| Microscopes | 84 | 95 | 95 | 84 | 97 | 99 |
| Cameras | 35 | 51 | 81 | 48 | 60 | 84 |
| Models (e.g., the solar system) | 80 | 74 | 79 | 80 | 82 | 92 |
| Small group meeting room | 44 | 56 | 59 | 50 | 56 | 59 |
| Mathematics laboratory | 16 | 31 | 15 | 10 | 17 | 21 |
| Learning resource center | -- | -- | -- | 62 | 62 | 67 |
| Science laboratory | -- | -- | -- | 27 | 70 | 91 |
| Outdoor study area | -- | -- | -- | 30 | 29 | 31 |
| Vivarium | -- | -- | -- | 1 | 5 | 3 |
| Portable planetarium | -- | -- | -- | 6 | 7 | 6 |
| Videocassette recorder | -- | -- | -- | 87 | 82 | 98 |
| Videodisc players* | -- | -- | -- | 29 | 41 | 43 |
| Sample N | 609 | 298 | 270 | 365 | 348 | 360 |

* The data on availability of videodisc players are suspect; they are much larger than those reported by other recent studies. It is possible that some principals did not distinguish between video<u>disc</u> players and video<u>cassette</u> players.

Table 68

AVAILABILITY OF COMPUTERS FOR SCIENCE AND MATHEMATICS INSTRUCTION

| | Percent of Classes | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics | | | Science | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| Not available | 27 | 28 | 24 | 33 | 32 | 24 |
| Available but quite difficult to access | 20 | 22 | 23 | 18 | 25 | 28 |
| Available but somewhat difficult to access | 24 | 23 | 23 | 21 | 25 | 27 |
| Readily available | 25 | 26 | 29 | 25 | 16 | 20 |
| Missing/inconsistent | 4 | 1 | 2 | 4 | 2 | 2 |
| Sample N | 686 | 671 | 565 | 710 | 658 | 1050 |

level reported that computers are either not available for use in the randomly selected class or are quite difficult to access. Only about 1 in 4 mathematics classes and 1 in 5 science classes have computers readily available for their use.

Principals who indicated that computers are used as part of their students' instructional programs were asked to indicate the year they first had computers available for instructional use. These results are shown in Table 69. High schools are considerably more likely than elementary and middle/junior high schools to have had computers available for a number of years -- 30 percent of schools with grades 10-12 but only 7 percent of K-6 schools and 14 percent of schools with grades 7-9 had computers available before 1980.

Table 70 shows the average number of computers (in schools that have computers) at each grade range. Note that the average number of computers increases substantially with grade range. At each grade range, schools have many more microcomputers than computer terminals connected to mini or mainframe computers. More of these computers are grouped in a central computer lab than are distributed in classrooms.

C. Problems in Science and Mathematics Instruction

Teachers and principals were given a list of "factors" that might affect science instruction in their school and asked to indicate which, if any, cause serious problems. As shown in Table 71, resource problems such as inadequate facilities, insufficient funds for purchasing equipment and supplies, lack of materials for individualizing instruction, and inadequate access to computers are often cited as serious problems in science instruction. In addition, a substantial number of principals and teachers see inadequate student reading abilities as deterrents to effective science instruction. Teachers are generally more likely than principals to view large class sizes as a serious problem in science.

At the elementary level, lack of teacher planning time and insufficient time to teach science are often cited as serious problems; the belief that science is less important than other subjects was less frequently cited. Many principals, but relatively few teachers, consider inadequate teacher preparation and lack of teacher interest in science to be serious problems.

Table 69

YEAR COMPUTERS WERE FIRST
AVAILABLE FOR INSTRUCTIONAL USE

| | Percent of Schools* | | |
|---|---|---|---|
| | K-6 | 7-9 | 10-12 |
| Before 1980 | 7 | 14 | 30 |
| 1980 | 13 | 13 | 15 |
| 1981 | 10 | 8 | 12 |
| 1982 | 18 | 14 | 21 |
| 1983 | 27 | 20 | 13 |
| 1984 | 14 | 18 | 3 |
| 1985 | 9 | 13 | 3 |
| Missing | 2 | 1 | 2 |
| Sample N | 316 | 313 | 349 |

* Schools that do not yet have computers available and those that provided inconsistent responses (e.g., said they do not have computers but circled the year first available) were excluded from these analyses.

Table 70

AVERAGE NUMBER OF COMPUTERS
IN SCHOOLS BY GRADE RANGE[1]

| | Total No. of Computers | | No. of Terminals | | No. of Microcomputers | | No. in Computer Laboratory | | No. in Classroom | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Standard Error | Mean | Standard Error | Mean | Standard Error | Mean | Standard Error | Mean | Standard Error |
| K-6 | 11.8 | .70 | 1.5 | .42 | 10.3 | .59 | 6.7 | .57 | 5.12 | .41 |
| 7-9 | 17.8 | 1.52 | 1.8 | .39 | 15.9 | 1.36 | 11.8 | 1.11 | 6.05 | .72 |
| 10-12 | 27.7 | 1.62 | 3.4 | .71 | 24.3 | 1.40 | 19.5 | 1.23 | 8.14 | .80 |

1/ Only those schools which indicated they have computers and provided consistent data were included in these analyses.

Table 71

PERCENT OF PRINCIPALS AND TEACHERS INDICATING THAT EACH FACTOR IS A SERIOUS PROBLEM IN THEIR SCHOOL, BY SUBJECT AND GRADE RANGE

A. Science

| | 1977 | | | | | | 1985-86 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Teachers | | | Principals | | | Teachers | | | Principals | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| a. Belief that science is less important than other subjects | 8 | 9 | 5 | 28 | 11 | 5 | 8 | 5 | 5 | 13 | 5 | 5 |
| b. Inadequate facilities | 28 | 26 | 20 | 43 | 40 | 18 | 25 | 25 | 18 | 36 | 27 | 18 |
| c. Insufficient funds for purchasing equipment and supplies | 29 | 24 | 27 | 40 | 32 | 24 | 30 | 28 | 23 | 42 | 40 | 28 |
| d. Lack of materials for individualizing instruction | 30 | 27 | 28 | 30 | 21 | 18 | 30 | 27 | 20 | 29 | 21 | 13 |
| e. Insufficient numbers of textbooks | 11 | 7 | 8 | 5 | 5 | 3 | 11 | 4 | 4 | 8 | 8 | 2 |
| f. Lack of student interest in science | 3 | 19 | 20 | 8 | 19 | 21 | 3 | 14 | 18 | 6 | 18 | 26 |
| g. Inadequate student reading abilities | 16 | 40 | 45 | 23 | 40 | 44 | 13 | 19 | 23 | 21 | 28 | 25 |
| h. Lack of teacher interest in science | 5 | 2 | 1 | 23 | 8 | 1 | 7 | 2 | 1 | 16 | 6 | 1 |
| i. Teachers inadequately prepared to teach science | 9 | 3 | 2 | 29 | 8 | 2 | 9 | 5 | 2 | 26 | 9 | 4 |
| j. Lack of teacher planning time | 22 | 7 | 14 | 22 | 8 | 5 | 24 | 13 | 13 | 18 | 7 | 10 |
| k. Not enough time to teach science | 19 | 4 | 10 | 17 | 8 | 1 | 21 | 9 | 10 | 20 | 4 | 4 |
| l. Class sizes too large | 12 | 19 | 22 | 12 | 12 | 13 | 16 | 19 | 18 | 9 | 13 | 9 |
| m. Difficulty in maintaining discipline | 5 | 6 | 9 | 7 | 7 | 8 | 4 | 9 | 6 | 4 | 8 | 2 |
| n. Inadequate articulation of instruction across grade levels | 9 | 10 | 11 | 15 | 15 | 13 | 7 | 3 | 7 | 11 | 14 | 9 |
| o. Inadequate diversity of science electives | 8 | 8 | 11 | 2 | 7 | 12 | 5 | 4 | 4 | 4 | 5 | 10 |
| p. Low enrollments in science courses | 2 | 4 | 7 | 6 | 8 | 20 | 2 | 2 | 4 | 0 | 3 | 9 |
| q. Poor quality of textbooks | -- | -- | -- | -- | -- | -- | 11 | 5 | 5 | 6 | 4 | 2 |
| r. Inadequate access to computers | -- | -- | -- | -- | -- | -- | 18 | 23 | 17 | 19 | 18 | 21 |
| s. Student absences | -- | -- | -- | -- | -- | -- | 3 | 11 | 17 | 5 | 8 | 11 |
| Sample | 558 | 535 | 586 | 809 | 298 | 270 | 710 | 658 | 1050 | 365 | 348 | 360 |

Table 71 (continued)

PERCENT OF PRINCIPALS AND TEACHERS INDICATING THAT EACH FACTOR IS A SERIOUS PROBLEM IN THEIR SCHOOL, BY SUBJECT AND GRADE RANGE

B. Mathematics

| | 1977 | | | | | | 1985-86 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Teachers | | | Principals | | | Teachers | | | Principals | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| a. Belief that math is less important than other subjects | 1 | 2 | 5 | 1 | 3 | 8 | 2 | 2 | 2 | 2 | 2 | 3 |
| b. Inadequate facilities | 3 | 10 | 7 | 8 | 11 | 5 | 4 | 3 | 5 | 9 | 9 | 8 |
| c. Insufficient funds for purchasing equipment and supplies | 13 | 13 | 15 | 19 | 15 | 15 | 11 | 11 | 9 | 18 | 22 | 11 |
| d. Lack of materials for individualizing instruction | 17 | 21 | 19 | 17 | 14 | 23 | 14 | 15 | 10 | 18 | 12 | 11 |
| e. Insufficient numbers of textbooks | 4 | 8 | 6 | 2 | 4 | 3 | 4 | 6 | 4 | 2 | 3 | 1 |
| f. Lack of student interest in math | 4 | 31 | 30 | 7 | 22 | 23 | 5 | 22 | 22 | 5 | 18 | 26 |
| g. Inadequate student reading abilities | 16 | 42 | 39 | 10 | 24 | 29 | 9 | 18 | 23 | 14 | 22 | 21 |
| h. Lack of teacher interest in math | 4 | 2 | 2 | 2 | 1 | 4 | 2 | 1 | 1 | 4 | 5 | 1 |
| i. Teachers inadequately prepared to teach math | 4 | 5 | 1 | 5 | 3 | 2 | 2 | 3 | 3 | 8 | 7 | 4 |
| j. Lack of teacher planning time | 15 | 6 | 4 | 14 | 7 | 3 | 13 | 6 | 6 | 11 | 7 | 11 |
| k. Not enough time to teach math | 4 | 4 | 4 | 4 | 1 | 0 | 4 | 6 | 4 | 8 | 3 | 1 |
| l. Class sizes too large | 17 | 23 | 24 | 10 | 13 | 8 | 15 | 15 | 12 | 9 | 10 | 7 |
| m. Difficulty in maintaining discipline | 6 | 12 | 11 | 3 | 5 | 6 | 4 | 8 | 7 | 4 | 7 | 4 |
| n. Inadequate articulation of instruction across grade levels | 8 | 10 | 16 | 9 | 14 | 14 | 4 | 7 | 6 | 7 | 13 | 10 |
| o. Inadequate diversity of math electives | 4 | 6 | 12 | 1 | 5 | 11 | 3 | 8 | 5 | 3 | 4 | 9 |
| p. Low enrollments in math courses | 1 | 4 | 7 | 0 | 8 | 21 | 1 | 1 | 3 | 0 | 2 | 7 |
| q. Poor quality of textbooks | -- | -- | -- | -- | -- | -- | 3 | 8 | 6 | 3 | 5 | 1 |
| r. Inadequate access to computers | -- | -- | -- | -- | -- | -- | 18 | 18 | 14 | 21 | 16 | 22 |
| s. Student absences | -- | -- | -- | -- | -- | -- | 3 | 13 | 24 | 6 | 9 | 11 |
| Sample | 558 | 550 | 548 | 609 | 298 | 270 | 686 | 671 | 565 | 365 | 348 | 360 |

Elementary teachers tend to be more concerned than their secondary counterparts about the quality of science textbooks as well as about an inadequate supply of textbooks. Secondary science teachers, on the other hand, were more likely to cite student attitudes and behaviors as problems, including lack of student interest in science and student absences. Relatively few principals or science teachers indicated that articulation of instruction across grade levels, inadequate diversity of electives, low enrollments in science courses, or difficulty in maintaining discipline caused serious problems in science instruction in their schools.

In mathematics, the problems most frequently cited as serious were inadequate access to computers, lack of materials for individualizing instruction, insufficient funds for purchasing equipment and supplies, and class size. As in science instruction, elementary mathematics teachers are more likely than their secondary school counterparts to consider lack of teacher planning time a major problem. Sizable numbers of teachers and principals consider lack of student interest in mathematics and inadequate student reading abilities to be serious problems in secondary mathematics. Many high school mathematics teachers are also very concerned about student absences.

Relatively few teachers and principals are concerned about inadequate facilities for mathematics instruction, and very few think the perceived unimportance of mathematics causes problems. Also, as was the case in science, relatively few principals or mathematics teachers indicated that articulation of instruction across grade levels, inadequate diversity of electives, low enrollments in mathematics courses, or difficulty in maintaining discipline are serious problems in mathematics instruction.

Overall the 1985-86 results are quite similar to those in 1977: resource-related problems are most frequently cited as serious (with the notable exception of numbers of textbooks), while difficulty in maintaining discipline is rarely considered a serious problem in science or mathematics instruction. The most striking change since 1977 is in the perception of student reading abilities as a serious problem for science and mathematics instruction. for example, in 1985-86, 20 to 25 percent of 7-9 and 10-12 science teachers and principals cited inadequate student reading abilities as a serious problem for science instruction, down from 40 to 45 percent in 1977. It is not clear whether this change is due to less difficult textbooks, improved students reading abilities, or other factors.

D. Teacher Supply and Demand

In order to get an indication of the nature and extent of teacher shortages, the 1985-86 survey asked secondary principals if they were experiencing any difficulty in hiring fully qualified teachers to fill vacancies in various subjects. As shown in Table 72, the most serious shortages appeared to be in physics, chemistry, computer science, mathematics and foreign language.

Secondary principals were also asked if their school districts provided each of a number of incentives to teachers in shortage areas. As can be seen in Table 73, while subsidized retraining for teachers is somewhat more common than differential salaries and extended contracts, none of these incentives is widespread. Principals and/or teachers were also asked for their opinions on a number of items related to the supply of qualified science and mathematics teachers: Would teachers prefer 11-month contracts? Should there be differential pay for teachers in shortage areas? Should prospective teachers be required to pass subject matter competency tests? What about experienced teachers? Finally, should industry scientists and mathematicians be allowed to teach in the public schools? The results for these items are shown in Table 74.

Typically teachers are employed in 9 or 10-month contracts. Many of the proposals for "career ladders" for teachers advocate providing opportunities for master teachers to work on curriculum development and in-service education of less qualified teachers during the summer. The intent would be to help retain highly qualified teachers both by providing them with opportunities for professional growth and by allowing them to increase their income. As Table 74 shows, however, most teachers do not want 11-month contracts. Differential pay for teachers in shortage areas tends to be favored by secondary principals, who must be able to fill their teaching vacancies, and by secondary science and mathematics teachers, who would be most likely to receive this extra pay, but not by elementary teachers who are at present not in short supply. More than

Table 72

DIFFICULTY IN HIRING FULLY QUALIFIED TEACHERS FOR VACANCIES IN SELECTED SUBJECTS*

| | Percent of High Schools | |
|---|---|---|
| Subject | N | Percent |
| Physics | 232 | 72 |
| Chemistry | 237 | 63 |
| Computer Science | 223 | 62 |
| Mathematics | 269 | 57 |
| Foreign Language | 247 | 52 |
| Biology/Life Science | 237 | 38 |
| Physical Science | 200 | 38 |
| Earth/Space Science | 170 | 38 |
| Special Education | 225 | 37 |
| General Science | 170 | 27 |
| Social Studies | 172 | 6 |

Sample N = 360

* Schools that indicated "No Vacancies/Does Not Apply" for a particular subject were not included in the analysis for that subject.

Table 73

INCENTIVES FOR TEACHERS IN SHORTAGE AREAS

| | Percent of Schools Affected | |
|---|---|---|
| | 7-9 | 10-12 |
| Extended contracts | 8 | 8 |
| Differential salaries | 9 | 12 |
| Subsidized retraining for teachers to change to a field specified as a shortage area | 14 | 17 |
| Sample N | 348 | 360 |

Table 74

TEACHER AND PRINCIPAL OPINIONS ABOUT
TEACHER SUPPLY ISSUES

| | Percent Agreeing[1] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mathematics | | | Science | | | Principals | | |
| | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 | K-6 | 7-9 | 10-12 |
| a. I would like an 11-month contract | 14 | 20 | 23 | 16 | 20 | 23 | -- | -- | -- |
| b. I am in favor of differential pay for teachers in shortage areas | 22 | 47 | 61 | 24 | 56 | 59 | 36 | 40 | 49 |
| c. Prospective teachers should have to pass subject matter competency tests | 62 | 58 | 72 | 61 | 64 | 66 | 81 | 90 | 82 |
| d. Experienced teachers should have to pass subject matter competency tests | 32 | 36 | 26 | 33 | 38 | 37 | 55 | 46 | 46 |
| Sample N | 686 | 671 | 565 | 710 | 658 | 1050 | 365 | 348 | 360 |

1/ Responded "Strongly Agree" or "Agree"; other choices were no opinion, disagree, strongly disagree.

60 percent of teachers and more than 80 percent of principals are in favor of requiring prospective teachers to pass subject matter competency tests; considerably fewer would also like experienced teachers to have to take such tests. The only surprising note was the substantial numbers of principals and teachers who agreed that industry scientists and mathematicians should be allowed to teach in the public schools, presumably without certification; percentages for the various groups ranged from 30 to 45 percent.

Appendix A

Sample Design and Sample Weights

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## Appendix A
## Sample Design and Sample Weights

The National Survey of Science and Mathematics Education utilized a national probability sample of schools, principals, and teachers in grades K through 12. The sample was designed so that national estimates of teacher preparation, course offerings and enrollments, and classroom practices could be made from the sample data. The sample design also ensured that estimates could be made for various subpopulations such as those in a particular region or a particular type of community.

A probability sample requires that every member of the population being sampled must have a positive chance of being selected. The sample design for this survey ensured that every principal or headmaster and teacher of mathematics and/or science in grades K-12 in the 50 states and the District of Columbia had a chance of being selected.

For this study, RTI used a two-stage probability sampling design with schools as the first stage sampling units and teachers as the second stage units. In the first sampling stage, RTI selected three independent grade-specific probability samples of schools with 425 schools in each sample. Schools were classified according to whether they contained grades K through 6, grades 7 through 9, or grades 10 through 12. Schools containing grades spanning two or more of the grade ranges were eligible to be selected for multiple samples. In each of the sampled schools, the principal was asked to provide a list of teachers with indication of course(s) taught by the teacher. In the second stage of sampling, a sample of 6,156 science and mathematics teachers was selected from these lists.

### A. Target Population

The target populations for this survey include (1) all public and private school principals or headmasters and (2) all public and private school teachers who teach science or mathematics in any of the grades K through 12 in the 50 states and the District of Columbia. For the principal target population, domains of interest were defined by grade range served by the school, K-6, 7-9, and 10-12. Within the teacher target population, the domains of interest were defined by grade range for which the school was selected, the classroom setting, and the subject(s) taught by the teacher. The classroom setting was classified by whether the teacher taught all subjects to the students in a class (that is, a self-contained classroom setting) or whether the teacher or the students change classrooms for instruction in academic subjects. For teachers in schools selected for grades K-6 and grades 7-9, the teacher domains were:

1. science only;
2. mathematics only;
3. science and mathematics (not in self-contained setting); and
4. self-contained classes

For teachers in schools sampled for the grades 10-12, the teacher domains, developed to be exhaustive and mutually exclusive, were:

1. biology only or biology and other sciences (excluding chemistry, physics, and earth science);
2. biology and chemistry, physics, or earth science;
3. chemistry only;
4. physics only;
5. earth science only;
6. mathematics and science;
7. calculus/advanced mathematics only;
8. other mathematics/computer science only; and
9. calculus/advanced mathematics and other mathematics/computer science.

B. Sampling Design

The sampling design was a two stage design performed independently on three grade range specific sampling frames. In the first stage, RTI selected schools (and, hence, the school principal or headmaster) using a probability proportional to size with minimal replacement selection scheme developed by Chromy (Chromy 1981). The size measure was the estimated number of teachers in the grade range. For each sampled school, the school officials were requested to provide a list of teachers. For each teacher, the school official was requested to indicate whether the teacher taught in a self-contained classroom or the type of mathematics or science taught by the teacher. In the second sampling stage, RTI selected a sample of teachers from each subject specific frame.

## C. School Sampling

The selection of schools required three activities:

1. construction of grade range specific frames;
2. computation of a size measure for each school; and
3. stratification and selection of schools.

These activities are described below.

### 1. Construction of Grade Specific Frames

The school sampling frames were constructed from the Quality Education Data, Inc. (QED) database which included school name and address, principal name, student enrollment, teacher count, and other data for public and private schools in the United States. The QED database also contains data items that indicate specific grades served.

The specific grade range data items consist of two paired data items. The first paired set of data items provides the lowest and highest grades taught in the school when a school serves consecutive grades (e.g., grades K-6, or K-12). The second paired set is used when the school has two separate consecutive grade ranges or a split grade range (for example, a school with kindergarten and grades 4-6). The grades are coded as follows:

| | |
|---|---|
| P = preschool | C = twelfth grade |
| K = kindergarten | D = special education |
| 1-9 = actual grade | E = vocational/technical |
| A = tenth grade | F = adult education |
| B = eleventh grade | G = alternative/continuation |

Schools with only preschool, special education, adult education, vocational/technical schools, or alternative/continuing education were excluded from the frames. Since grade range served varies among schools, a school could be included in two or more grade range specific frames. A school included in more than one grade range frame could be selected for one or more grade range samples; only a few schools were selected for more than one grade range sample. The schools frame sizes were 74,777 K-6 schools, 49,940 7-9 schools, and 22,053 10-12 schools.

2. Computation of Size Measure

For most schools, QED data contained a teacher count. From this teacher count and the number of grades served in the school, RTI computed an average number of teachers per grade in each school. A grade range specific estimated number of teachers in the school was computed from the average number of teachers per grade times the number of grades served in the grade range. This estimated number of teachers was used as the school size measure. That is, where $MOS_d$ is the school size measure for domain d,

$$MOS_d = (\text{Ave. Number of Teachers}) * (\text{Number of Grades in Domain d}).$$

Approximately 180 schools had a zero teacher count and approximately 129 of these had a non zero student enrollment. The 51 schools with both a zero teacher count and a zero student count were excluded from the sampling frames. For the schools with positive student counts, RTI used the student enrollment and the state specific students per teacher ratios contained in Tables 36 and 40 of the Digest of Education Statistics, 1983-1984 (DE 1984) to compute an estimated teacher count. An average number of teachers per grade was computed from the estimated teacher count and an estimated size measure was computed according to procedures described above.

3. Stratification Factors and School Selection

To control the distribution of the school samples, RTI used implicit stratification by eight factors. Implicit stratification, as opposed to explicit stratification, is a form of stratification in which sampling units are ordered in the sampling frame so that units with similar characteristics are near each other. A single sample is selected from the ordered frame using a sequential sampling procedure so that the sample has the same proportional distribution on the stratification factors as the frame. Explicit stratification, on the other hand, groups sampling units into strata and a fixed sample size is selected independently in each strata. One of the key benefits to implicit stratification is that variation in selection probabilities induced by fixing sample sizes for explicit strata is avoided. The implicit stratification was imposed on the sampling frames by sorting frames in a serpentine fashion by the stratification factors. The stratification factors were:

1. Census region (4 categories);
2. state;
3. urbanicity (4 categories: urban, suburban, rural, and unclassified);
4. auspices: public versus private school;
5. ethnicity: White students as a percentage of total students;
6. instructional dollars per pupil (10 categories);
7. Orshansky percentile: percentage of students in the school district in families under poverty guidelines; and
8. the size measure.

For two continuous items (ethnicity and the Orshansky percentile), RTI developed categories before use as stratification factors. Ethnicity, instructional dollars per pupil, and the Orshansky percentile were not available for private schools.

For school selection, RTI used Chromy's probability minimal replacement sequential selection algorithm to select 425 schools from each frame with probability strictly proportional to the school size measure (Chromy 1981). Chromy's sequential selection algorithm incorporates the implicit stratification benefits of probability proportional to size systematic sampling and also incorporates randomization mechanisms that permits unbiased estimation of sampling errors.

## D. Teacher Sampling

The teacher sampling was performed using teacher lists requested from school officials at the sampled schools. RTI requested the school official to indicate the number of teachers in self-contained classroom settings and to list all other teachers and the subject(s) taught by each teacher. For teachers in schools selected for the grades K-6 sample or the grades 7-9 sample, the school officials were requested to classify the teacher as teaching in a self-contained setting or teaching either mathematics only, science only, or both mathematics and science. For teachers in schools selected for grades 10 to 12, RTI requested the school officials to indicate the types of science and/or mathematics taught. The science classifications were biology, chemistry, physics, earth science, and "other sciences." The mathematics classifications were calculus/advanced mathematics and "other mathematics."

Separate sampling frames were constructed for each grade range and study domain. For teachers in schools selected for grade range K-6 and grade range 7-9, the teacher frames were:

1. science only;
2. mathematics only;
3. science and mathematics (not in self-contained setting); and
4. self-contained classes

For teachers in schools sampled for the 10-12 grade range, the teacher frames were:

1. biology only or biology and other sciences (excluding chemistry, physics, and earth science);
2. biology and chemistry, physics, or earth science;
3. chemistry only;
4. physics only;
5. earth science only;
6. mathematics and science;
7. calculus/advanced mathematics only;
8. other mathematics/computer science only; and
9. calculus/advanced mathematics and other mathematics/computer science.

Within each frame, teachers were selected to achieve equal teacher sampling weights, to the extent possible. For each teacher, RTI computed a sample allocation using the response-adjusted school weight as the presampling teacher weight. That is, for teacher t in domain d in school i, RTI computed a sample allocation $n_{tid}$, where

$$n_{tid} = n_d * W_{ti} / S_d, \text{ and}$$

$n_d$ is the teacher sample size for domain d,

$W_{ti}$ is the presampling teacher weight in school i, and

$S_d$ is the sum of the weights $W_{ti}$ for teachers in domain d.

The sample allocation $n_{tid}$ is the expected number of times that teacher t will be selected given that school i is in the sample. When the sample allocation $n_{tid}$ is greater than one, a teacher can be selected more than once. RTI wanted to avoid multiple selections on a single teacher and to select fewer than four teachers within a single school for a specific domain. To do this, RTI trimmed the sample allocation and distributed the excess among other frame members. The trimmed sample allocation is always less than or equal to one and is the conditional probability of selecting teacher t for domain d given that school i is in the sample. Trimming the sample allocations resulted in departures from equal sampling weights for teachers in the same domain. To select the teacher samples, RTI used Chromy's sequential selecting algorithm with probability proportional to the trimmed sample allocation. Within each domain, the teachers were implicitly stratified by school to control the number of teachers selected in each school.

RTI also sought data specific to a particular class. One class was selected for each teacher from information on the subject-specific class count for each teacher provided by the school officials.

A total of 1,974 teachers, 1,882 teachers, and 2,300 teachers were selected from sample school in grade range K-6, 7-9, and 10-12, respectively. Teachers who taught both mathematics and science were randomly assigned to respond for either mathematics or science. Of the 1,974 K-6 teachers selected, 986 teachers either taught only science or were selected to respond only for the science portion of their instruction and 988 teachers were selected for the mathematics subsample. Similarly, 942 grade 7-9 teachers were selected for the science subsample and 940 teachers were selected for the mathematics subsample. For the grade 10-12 teacher sample, 800 teachers were selected for the mathematics subsample, 500 for the biology subsample, and 1,000 for other sciences.

F. Computation of Sampling Weights and Nonresponse Compensation

The sampling weight is the inverse of the unit's probability of selection. RTI computed sampling weights for principals, teachers, and classes. For the principals, the initial sampling weight is the inverse of the school's selection probability. For the teachers, two sampling weights were computed, a total teachers weight and a science/math teacher weight. The total teachers weight is for computing estimates relating to the total population of science and mathematics teachers. The second teacher weight is for computing estimates for the population of science teachers or for the population of mathematics teachers, it takes into account the fact that sampled teachers who taught both science and mathematics were randomly selected to respond for only the science or the mathematics portion of their instruction.

For the total teachers weight, the initial sampling weight is the inverse of the product of the school's probability of selection and the conditional probability of selecting the teacher given that the school was selected. As stated previously, the trimmed sample allocation equals the conditional probability of selecting the teacher. The second teacher weight, the science/math teacher weight, is the same as the total teachers weight for all teachers who taught in a self-contained setting or who taught only science or mathematics. For teachers who taught both science and mathematics, the science/math teacher weight is the product of the total teachers weight and the inverse of the conditional probability of selecting the teacher to respond only for science or only for mathematics (given that the teacher was selected).

The class weights are based on the initial science/math teacher weights and the number of classes that the teacher has in the subject area, either science or mathematics, for which the teacher was selected to respond. The initial class sampling weight was computed as the product of the initial science/math teacher sampling weight and the inverse of the probability of selecting one of the teacher's classes.

Some of the initial sampling weights for principals and teachers were substantially different from the majority of the other sampling weights within a study domain. RTI assessed the distribution of the sampling weights and for a few respondents with extremely large initial sampling weights, RTI trimmed the extremely large sampling weights and distributed the trimmed excess among the remaining sample members. The weight trimming may result in some bias in the estimates. The rationale for trimming extremely large weights is the expectation that the sampling variance will be reduced enough by the trimming to achieve a smaller mean square error relative to statistics based on the untrimmed sampling weights.

When the final response status was determined for all samples, RTI computed nonresponse-compensated analysis weights. RTI used the standard weighting class nonresponse compensation procedure to compute these weights (Oh and Scheuren 1983). For the principals, the weighting classes were constructed based on school auspices (public versus private) and, for public schools, urbanicity. For both teacher weights and the class weights, the weighting classes were constructed on the basis of the teacher domains and, for teacher domains with over 200 responding teachers, urbanicity. All weighting classes contained more than 20 respondents and most contained over 50 respondents. For a few samples, differential nonresponse resulted in extreme nonresponse-compensated weights. These weights were trimmed and the excess distributed among the other respondents.

## REFERENCES


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# Appendix B

## Generalized Sampling Error Tables

## Appendix B

## Generalized Sampling Error Tables

The results of any survey based on a sample of a population are subject to sampling variability; the standard error of an estimate is a measure of this variability. To assist the reader in determining the variability of particular estimates, and consequently whether any observed differences are statistically significant, we have included a table of generalized standard errors for each of the groups included in this survey.

In order to construct a generalized sampling error table, a measure for indicating the inefficiency of the sample design must be defined. The design effect (DEFF) is a measure of the inefficiency of the design compared to a simple random sample design of the same size. The DEFF is defined by

$$\text{DEFF} = \frac{\text{Sampling variance calculated for design used}}{\text{Sampling variance for a simple random sample of the same size}}$$

A DEFF greater than one indicates that the sample design is less efficient than a simple random sample; that is, the estimated variance for the survey is greater than the variance for a simple random sample of the same size. A DEFF less than one indicates the sample design is more efficient than a simple random sample.

Usually, stratification prior to sample selection decreases the DEFF, making the sample more efficient by decreasing the size of the sampling error. Cluster designs and designs in which the final selection probabilities (and hence the weights) are very unequal serve to increase the size of the DEFF and the corresponding sampling error. Nonresponse can drastically affect the weights, causing a sample in which sample members originally had approximately equal weights to have very unequal weights and thus a larger sampling error than originally planned.

DEFFs are used in the production of generalized sampling error tables. After sampling errors have been calculated for a specified number of proportions and reporting groups, the DEFFs are averaged for those proportions of like magnitude and denominators of similar size within the same type of reporting group. Once the average DEFF is obtained, the sampling error for a given proportion $\hat{p}$, sample size n, and reporting group can be determined using the generalized table or calculated by

$$SE(\hat{p}) = \sqrt{DEFF\ \hat{p}(1-\hat{p})/(n-1)}$$

where $\hat{p}$ is the estimated proportion and n the sample size. The value of $\hat{p}(1-\hat{p})/(n-1)$ is the estimated variance of $\hat{p}$ based on a simple random sample. The entries in the generalized sampling error tables are based on average DEFFs obtained from many different items. They can differ for different values of $\hat{p}$, different sample sizes, and types of reporting groups. Thus, they provide only a general order of magnitude of sampling error of any given estimated proportion.

Table B.1 in the Appendix is a generalized table of sampling errors (or standard errors) for estimates based on data collected from K-6 teachers in this study; Tables B.2, B.3, B.4, B.5 present standard error estimates for 7-9 teachers, 10-12 teachers, K-6 principals, and 7-12 principals, respectively.

The following examples will illustrate the use of these tables. It was estimated that 80 percent of grade 10-12 mathematics teachers have had a college-level course in geometry. Table B.3 (10-12 teacher standard errors) would be entered with the p-value (in this case 80 percent) determining the column and the sample size determining the row. Since there is no row for N = 565, the 550 row would be used.[1] The intersection of the 80 percent column and the 550 row indicates that the standard error is 2.22. The 95 percent confidence interval for the percent of teachers is the estimated 80 percent ± 4.44 or roughly from 76 percent to 84 percent. Similarly, the standard

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1/ Using the smaller N and the p-value closer to 50 percent when the exact values are not in the table would be the more conservative approach. However, for most purposes it is sufficient to use the closest value. In either case one can interpolate the standard error va...e if a more precise estimate is desired.

error for grade 7-9 mathematics teachers ($p = 67$, $n = 671$) is approximately 3.10 (the value in Table B.2 for $p = 60$, $n = 600$) and the 95 percent confidence interval is roughly 61 percent to 73 percent. Since these two confidence intervals do not overlap, it is clear that grade 10-12 mathematics teachers are significantly more likely than 7-9 mathematics teachers to have completed a college course in geometry.

It is also possible for differences to be statistically significant if the two confidence intervals do overlap. If the observed difference is at least twice the standard error of the difference, then the difference is significant at the .05 level. The estimated standard error of a difference is the square root of the variance of that difference. Assuming a zero covariance term,[2] the standard error of the difference can be calculated as

$$SE\ (\hat{p}_1 - \hat{p}_2)^2 = \sqrt{(SE\hat{p}_1)^2 + (SE\hat{p}_2)^2}$$

Thus if an estimate of 28 percent has a standard error of 3, and an estimate of 40 percent has a standard error of 4, the standard error of the difference is $\sqrt{(3)^2 + (4)^2} = \sqrt{25} = 5$. since the observed difference, 12 percent, is more than twice the standard error 5, this difference is statistically significant even though the confidence intervals overlap (22-34 percent and 32-48 percent).

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2/ This assumption is conservative. The covariance term is expected to be positive, and therefore the standard error will be smaller than given by this formula. The standard error of the difference would be calculated as

$$SE\ (\hat{p}_1 - \hat{p}_2) = \sqrt{(SE\hat{p}_1)^2 + (SE\hat{p}_2)^2 - 2rSE_1SE_2}.$$

However, preliminary investigations have shown that the correlation, r, is generally quite small, thus providing only a very minor reduction in standard error due to covariance.

TABLE B.1

TABLE OF GENERALIZED STANDARD ERRORS --
K-6 TEACHERS 1/

| Sample Size (N) | Average Sampling Errors in Percents P-Values in Percents 2 or 98 | 5 or 95 | 10 or 90 | 20 or 80 | 30 or 70 | 40 or 60 | 50 |
|---|---|---|---|---|---|---|---|
| 100 | 1.47 | 2.29 | 3.15 | 4.20 | 4.81 | 5.14 | 5.24 |
| 150 | 1.20 | 1.87 | 2.57 | 3.43 | 3.92 | 4.20 | 4.28 |
| 200 | 1.04 | 1.62 | 2.22 | 2.97 | 3.40 | 3.63 | 3.71 |
| 250 | 0.93 | 1.45 | 1.99 | 2.65 | 3.04 | 3.25 | 3.32 |
| 300 | 0.85 | 1.32 | 1.82 | 2.42 | 2.77 | 2.97 | 3.03 |
| 350 | 0.78 | 1.22 | 1.68 | 2.24 | 2.57 | 2.75 | 2.80 |
| 400 | 0.73 | 1.14 | 1.57 | 2.10 | 2.40 | 2.57 | 2.62 |
| 450 | 0.69 | 1.08 | 1.48 | 1.98 | 2.27 | 2.42 | 2.47 |
| 500 | 0.66 | 1.02 | 1.41 | 1.88 | 2.15 | 2.30 | 2.35 |
| 550 | 0.63 | 0.97 | 1.34 | 1.79 | 2.05 | 2.19 | 2.24 |
| 600 | 0.60 | 0.93 | 1.28 | 1.71 | 1.96 | 2.10 | 2.14 |
| 700 | 0.55 | 0.86 | 1.19 | 1.59 | 1.82 | 1.94 | 1.98 |
| 800 | 0.52 | 0.81 | 1.11 | 1.48 | 1.70 | 1.82 | 1.85 |
| 900 | 0.49 | 0.76 | 1.05 | 1.40 | 1.60 | 1.71 | 1.75 |
| 1000 | 0.46 | 0.72 | 0.99 | 1.33 | 1.52 | 1.62 | 1.66 |
| 1100 | 0.44 | 0.69 | 0.95 | 1.26 | 1.45 | 1.55 | 1.58 |
| 1200 | 0.42 | 0.66 | 0.91 | 1.21 | 1.39 | 1.48 | 1.51 |
| 1300 | 0.41 | 0.63 | 0.87 | 1.16 | 1.33 | 1.43 | 1.45 |
| 1400 | 0.39 | 0.61 | 0.84 | 1.12 | 1.28 | 1.37 | 1.40 |

1/ $S.E. = \sqrt{\frac{DEFF*p(100-p)}{n}}$ ; DEFF for K-6 teacher sample = 1.1

TABLE B.2
TABLE OF GENERALIZED STANDARD ERRORS --
7-9 TEACHERS 1/

| Sample Size (N) | Average Sampling Errors in Percents P-Values in Percents 2 or 98 | 5 or 95 | 10 or 90 | 20 or 80 | 30 or 70 | 40 or 60 | 50 |
|---|---|---|---|---|---|---|---|
| 100 | 2.17 | 3.38 | 4.65 | 6.20 | 7.10 | 7.59 | 7.75 |
| 150 | 1.77 | 2.76 | 3.79 | 5.06 | 5.80 | 6.20 | 6.32 |
| 200 | 1.53 | 2.39 | 3.29 | 4.38 | 5.02 | 5.37 | 5.48 |
| 250 | 1.37 | 2.14 | 2.94 | 3.92 | 4.49 | 4.80 | 4.90 |
| 300 | 1.25 | 1.95 | 2.68 | 3.58 | 4.10 | 4.38 | 4.47 |
| 350 | 1.16 | 1.80 | 2.48 | 3.31 | 3.79 | 4.06 | 4.14 |
| 400 | 1.08 | 1.69 | 2.32 | 3.10 | 3.55 | 3.79 | 3.87 |
| 450 | 1.02 | 1.59 | 2.19 | 2.92 | 3.35 | 3.58 | 3.65 |
| 500 | 0.97 | 1.51 | 2.08 | 2.77 | 3.17 | 3.39 | 3.46 |
| 550 | 0.92 | 1.44 | 1.98 | 2.64 | 3.03 | 3.24 | 3.30 |
| 600 | 0.89 | 1.38 | 1.90 | 2.53 | 2.90 | 3.10 | 3.16 |
| 700 | 0.82 | 1.28 | 1.76 | 2.34 | 2.68 | 2.87 | 2.93 |
| 800 | 0.77 | 1.19 | 1.64 | 2.19 | 2.51 | 2.68 | 2.74 |
| 900 | 0.72 | 1.13 | 1.55 | 2.07 | 2.37 | 2.53 | 2.58 |
| 1000 | 0.69 | 1.07 | 1.47 | 1.96 | 2.24 | 2.40 | 2.45 |
| 1100 | 0.65 | 1.02 | 1.40 | 1.87 | 2.14 | 2.29 | 2.34 |
| 1200 | 0.63 | 0.97 | 1.34 | 1.79 | 2.05 | 2.19 | 2.24 |
| 1300 | 0.60 | 0.94 | 1.29 | 1.72 | 1.97 | 2.10 | 2.15 |
| 1329 | 0.59 | 0.93 | 1.27 | 1.70 | 1.95 | 2.08 | 2.12 |

1/ $S.E. = \sqrt{\frac{DEFF*p(100-p)}{n}}$ ; DEFF for 7-9 teacher sample = 2.4

TABLE B.3

TABLE OF GENERALIZED STANDARD ERRORS --
10-12 TEACHERS 1/

Average Sampling Errors in Percents

| Sample Size (N) | P-Values in Percents: 2 or 98 | 5 or 95 | 10 or 90 | 20 or 80 | 30 or 70 | 40 or 60 | 50 |
|---|---|---|---|---|---|---|---|
| 100 | 1.83 | 2.84 | 3.91 | 5.22 | 5.97 | 6.39 | 6.52 |
| 150 | 1.49 | 2.32 | 3.19 | 4.26 | 4.88 | 5.22 | 5.32 |
| 200 | 1.29 | 2.01 | 2.77 | 3.69 | 4.22 | 4.52 | 4.61 |
| 250 | 1.15 | 1.80 | 2.47 | 3.30 | 3.78 | 4.04 | 4.12 |
| 300 | 1.05 | 1.64 | 2.26 | 3.01 | 3.45 | 3.69 | 3.76 |
| 350 | 0.98 | 1.52 | 2.09 | 2.79 | 3.19 | 3.41 | 3.48 |
| 400 | 0.91 | 1.42 | 1.96 | 2.61 | 2.99 | 3.19 | 3.26 |
| 450 | 0.86 | 1.34 | 1.84 | 2.46 | 2.82 | 3.01 | 3.07 |
| 500 | 0.82 | 1.27 | 1.75 | 2.33 | 2.67 | 2.86 | 2.92 |
| 550 | 0.78 | 1.21 | 1.67 | 2.22 | 2.55 | 2.72 | 2.78 |
| 600 | 0.75 | 1.16 | 1.60 | 2.13 | 2.44 | 2.61 | 2.66 |
| 700 | 0.69 | 1.07 | 1.48 | 1.97 | 2.26 | 2.41 | 2.46 |
| 800 | 0.65 | 1.00 | 1.38 | 1.84 | 2.11 | 2.26 | 2.30 |
| 900 | 0.61 | 0.95 | 1.30 | 1.74 | 1.99 | 2.13 | 2.17 |
| 1000 | 0.58 | 0.90 | 1.24 | 1.65 | 1.89 | 2.02 | 2.06 |
| 1100 | 0.55 | 0.86 | 1.18 | 1.57 | 1.80 | 1.93 | 1.97 |
| 1200 | 0.53 | 0.82 | 1.13 | 1.51 | 1.72 | 1.84 | 1.88 |
| 1300 | 0.51 | 0.79 | 1.08 | 1.45 | 1.66 | 1.77 | 1.81 |
| 1400 | 0.49 | 0.76 | 1.05 | 1.39 | 1.60 | 1.71 | 1.74 |
| 1500 | 0.47 | 0.73 | 1.01 | 1.35 | 1.54 | 1.65 | 1.68 |
| 1600 | 0.46 | 0.71 | 0.98 | 1.30 | 1.49 | 1.60 | 1.63 |
| 1615 | 0.45 | 0.71 | 0.97 | 1.30 | 1.49 | 1.59 | 1.62 |

1/ $S.E. = \sqrt{\frac{DEFF*p(100-p)}{n}}$ ; DEFF for 10-12 teacher sample = 1.7

TABLE B.4

TABLE OF GENERALIZED STANDARD ERRORS --
K-6 PRINCIPALS 1/

| Sample Size (N) | Average Sampling Errors in Percents | | | | | | |
|---|---|---|---|---|---|---|---|
| | P-Values in Percents | | | | | | |
| | 2 or 98 | 5 or 95 | 10 or 90 | 20 or 80 | 30 or 70 | 40 or 60 | 50 |
| 100 | 1.71 | 2.67 | 3.67 | 4.90 | 5.61 | 6.00 | 6.12 |
| 150 | 1.40 | 2.18 | 3.00 | 4.00 | 4.58 | 4.90 | 5.00 |
| 200 | 1.21 | 1.89 | 2.60 | 3.46 | 3.97 | 4.24 | 4.33 |
| 250 | 1.08 | 1.69 | 2.32 | 3.10 | 3.55 | 3.79 | 3.87 |
| 300 | 0.99 | 1.54 | 2.12 | 2.83 | 3.24 | 3.46 | 3.54 |
| 350 | 0.92 | 1.43 | 1.96 | 2.62 | 3.00 | 3.21 | 3.27 |
| 365 | 0.90 | 1.40 | 1.92 | 2.56 | 2.94 | 3.14 | 3.21 |

1/ $S.E. = \sqrt{\frac{DEFF*p(100-p)}{n}}$ ; DEFF for K-6 principal sample = 1.5

TABLE B.5

TABLE OF GENERALIZED STANDARD ERRORS -- 7-12 PRINCIPALS 1/

| Sample Size (N) | Average Sampling Errors in Percents | | | | | | |
|---|---|---|---|---|---|---|---|
| | P-Values in Percents | | | | | | |
| | 2 or 98 | 5 or 95 | 10 or 90 | 20 or 80 | 30 or 70 | 40 or 60 | 50 |
| 100 | 2.17 | 3.38 | 4.65 | 6.20 | 7.10 | 7.59 | 7.75 |
| 150 | 1.77 | 2.76 | 3.79 | 5.06 | 5.80 | 6.20 | 6.32 |
| 200 | 1.53 | 2.39 | 3.29 | 4.38 | 5.02 | 5.37 | 5.48 |
| 250 | 1.37 | 2.14 | 2.94 | 3.92 | 4.49 | 4.80 | 4.90 |
| 300 | 1.25 | 1.95 | 2.68 | 3.58 | 4.10 | 4.38 | 4.47 |
| 350 | 1.16 | 1.80 | 2.48 | 3.31 | 3.79 | 4.06 | 4.14 |
| 400 | 1.08 | 1.69 | 2.32 | 3.10 | 3.55 | 3.79 | 3.87 |
| 450 | 1.02 | 1.59 | 2.19 | 2.92 | 3.35 | 3.58 | 3.65 |
| 500 | 0.97 | 1.51 | 2.08 | 2.77 | 3.17 | 3.39 | 3.46 |
| 550 | 0.92 | 1.44 | 1.98 | 2.64 | 3.03 | 3.24 | 3.30 |
| 600 | 0.89 | 1.38 | 1.90 | 2.53 | 2.90 | 3.10 | 3.16 |
| 650 | 0.85 | 1.32 | 1.82 | 2.43 | 2.78 | 2.98 | 3.04 |
| 700 | 0.82 | 1.28 | 1.76 | 2.34 | 2.68 | 2.87 | 2.93 |

1/ $S.E. = \sqrt{\frac{DEFF*p(100-p)}{n}}$ ; DEFF for 7-12 principal sample = 2.4

# Appendix C

## Tables of Most Commonly Used Science and Mathematics Textbooks by Grade Range

Table C.1

MOST COMMONLY USED SCIENCE TEXTBOOKS BY GRADE RANGE

| Publisher | Textbook | Percent of K-6 Classes (N=710) |
| --- | --- | --- |
| Silver Burdett | Science: Understanding Your Environment | 17 |
| Merrill | Accent on Science | 10 |
| D.C. Heath | Science | 10 |
| Holt, Rinehart, Winston | Science | 8 |
| McGraw Hill | Gateways to Science | 5 |
| Harcourt, Brace, Jovanovich | Concepts in Science | 3 |
| Laidlaw | Exploring Science | 2 |
| | | **Percent of 7-9 Classes (N=658)** |
| Merrill | Focus on Life Science | 9 |
| Merrill | Principles of Science | 8 |
| Merrill | Focus on Physical Science | 8 |
| Holt, Rinehart, Winston | Modern Biology | 5 |
| Merrill | Focus on Earth Science | 3 |
| Scott, Foresman | Life Science | 3 |
| Prentice Hall | Introductory Physical Science | 2 |

| | | Percent of 10-12 Classes (N=1050) |
|---|---|---|
| Holt, Rinehart, Winston | Modern Biology | 14 |
| Holt, Rinehart, Winston | Modern Chemistry | 9 |
| Merrill | Chemistry: A Modern Course | 5 |
| Merrill | Physics: Principles and Problems | 4 |
| Holt, Rinehart, Winston | Modern Physics | 3 |
| Merrill | Biology: Living Systems | 3 |
| Holt, Rinehart, Winston | Modern Human Physiology | 3 |
| Merrill | Biology Everyday Experience | 3 |

Table C.2

MOST COMMONLY USED MATHEMATICS TEXTBOOKS BY GRADE RANGE

| Publisher | Textbook | Percent of K-6 Classes (N=686) |
|---|---|---|
| Addison-Wesley | Mathematics in Our World | 16 |
| D.C. Heath | Mathematics | 15 |
| Scott, Foresman | Invitation to Mathematics | 7 |
| Holt, Rinehart, Winston | Mathematics | 6 |
| MacMillan | Mathematics | 5 |
| Houghton Mifflin | Modern School Mathematics | 3 |
| | | **Percent of 7-9 Classes (N=671)** |
| Houghton Mifflin | Algebra: Structure and Method | 7 |
| D.C. Heath | Mathematics | 4 |
| Scott, Foresman | Mathematics Around Us | 4 |
| Holt, Rinehart, Winston | Mathematics | 4 |
| Harcourt, Brace, Jovanovich | Mathematics Today | 4 |
| Harcourt, Brace, Jovanovich | Mathematics | 3 |
| | | **Percent of 10-12 Classes (N=565)** |
| Houghton Mifflin | Algebra: Structure and Method | 14 |
| Houghton Mifflin | Geometry | 8 |
| Holt, Rinehart, Winston | Algebra with Trigonometry | 2 |

| | | |
|---|---|---|
| Merrill | Advanced Mathematical Concepts | 2 |
| Scott, Foresman | Geometry | 2 |
| Holt, Rinehart, Winston | Geometry | 2 |

# Appendix D

## Questionnaires

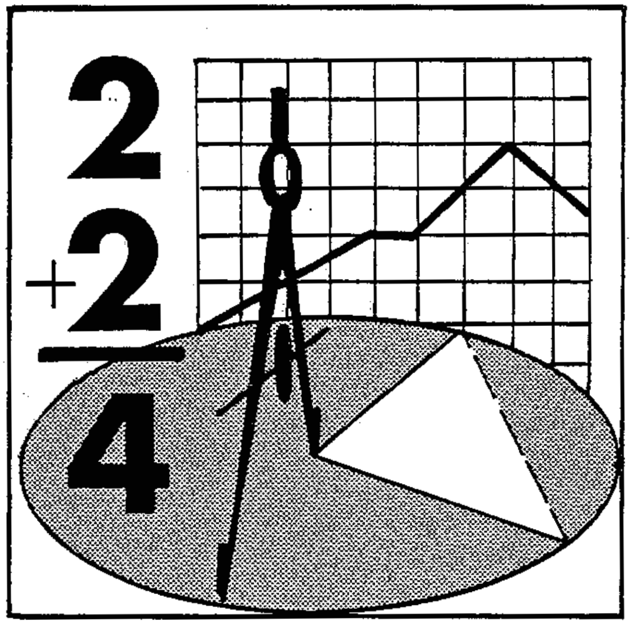
Secondary Principal Questionnaire (S)
(Elementary version omits questions 22-27)

Teacher Questionnaires

Elementary Science (ES)
Secondary Science (SS)
Elementary Mathematics (EM)
Secondary Mathematics (SM)

GREY

# 1985 NATIONAL SURVEY SCIENCE & MATHEMATICS EDUCATION




## Principal Questionnaire

Conducted by Research Triangle Institute
P.O. Box 12194 Research Triangle Park, NC 27709

If you have any questions, call Jennifer McNeill 800-334-8571

S

Many educators have raised questions about how best to prepare young people for the challenges they will face in our increasingly technological society.

To help collect information on the status of science and mathematics education in our schools, the National Science Foundation sponsored a 1977 survey of teachers and principals. The purpose of the current study is to identify trends that have emerged since that time, and to suggest improvements that might be made in the future.

The topics to be covered in this study include science and mathematics course offerings and enrollments, availability of facilities and equipment, instructional techniques, textbook usage, teacher background, and needs for in-service education. Information will be collected from selected teachers and principals by printed questionnaire only—no classroom visits will be involved. Data will be kept strictly confidential, and will be reported only in aggregate form, such as by grade level, and by region. No individually identifying information will be released.

The 1985 National Survey of Science and Mathematics Education has been coordinated with the data collection efforts of the Department of Education, the National Assessment of Educational Progress, and the International Assessments of Science and Mathematics in order to avoid unnecessary duplication. The survey has also been endorsed by more than 20 professional organizations, whose names appear below.

Endorsed by:

American Association for the Advancement of Science (AAAS)

American Association of School Administrators (AASA)

American Association of Physics Teachers (AAPT)

American Chemical Society (ACS)

American Federation of Teachers (AFT)

American Institute of Biological Sciences (AIBS)

Association for Computing Machinery (ACM)

Association of State Supervisors of Mathematics (ASSM)

Council of Chief State School Officers (CCSSO)

Council of State Science Supervisors (CSSS)

National Association for Research in Science Teaching (NARST)

National Association of Biology Teachers (NABT)

National Association of Elementary School Principals (NAESP)

National Association of Geology Teachers (NAGT)

National Association of Secondary School Principals (NASSP)

National Catholic Education Association (NCEA)

National Council of Teachers of Mathematics (NCTM)

National Earth Science Teachers Association (NESTA)

National Education Association (NEA)

National Science Supervisors Association (NSSA)

National Science Teachers Association (NSTA)

School Science and Mathematics Association (SSMA)

## SECTION A: PRINCIPAL BACKGROUND INFORMATION

1. **Indicate your sex:**

(Circle one.)

Male ........................ 1
Female ...................... 2

2. **Are you:**

(Circle one.)

White (not of Hispanic origin) .................................... 1
Black (not of Hispanic origin) .................................... 2
Hispanic .................................................. 3
American Indian or Alaskan Native ................................. 4
Asian or Pacific Islander ......................................... 5
Other *(please specify* ________________ *)* .................... 6

3. **How old are you?** ________

4. **How many years teaching experience did you have prior to becoming a principal?** ______

5. **Prior to this school year, how many years have you been:**

a. A principal? ______

b. The principal at this school? ______

6. **Which of the following was your undergraduate major in college?**
**(If you majored in education, check here ☐ and indicate the subject area of greatest concentration.)**

(Circle one.)

Mathematics .............................................. 1
Science .................................................. 2
Computer science ......................................... 3
Social studies/history ................................... 4
Reading, language arts, English .......................... 5
Physical education/health ................................ 6
Fine arts ................................................ 7
Vocational, business education ........................... 8
Foreign language ......................................... 9
Other subject area *(please specify* ____________________ *)* ... 10

## SECTION B: SCHOOL BACKGROUND INFORMATION

7. **How many students are there in your school (first month's average daily membership)?** ____________

8. **Indicate the grades included in this school.**

**(Circle all that apply.)**

K 1 2 3 4 5 6 7 8 9 10 11 12 Special

9. **Which best describes the location of your school?**

**(Circle one.)**

Inner city .................... 1
Urban, but not inner city ........ 2
Suburb ...................... 3
Rural ....................... 4

10. **Does your school qualify for ECIA Chapter 1 assistance?**

**(Circle one.)**

Yes – Specify approximate number of students
qualifying for Chapter 1 assistance: ____________ .... 1
No ............................................. 2
Don't know ...................................... 3

11. **Approximately what percentage of the students attending your school are children of:**

_____ a. Professional or managerial personnel

_____ b. Sales, clerical, technical, or skilled workers

_____ c. Factory or other blue collar workers

_____ d. Farm workers

_____ e. Persons not regularly employed

_____ f. Persons on welfare

100% Total (Items a-f should add to 100%).

12. **Approximately what percentage of the students attending your school are:**

_____ a. White (not of Hispanic origin)

_____ b. Black (not of Hispanic origin)

_____ c. Hispanic, regardless of race (Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin)

_____ d. American Indian or Alaskan Native

_____ e. Asian or Pacific Islander

_____ f. Other *(please specify* ______________________________*)*

100% Total (Items a-f should add to 100%)

## SECTION C: SCIENCE AND MATHEMATICS INSTRUCTION IN YOUR SCHOOL

**13. Most principals feel better qualified in some areas than in others. How qualified do you feel to assist teachers in improving instruction in each of the following subject areas?**

(Circle one on each line.)

| | Not Well Qualified | Adequately Qualified | Very Well Qualified |
|---|---|---|---|
| a. Mathematics | 1 | 2 | 3 |
| b. Life sciences | 1 | 2 | 3 |
| c. Physical sciences | 1 | 2 | 3 |
| d. Earth/space sciences | 1 | 2 | 3 |
| e. Social studies, history | 1 | 2 | 3 |
| f. Reading, language arts, English | 1 | 2 | 3 |

**14. During the last three years, have you attended any workshops or conferences related to:**

(Circle one on each line.)

| | Yes | No |
|---|---|---|
| a. Mathematics teaching | 1 | 2 |
| b. Science teaching | 1 | 2 |
| c. Reading/language arts, English teaching | 1 | 2 |
| d. Social studies/history teaching | 1 | 2 |
| e. Instructional leadership | 1 | 2 |
| f. School organization/management | 1 | 2 |
| g. Instructional uses of computers | 1 | 2 |
| h. Administrative uses of computers | 1 | 2 |

**15. Which of the following instructional resources are available to students in your school?**

(Circle all that apply.)

| | |
|---|---|
| Microcomputers | 1 |
| Terminals connected to mini/mainframe computers | 2 |
| Greenhouse | 3 |
| Telescope | 4 |
| Darkroom | 5 |
| Weather station | 6 |
| Hand-held calculators | 7 |
| Microscopes | 8 |
| Cameras | 9 |
| Models (e.g., of the solar system, parts of organisms, mathematical figures) | 10 |
| Small group meeting rooms | 11 |
| Learning resource center | 12 |
| Mathematics laboratory | 13 |
| Science laboratory | 14 |
| Outdoor study area | 15 |
| Vivarium | 16 |
| Portable planetarium | 17 |
| Videocassette recorder | 18 |
| Videodisc players | 19 |

**16. Is anyone in your building (other than the principal) specifically designated to coordinate or supervise:**

**(Circle one on each line.)**

| | Yes | No |
|---|---|---|
| a. Mathematics instruction | 1 | 2 |
| b. Science instruction | 1 | 2 |
| c. Instructional uses of computers | 1 | 2 |

**17. Please give us your opinion about each of the following statements.**

**(Circle one on each line.)**

| | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| a. I am in favor of differential pay for teachers in shortage areas such as science and mathematics | 1 | 2 | 3 | 4 | 5 |
| b. Science is a difficult subject for children to learn | 1 | 2 | 3 | 4 | 5 |
| c. Prospective teachers should have to pass competency tests in the subjects they will teach | 1 | 2 | 3 | 4 | 5 |
| d. Hands-on science experiences aren't worth the time and expense | 1 | 2 | 3 | 4 | 5 |
| e. Experienced teachers should be required to pass competency tests in the subjects they teach | 1 | 2 | 3 | 4 | 5 |
| f. Laboratory-based science classes are more effective than non-laboratory classes | 1 | 2 | 3 | 4 | 5 |
| g. Mathematics is a difficult subject for children to learn | 1 | 2 | 3 | 4 | 5 |
| h. Industry scientists and mathematicians should be allowed to teach in the public schools | 1 | 2 | 3 | 4 | 5 |

**18. Does your school use computers (microcomputers or terminals to mini/mainframe) as part of the students' instructional program?**

**(Circle one.)**

Yes ........................ 1→ *Go to Question 19*

No ........................ 2→ *Skip to Question 21*

**19. In what year did you first have computers available for instructional use?**

**(Circle one.)**

| | |
|---|---|
| Before 1980 | 1 |
| 1980 | 2 |
| 1981 | 3 |
| 1982 | 4 |
| 1983 | 5 |
| 1984 | 6 |
| 1985 | 7 |

20. a. How many computers does your school now have that students can use?

_______ Terminals (to mini/mainframe)

_______ Microcomputers

_______ Total

b. How many of the total are:

Grouped in a central computer lab? _______

Distributed in classrooms? _______

21. Here is a list of factors that may cause serious problems in mathematics and/or science instruction in your school. For each factor, indicate if it is a serious problem in these subjects.

If none of these cause serious problems in either mathematics or science, check here ☐ and go on to Question 22.

(Circle all that apply on each line.)

| | | Mathematics | Science |
|---|---|---|---|
| a. | Belief that this subject is less important than other subjects | 1 | 2 |
| b. | Inadequate facilities | 1 | 2 |
| c. | Insufficient funds for purchasing equipment and supplies | 1 | 2 |
| d. | Lack of materials for individualizing instruction | 1 | 2 |
| e. | Insufficient number of textbooks | 1 | 2 |
| f. | Poor quality of textbooks | 1 | 2 |
| g. | Inadequate access to computers | 1 | 2 |
| h. | Lack of student interest in subject | 1 | 2 |
| i. | Inadequate student reading abilities | 1 | 2 |
| j. | Lack of teacher interest in subject | 1 | 2 |
| k. | Teachers inadequately prepared to teach subject | 1 | 2 |
| l. | Student absences | 1 | 2 |
| m. | Lack of teacher planning time | 1 | 2 |
| n. | Not enough time to teach subject | 1 | 2 |
| o. | Class sizes too large | 1 | 2 |
| p. | Difficulty in maintaining discipline | 1 | 2 |
| q. | Inadequate articulation of instruction across grade levels | 1 | 2 |
| r. | Inadequate diversity of electives | 1 | 2 |
| s. | Low enrollments in courses | 1 | 2 |
| t. | Mainstreaming of handicapped students | 1 | 2 |
| u. | "Pull-out" of students (e.g., Chapter 1, learning disabled) | 1 | 2 |

22. **Please indicate the number of sections of each science, mathematics, and computer science course currently offered in your school.**

**If any of your course offerings are not included in the list, please use the appropriate "other" area to record those sections.**

**NOTE:** ***Do not include the same course more than once.*** **For example, if 7th grade science in your school is actually life science, enter the number of sections as "Life Science," not "General Science, Grade 7."**

| SCIENCE | | No. of Sections |
|---|---|---|
| a. | Life science | ______ |
| b. | Earth science | ______ |
| c. | Physical science | ______ |
| d. | General science, grade 7 | ______ |
| e. | General science, grade 8 | ______ |
| f. | General science, grade 9 | ______ |
| g. | General science, grades 10-12 | ______ |
| h. | Biology, 1st year | ______ |
| i. | Chemistry, 1st year | ______ |
| j. | Physics, 1st year | ______ |
| k. | Biology, 2nd year | ______ |
| l. | Chemistry, 2nd year | ______ |
| m. | Physics, 2nd year | ______ |
| n. | Astronomy | ______ |
| o. | Anatomy | ______ |
| p. | Physiology | ______ |
| q. | Zoology | ______ |
| r. | Ecology, environmental science | ______ |
| s. | Other *(please specify)* | |
| | 1. ______________________ | ______ |
| | 2. ______________________ | ______ |

| MATHEMATICS | | No. of Sections |
|---|---|---|
| a. | Mathematics, grade 7 | ______ |
| b. | Mathematics, grade 8 | ______ |
| c. | General mathematics, grade 9 | ______ |
| d. | General mathematics, grades 10-12 | ______ |
| e. | Business mathematics | ______ |
| f. | Consumer mathematics | ______ |
| g. | Remedial mathematics | ______ |
| h. | Pre-algebra/introduction to algebra | ______ |
| i. | Algebra, 1st year | ______ |
| j. | Algebra, 2nd year | ______ |
| k. | Geometry | ______ |
| l. | Trigonometry | ______ |
| m. | Probability/statistics | ______ |
| n. | Advanced senior mathematics, not including calculus | ______ |
| o. | Advanced senior mathematics, including some calculus | ______ |
| p. | Calculus | ______ |
| q. | Advanced placement calculus | ______ |
| r. | Other *(please specify)* | |
| | 1. ______________________ | ______ |
| | 2. ______________________ | ______ |

22. (continued)

| COMPUTER SCIENCE | No. of Sections |
|---|---|
| a. Computer awareness or literacy | ______ |
| b. Applications and implications of computers | ______ |
| c. Introductory computer programming | ______ |
| d. Advanced computer programming | ______ |
| e. Advanced placement computer science | ______ |
| f. Other *(please specify)* | |
| 1. ______________________ | ______ |
| 2. ______________________ | ______ |

**23. Does your school find it difficult to hire fully qualified teachers for vacancies in each of the following fields?**

(Circle one on each line)

| | Yes | No | No Vacancies/ Does Not Apply |
|---|---|---|---|
| a. Mathematics | 1 | 2 | 3 |
| b. Biology/life science | 1 | 2 | 3 |
| c. Chemistry | 1 | 2 | 3 |
| d. Physics | 1 | 2 | 3 |
| e. Physical science | 1 | 2 | 3 |
| f. Earth/space science | 1 | 2 | 3 |
| g. General science | 1 | 2 | 3 |
| h. Computer science | 1 | 2 | 3 |
| i. Foreign language | 1 | 2 | 3 |
| j. Social studies | 1 | 2 | 3 |
| k. Special education | 1 | 2 | 3 |

**24. a. How many teachers in your school teach one or more classes of mathematics?** ______

**b. Of these, how many do you consider:**

1. Highly competent to teach mathematics ______
2. Competent to teach mathematics ______
3. Not adequately prepared to teach mathematics ______

**TOTAL (should be the same as Q24a)** ______

**25. a. How many teachers in your school teach one or more classes of science?** ______

**b. Of these, how many do you consider:**

1. Highly competent to teach science ______
2. Competent to teach science ______
3. Not adequately prepared to teach science ______

**TOTAL (should be the same as Q25a)** ______

26. a. **How many teachers in your school teach one or more classes of social studies/history?** ______

b. **Of these, how many do you consider:**

1. Highly competent to teach social studies/history . . . . . . . . . . . ______
2. Competent to teach social studies/history . . . . . . . . . . . . . . . . ______
3. Not adequately prepared to teach social studies/history . . . . . ______

**TOTAL (should be the same as Q26a)** ______

27. **Indicate if your school district provides each of the following as an incentive to teachers in shortage areas.**

(Circle one on each line.)

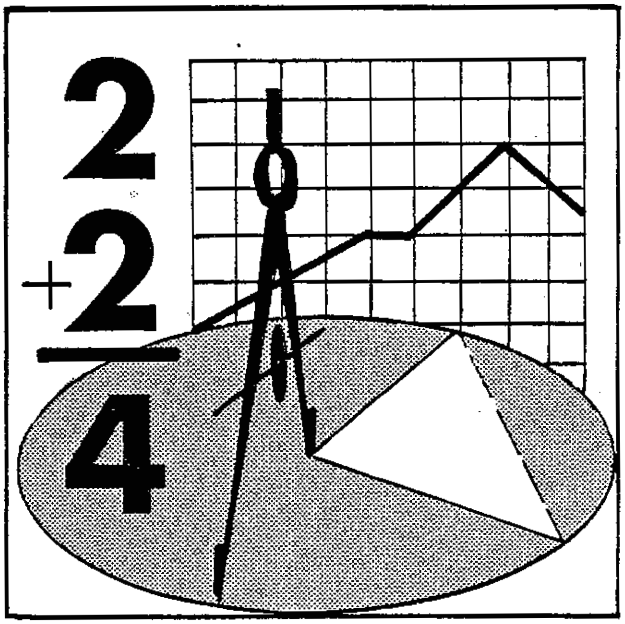
| | Yes | No | Don't Know |
|---|---|---|---|
| a. Extended contracts (11-12 months) | 1 | 2 | 3 |
| b. Differential salaries | 1 | 2 | 3 |
| c. Subsidized retraining for teachers to change to a field specified as a shortage area | 1 | 2 | 3 |
| d. Other *(please specify* ______________________*)* | 1 | 2 | 3 |

28. **When did you complete this questionnaire?** ______ (Month) ______ (Day) ______ (Year)

*THANK YOU FOR YOUR COOPERATION!*

GREEN

# 1985 NATIONAL SURVEY SCIENCE & MATHEMATICS EDUCATION




## Teacher Questionnaire


Conducted by Research Triangle Institute
P.O. Box 12194 Research Triangle Park, NC 27709


If you have any questions, call Jennifer McNeill 800-334-8571

ES

Many educators have raised questions about how best to prepare young people for the challenges they will face in our increasingly technological society.

To help collect information on the status of science and mathematics education in our schools, the National Science Foundation sponsored a 1977 survey of teachers and principals. The purpose of the current study is to identify trends that have emerged since that time, and to suggest improvements that might be made in the future.

The topics to be covered in this study include science and mathematics course offerings and enrollments, availability of facilities and equipment, instructional techniques, textbook usage, teacher background, and needs for in-service education. Information will be collected from selected teachers and principals by printed questionnaire only—no classroom visits will be involved. Data will be kept strictly confidential, and will be reported only in aggregate form, such as by grade level, and by region. No individually identifying information will be released.

The 1985 National Survey of Science and Mathematics Education has been coordinated with the data collection efforts of the Department of Education, the National Assessment of Educational Progress, and the International Assessments of Science and Mathematics in order to avoid unnecessary duplication. The survey has also been endorsed by more than 20 professional organizations, whose names appear below.

Endorsed by:

American Association for the Advancement of Science (AAAS)
American Association of School Administrators (AASA)
American Association of Physics Teachers (AAPT)
American Chemical Society (ACS)
American Federation of Teachers (AFT)
American Institute of Biological Sciences (AIBS)
Association for Computing Machinery (ACM)
Association of State Supervisors of Mathematics (ASSM)
Council of Chief State School Officers (CCSSO)
Council of State Science Supervisors (CSSS)
National Association for Research in Science Teaching (NARST)
National Association of Biology Teachers (NABT)
National Association of Elementary School Principals (NAESP)
National Association of Geology Teachers (NAGT)
National Association of Secondary School Principals (NASSP)
National Catholic Education Association (NCEA)
National Council of Teachers of Mathematics (NCTM)
National Earth Science Teachers Association (NESTA)
National Education Association (NEA)
National Science Supervisors Association (NSSA)
National Science Teachers Association (NSTA)
School Science and Mathematics Association (SSMA)

## SECTION A: BACKGROUND INFORMATION

1. **Indicate your sex:**

**(Circle one.)**

Male ........................ 1
Female ..................... 2

2. **Are you:**

**(Circle one.)**

White (not of Hispanic origin) .................................... 1
Black (not of Hispanic origin) .................................... 2
Hispanic ........................................................... 3
American Indian or Alaskan Native ................................ 4
Asian or Pacific Islander .......................................... 5
Other *(please specify* ________________________*)* ............ 6

3. **How old are you?** __________

4. **How many years have you taught prior to this school year?** _______

## SECTION B: SCIENCE INSTRUCTION IN YOUR SCHOOL

5. **Do you teach in a self-contained classroom, i.e., are you responsible for teaching all or most academic subjects to one class?**

**(Circle one.)**

Yes ........................ 1 *Specify grade level(s)* ________ *then go to Question 6*
No ......................... 2 → *Go to Question 7*

6. **We are interested in knowing how much time your students spend studying various subjects. In a typical week, how many days do you have lessons on each of the following subjects, and how many minutes long is an average lesson? (Please write "0" if you do not teach a particular subject to this class.)**

| | Number of Days per Week | Approximate Number of Minutes per Day |
|---|---|---|
| 1. Mathematics | _____ | _____ |
| 2. Science | _____ | _____ |
| 3. Social studies | _____ | _____ |
| 4. Reading | _____ | _____ |

*Go to Question 8*

7. For each class you are currently teaching, please indicate the average number of minutes the students spend per week on each of the following subjects.

| Class Number | Number of Minutes per Week: Mathematics | Science |
|---|---|---|
| 1 | ______ | ______ |
| 2 | ______ | ______ |
| 3 | ______ | ______ |
| 4 | ______ | ______ |
| 5 | ______ | ______ |
| 6 | ______ | ______ |
| 7 | ______ | ______ |
| 8 | ______ | ______ |
| 9 | ______ | ______ |
| 10 | ______ | ______ |

8. Many teachers feel better qualified to teach some subject areas than others. How qualified do you feel to teach each of the following (whether or not they are currently included in your curriculum)?

(Circle one on each line.)

| | Not Well Qualified | Adequately Qualified | Very Well Qualified |
|---|---|---|---|
| a. Mathematics | 1 | 2 | 3 |
| b. Life sciences | 1 | 2 | 3 |
| c. Physical sciences | 1 | 2 | 3 |
| d. Earth/space sciences | 1 | 2 | 3 |
| e. Social studies, history | 1 | 2 | 3 |
| f. Reading, language arts, English | 1 | 2 | 3 |

9. a. In the last year, have you received any assistance (e.g., curriculum materials, guest speakers, support to attend workshops, etc.) *from private industry?*

(Circle one.)

Yes . . . . . . . . . . . . . . . . . . . . . . . 1 → *Go to Question 9b*
No . . . . . . . . . . . . . . . . . . . . . . . . 2 } → *Go to Question 10*
Not sure . . . . . . . . . . . . . . . . . . . . 3 }

b. Indicate the type(s) of assistance you have received.

(Circle all that apply.)

Curriculum materials . . . . . . . . . . . . . . . . . . . . . . 1
Equipment . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2
Guest speakers . . . . . . . . . . . . . . . . . . . . . . . . . 3
Travel/stipends to attend professional meetings . . . . . . . . 4
Teacher awards/scholarships . . . . . . . . . . . . . . . . . . 5
Teacher summer employment . . . . . . . . . . . . . . . . . . 6
Other *(please specify* ______________________*)* . . . . . . . . . . 7

10. **The following factors may affect science instruction *in your school as a whole.* In your opinion, how great a problem is caused by each of the following?**

(Circle one on each line.)

| | | Serious Problem | Somewhat of a Problem | Not a Significant Problem |
|---|---|---|---|---|
| a. | Belief that science is less important than other subjects | 1 | 2 | 3 |
| b. | Inadequate facilities | 1 | 2 | 3 |
| c. | Insufficient funds for purchasing equipment and supplies | 1 | 2 | 3 |
| d. | Lack of materials for individualizing instruction | 1 | 2 | 3 |
| e. | Insufficient numbers of textbooks | 1 | 2 | 3 |
| f. | Poor quality of textbooks | 1 | 2 | 3 |
| g. | Inadequate access to computers | 1 | 2 | 3 |
| h. | Lack of student interest in science | 1 | 2 | 3 |
| i. | Inadequate student reading abilities | 1 | 2 | 3 |
| j. | Lack of teacher interest in science | 1 | 2 | 3 |
| k. | Teachers inadequately prepared to teach science | 1 | 2 | 3 |
| l. | Student absences | 1 | 2 | 3 |
| m. | Lack of teacher planning time | 1 | 2 | 3 |
| n. | Not enough time to teach science | 1 | 2 | 3 |
| o. | Class sizes too large | 1 | 2 | 3 |
| p. | Difficulty in maintaining discipline | 1 | 2 | 3 |
| q. | Inadequate articulation of instruction across grade levels | 1 | 2 | 3 |
| r. | Inadequate diversity of science electives | 1 | 2 | 3 |
| s. | Low enrollments in science courses | 1 | 2 | 3 |

## SECTION C: YOUR SCIENCE TEACHING IN A PARTICULAR CLASS

The questions in Sections C and D relate to *your science teaching* in a particular class. If you teach science to more than one class per day, please consult the label on the front of this questionnaire to determine the randomly selected science class for which these questions should be answered.

11. a. **How many students are there in this class?** ________

b. **Please indicate the number of students in this class in each race/sex category:**

| | Male | Female |
|---|---|---|
| White (not of Hispanic origin) | ______ | ______ |
| Black (not of Hispanic origin) | ______ | ______ |
| Hispanic | ______ | ______ |
| American Indian or Alaskan Native | ______ | ______ |
| Asian or Pacific Islander | ______ | ______ |
| Other *(please specify* ____________________ *)* | ______ | ______ |
| Total | ______ | ______ |

Note: The total number of males and females should be the same as the number of students in Question 11a.

**12. What is the most common grade designation of the students in this class?**

**(Circle one.)**

K
1
2
3
4
5
6
Multi-grade *(specify ___________)*

**13. Which of the following best describes the ability makeup of this class? (Comparison should be with the average student in the grade.)**

**(Circle one.)**

Primarily high ability students . . . . . . . . . . 1
Primarily low ability students . . . . . . . . . . 2
Primarily average ability students . . . . . . . . . . 3
Students of widely differing ability levels . . . . . . . . . . 4

**14. How does the amount of time spent on science in this class compare to the amount of time spent on science in a similar class *three years ago*?**

**(Circle one.)**

I did not teach this grade level three years ago . . . . . . . . . . 1
More time is spent on science now . . . . . . . . . . 2
About the same amount of time is spent on science now as three years ago . . . . . . . . . . 3
Less time is spent on science now . . . . . . . . . . 4

**15. Indicate the kind of room you use to conduct this class.**

**(Circle one.)**

Laboratory or special science room . . . . . . . . . . 1
Classroom with portable science kits or materials . . . . . . . . . . 2
Classroom with *no* science facilities or materials . . . . . . . . . . 3

**16. On the average, how many minutes of science homework do you expect the typical student in this class to complete each week?**

_______ minutes/week

**17. Are there any professional magazines or journals which you find particularly helpful in teaching science to this class?**

**(Circle one.)**

Yes . . . . . . . . . . 1 *Please specify:* a. ____________________
No . . . . . . . . . . 2

b. ____________________

c. ____________________

**18. Are you using one or more published textbooks or programs for teaching science to this class?**

**(Circle one.)**

Yes ........................ 1 → *Go to Question 20*

No ........................ 2 → *Go to Question 19*

**19. Why did you choose not to use a textbook?**

**(Circle all that apply.)**

I prefer to teach without a textbook .................................... 1

I did not like the textbook assigned to this class ........................ 2

Available textbooks were not appropriate for this class .................. 3

There were insufficient funds to purchase textbooks ................... 4

Other *(specify* ______________________ ............. 5

______________________*)*

*Go to Question 25*

**20. Indicate the publisher of the <u>one</u> textbook/program used most often by the students in this class.**

**(Circle one.)**

Addison-Wesley ............................ 01

American Book ............................ 02

Coronado ............................ 03

Delta Education ............................ 04

Economy ............................ 05

Ginn ............................ 06

Harcourt, Brace, & Jovanovich ................ 07

Harper & Row ............................ 08

D. C. Heath ............................ 09

Holt, Rinehart, Winston ...................... 10

Houghton Mifflin ............................ 11

Laidlaw Brothers ............................ 12

McGraw Hill ............................ 13

Merrill ............................ 14

National Science Program ..................... 15

Prentice Hall ............................ 16

Rand McNally ............................ 17

Scott, Foresman ............................ 18

Silver Burdett ............................ 19

Steck-Vaughn ............................ 20

Other *(please specify* ______________*)* ... 21

**21. Indicate the title, author, and most recent copyright date of this textbook/program.**

Title: ______________________

Author: ______________________

Most recent copyright date: __________

**22. Approximately what percentage of the textbook will you "cover" in this course?**

**(Circle one.)**

Less than 25% ............... 1

25-49% ..................... 2

50-74% ..................... 3

75-90% ..................... 4

More than 90% ............... 5

**23. Please give us your opinion about each of the following statements related to the textbook you are using most often in this class.**

(Circle one on each line.)

| This textbook: | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| a. Is at an appropriate reading level for most of my students | 1 | 2 | 3 | 4 | 5 |
| b. Is not very interesting to my students | 1 | 2 | 3 | 4 | 5 |
| c. Is unclear and disorganized | 1 | 2 | 3 | 4 | 5 |
| d. Helps develop problem-solving skills | 1 | 2 | 3 | 4 | 5 |
| e. Needs more examples to reinforce concepts | 1 | 2 | 3 | 4 | 5 |
| f. Explains concepts clearly | 1 | 2 | 3 | 4 | 5 |
| g. Provides good suggestions for activities and assignments | 1 | 2 | 3 | 4 | 5 |
| h. Lacks examples of the use of science in daily life | 1 | 2 | 3 | 4 | 5 |
| i. Shows the applications of science in careers | 1 | 2 | 3 | 4 | 5 |
| j. Has high quality supplementary materials | 1 | 2 | 3 | 4 | 5 |

**24. Indicate the persons or groups who helped determine that you would use this particular textbook in this science class.**

(Circle all that apply.)

I did .......... 1
The principal .......... 2
A group of teachers from this school .......... 3
A district-wide textbook adoption committe .......... 4
A state-wide textbook adoption committee .......... 5
Other *(please specify* ______________________*)* ... 6

**25. If you are using any materials instead of, or in addition to, a published textbook or program, briefly describe below.**

______________________________

______________________________

______________________________

**26. Which best describes the availability of computers (microcomputers or terminals to mini/mainframe) for use in teaching science to this class?**

(Circle one.)

Not available .......... 1 — *Skip to Question 29*
Available but quite difficult to access .......... 2
Available but somewhat difficult to access .......... 3
Readily available .......... 4

**27. How does this class use computers in its science lessons?**
**If not used, check here ☐ and skip to Question 29.**

(Circle all that apply.)

| | |
|---|---|
| Teacher demonstrating computer use | 1 |
| Writing programs | 2 |
| Learning science content | 3 |
| Laboratory tool | 4 |
| Drill and practice | 5 |
| Using simulations | 6 |
| Problem solving | 7 |
| Using computer graphics | 8 |
| Games | 9 |
| Testing and evaluation | 10 |
| Other *(please specify* ______________________) | 11 |

**28. During the *last week* of instruction, how many minutes did a typical student spend working with computers as part of this science class?**

(Circle one.)

| | |
|---|---|
| None | 1 |
| 1-14 minutes | 2 |
| 15-29 minutes | 3 |
| 30-44 minutes | 4 |
| 45-60 minutes | 5 |
| More than 60 minutes | 6 |

**29. Think about your plans for this science class for the entire year. How much emphasis will each of the following *objectives* receive in your science instruction?**

(Circle one on each line.)

| | None | Minimal Emphasis | | Moderate Emphasis | | Very Heavy Emphasis |
|---|---|---|---|---|---|---|
| a. Become interested in science | 1 | 2 | 3 | 4 | 5 | 6 |
| b. Learn basic science concepts | 1 | 2 | 3 | 4 | 5 | 6 |
| c. Prepare for further study in science | 1 | 2 | 3 | 4 | 5 | 6 |
| d. Develop inquiry skills | 1 | 2 | 3 | 4 | 5 | 6 |
| e. Develop a systematic approach to solving problems | 1 | 2 | 3 | 4 | 5 | 6 |
| f. Learn to effectively communicate ideas in science | 1 | 2 | 3 | 4 | 5 | 6 |
| g. Become aware of the importance of science in daily life | 1 | 2 | 3 | 4 | 5 | 6 |
| h. Learn about applications of science in technology | 1 | 2 | 3 | 4 | 5 | 6 |
| i. Learn about the career relevance of science | 1 | 2 | 3 | 4 | 5 | 6 |
| j. Learn about the history of science | 1 | 2 | 3 | 4 | 5 | 6 |
| k. Develop awareness of safety issues in lab | 1 | 2 | 3 | 4 | 5 | 6 |
| l. Develop skill in lab techniques | 1 | 2 | 3 | 4 | 5 | 6 |

## SECTION D: YOUR MOST RECENT SCIENCE LESSON IN THIS CLASS

Please answer the following questions specific to *your most recent science lesson* in this class. Do not be concerned if this lesson was not typical of instruction in this class.

**30. a. How many minutes were allocated for that science lesson?** ________

**b. Of these, how many were spent on the following:**

Daily routines, interruptions, and other non-instructional activities . . . . . . . . . . . . ________

Lecture . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ________

Working with hands-on, manipulative, or laboratory materials . . . . . . . . . . . . . . . ________

Reading about science . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ________

Test or quiz . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ________

Other science instructional activities . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ________

Total ________

(Should be the same as Question 30a)

**31. Did that lesson take place on the most recent day your school was in session?**

**(Circle one.)**

Yes . . . . . . . . . . . . . . . . . . . . . . . . 1

No . . . . . . . . . . . . . . . . . . . . . . . . . 2

**32. Indicate the activities that took place during that science lesson.**

**(Circle all that apply.)**

Lecture . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1

Discussion . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2

Teacher demonstration . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3

Student use of hands-on or laboratory materials . . . . . . . . . . . . . . . . . . . . . 4

Student use of computers . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5

Students working in small groups . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 6

Students doing seatwork assigned from textbook . . . . . . . . . . . . . . . . . . . . 7

Students completing supplemental worksheets . . . . . . . . . . . . . . . . . . . . . . 8

Assigning homework . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9

## SECTION E: TEACHER PREPARATION

33. **Indicate the degrees you hold. Then indicate your major area of study for each degree using the list of code numbers to the right. Space has been provided for you to enter a code number for a second bachelor's or master's degree. Enter more than one code number on the same line only if you had a double major.**

**If no degree, check here ☐ and go on to Question 34.**

| **Degree** | **(Circle all that apply.)** | **Specify Major Area Code No.** |
|---|---|---|
| Associate | 1 | ______ |
| Bachelor's | 2 | ______ |
| 2nd Bachelor's | | ______ |
| Master's | 3 | ______ |
| 2nd Master's | | ______ |
| Specialist or 6-year certificate | 4 | ______ |
| Doctorate | 5 | ______ |

**MAJOR AREA CODE NUMBERS**

**EDUCATION**
- 11 Elementary education
- 12 Middle school education
- 13 Secondary education
- 14 Mathematics education
- 15 Science education
- 16 Other education

**MATHEMATICS/COMPUTER SCIENCE**
- 21 Mathematics
- 22 Computer science

**SCIENCE**
- 31 Biology, environmental, life sciences
- 32 Chemistry
- 33 Physics
- 34 Physical science
- 35 Earth/space sciences

**OTHER DISCIPLINES**
- 41 History, English, foreign language, etc.

34. **Indicate the categories in which you have completed one or more college courses.**

| | **(Circle all that apply.)** |
|---|---|
| **EDUCATION** | |
| General methods of teaching | 1 |
| Methods of teaching elementary school science | 2 |
| Methods of teaching middle school science | 3 |
| Methods of teaching secondary school science | 4 |
| Supervised student teaching | 5 |
| Instructional uses of computers | 6 |
| Psychology, human development | 7 |
| **SCIENCE** | |
| Biology, environmental, life sciences | 8 |
| Chemistry | 9 |
| Physics | 10 |
| Physical science | 11 |
| Earth/space sciences | 12 |
| Engineering | 13 |
| **MATHEMATICS/COMPUTER SCIENCE** | |
| College algebra, trigonometry, elementary functions | 14 |
| Calculus | 15 |
| Computer programming | 16 |

35. **What type of state teaching certification do you have?**

**(Circle one.)**

Not certified . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 — *Skip to Question 37*
Provisional (lacking some requirements) . . . . . . . . . . . . . . . . . . . . . . . . . . . 2
Regular, lifetime, or other certification in *any* subject . . . . . . . . . . . . . . . . . . . 3

36. **In which subject areas do you have state teaching certification?**

**(Circle all that apply.)**

Elementary education *(please specify grades: ____________)* . . . . . . . . . . . . 1
Middle school education *(please specify grades: ____________)* . . . . . . . . . . 2
General science . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3
Biology, environmental, life sciences . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4
Earth/space sciences . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5
Physical sciences . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 6
Chemistry . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7
Physics . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 8
Mathematics . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9
Computer science . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 10
Business . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 11
Reading, language arts, English . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 12
Physical education, health . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 13
Social studies, history . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 14
Foreign language . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15
Other *(please specify ______________________________)* . . . . . . 16

## SECTION F: IN-SERVICE EDUCATION IN SCIENCE

37. **During the *last 12 months*, what is the *total* amount of time you have spent on in-service education in science or the teaching of science? (Include attendance at professional meetings, workshops, and conferences, but do *not* include formal courses for which you received college credit.)**

**(Circle one.)**

None . . . . . . . . . . . . . . . . . . . . . . . 1 — *Skip to Question 39*
Less than 6 hours . . . . . . . . . . . . . 2
6-15 hours . . . . . . . . . . . . . . . . . . . 3
16-35 hours . . . . . . . . . . . . . . . . . . 4
More than 35 hours . . . . . . . . . . . 5

**38. What type(s) of support have you received?**

**(Circle all that apply.)**

| | |
|---|---|
| None | 1 |
| Released time from teaching | 2 |
| Travel and/or per diem expenses | 3 |
| Stipends | 4 |
| Professional growth credits | 5 |
| Other *(please specify* ______________________) | 6 |

**39. If an in-service program that interested you were available, how likely would you be to attend if it were offered at the following times?**

**(Circle one on each line.)**

| | Not Likely | Somewhat Likely | Very Likely |
|---|---|---|---|
| a. After school | 1 | 2 | 3 |
| b. Evenings | 1 | 2 | 3 |
| c. Saturdays | 1 | 2 | 3 |
| d. Summers | 1 | 2 | 3 |
| e. Teacher work days | 1 | 2 | 3 |

**40. In what year did you last take a course <u>*for college credit*</u> in science or the teaching of science?**______________

**41. Think about a specific science topic that you would find difficult to teach.**

**a. What is this topic?** ________________________________________________

**b. Which would be the <u>*most*</u> useful in helping you to teach that topic?**

**(Circle one.)**

| | |
|---|---|
| Learning more about the basic concepts | 1 |
| Learning more about applications of those concepts in daily life, technology, and careers | 2 |
| Learning more about instructional materials/techniques | 3 |

**42. Suppose you wanted to find out about the research related to a topic (e.g., discovery learning, science anxiety, or sex differences in learning). How likely would you be to use each of the following sources of information?**

**(Circle one on each line.)**

| | Not Likely | Somewhat Likely | Very Likely |
|---|---|---|---|
| a. Other teacher(s) | 1 | 2 | 3 |
| b. Principals | 1 | 2 | 3 |
| c. Local science specialists/coordinators | 1 | 2 | 3 |
| d. State Department personnel | 1 | 2 | 3 |
| e. Consultants | 1 | 2 | 3 |
| f. College courses | 1 | 2 | 3 |
| g. In-service programs | 1 | 2 | 3 |
| h. Meetings of professional organizations | 1 | 2 | 3 |
| i. Journals | 1 | 2 | 3 |
| j. Research reviews | 1 | 2 | 3 |
| k. Newspapers/magazines | 1 | 2 | 3 |
| l. Television/radio | 1 | 2 | 3 |
| m. Publishers and sales representatives | 1 | 2 | 3 |

43. **How adequately prepared do you feel to teach science in a class that includes the following types of children with special needs?**

(Circle one on each line.)

| | Totally Unprepared | Somewhat Unprepared | Adequately Prepared | Well Prepared | Very Well Prepared |
|---|---|---|---|---|---|
| a. Physically handicapped | 1 | 2 | 3 | 4 | 5 |
| b. Mentally retarded | 1 | 2 | 3 | 4 | 5 |
| c. Learning disabled | 1 | 2 | 3 | 4 | 5 |

44. **What training have you received in educating handicapped children in the regular science classroom?**

(Circle all that apply.)

None .......... 1
College course(s) .......... 2
In-service workshop(s) .......... 3
Other *(please specify* ________________) .......... 4

45. **How adequately prepared do you feel to use computers as an instructional tool in teaching science?**

(Circle one.)

Totally unprepared .......... 1
Somewhat unprepared .......... 2
Adequately prepared .......... 3
Well prepared .......... 4
Very well prepared .......... 5

46. **What training have you received in the *instructional* uses of computers?**

(Circle all that apply.)

None .......... 1
College coursework .......... 2
Less than 3 days' in-service education .......... 3
Three or more days' in-service education .......... 4
Self-taught .......... 5
Other *(please specify* ________________) ... 6

47. **To which of the following professional organizations do you currently belong? If none, check here ☐ and go on to Question 48.**

(Circle all that apply.)

National Science Teachers Association .......... 1
State-level science education organization .......... 2
National Council of Teachers of Mathematics .......... 3
State-level mathematics education organization .......... 4

International Reading Association .......... 5
National Association of Elementary School Teachers .......... 6
American Federation of Teachers .......... 7
National Education Association .......... 8

Other *(please specify)* ________________) .......... 9

**48. Please give us your opinion about each of the following statements.**

(Circle one on each line.)

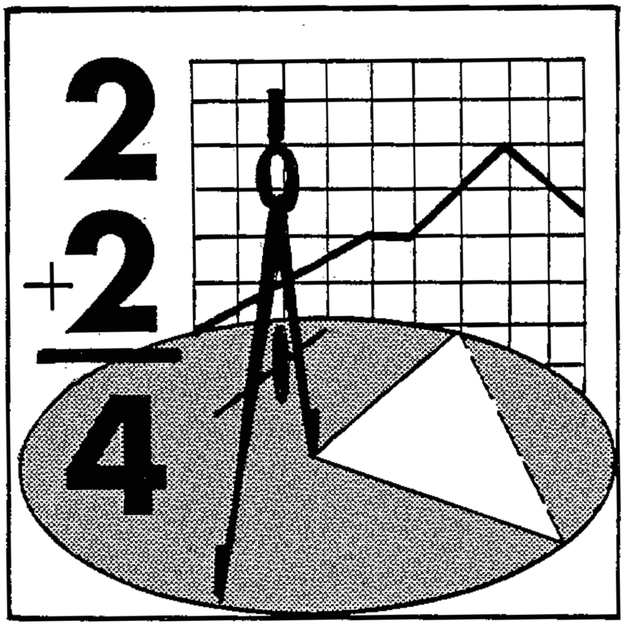
| | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| a. I am in favor of differential pay for teachers in shortage areas such as science | 1 | 2 | 3 | 4 | 5 |
| b. Science is a difficult subject for children to learn | 1 | 2 | 3 | 4 | 5 |
| c. Prospective teachers should have to pass competency tests in the subjects they will teach | 1 | 2 | 3 | 4 | 5 |
| d. Hands-on science experiences aren't worth the time and expense | 1 | 2 | 3 | 4 | 5 |
| e. I would like an 11-month contract | 1 | 2 | 3 | 4 | 5 |
| f. My principal really does not understand the problems of teaching science | 1 | 2 | 3 | 4 | 5 |
| g. Experienced teachers should be required to pass competency tests in the subjects they teach | 1 | 2 | 3 | 4 | 5 |
| h. I enjoy teaching science | 1 | 2 | 3 | 4 | 5 |
| i. Laboratory-based science classes are more effective than non-laboratory classes | 1 | 2 | 3 | 4 | 5 |
| j. Industry scientists should be allowed to teach in the public schools | 1 | 2 | 3 | 4 | 5 |
| k. I consider myself a "master" science teacher | 1 | 2 | 3 | 4 | 5 |

**49. When did you complete this questionnaire?** ________ (Month) ________ (Day) ________ (Year)

*THANK YOU FOR YOUR COOPERATION!*

CANARY

# 1985 NATIONAL SURVEY SCIENCE & MATHEMATICS EDUCATION




## Teacher Questionnaire

Conducted by Research Triangle Institute
P.O. Box 12194 Research Triangle Park, NC 27709

If you have any questions, call Jennifer McNeill 800-334-8571

Many educators have raised questions about how best to prepare young people for the challenges they will face in our increasingly technological society.

To help collect information on the status of science and mathematics education in our schools, the National Science Foundation sponsored a 1977 survey of teachers and principals. The purpose of the current study is to identify trends that have emerged since that time, and to suggest improvements that might be made in the future.

The topics to be covered in this study include science and mathematics course offerings and enrollments, availability of facilities and equipment, instructional techniques, textbook usage, teacher background, and needs for in-service education. Information will be collected from selected teachers and principals by printed questionnaire only—no classroom visits will be involved. Data will be kept strictly confidential, and will be reported only in aggregate form, such as by grade level, and by region. No individually identifying information will be released.

The 1985 National Survey of Science and Mathematics Education has been coordinated with the data collection efforts of the Department of Education, the National Assessment of Educational Progress, and the International Assessments of Science and Mathematics in order to avoid unnecessary duplication. The survey has also been endorsed by more than 20 professional organizations, whose names appear below.

Endorsed by:

American Association for the Advancement of Science (AAAS)
American Association of School Administrators (AASA)
American Association of Physics Teachers (AAPT)
American Chemical Society (ACS)
American Federation of Teachers (AFT)
American Institute of Biological Sciences (AIBS)
Association for Computing Machinery (ACM)
Association of State Supervisors of Mathematics (ASSM)
Council of Chief State School Officers (CCSSO)
Council of State Science Supervisors (CSSS)
National Association for Research in Science Teaching (NARST)
National Association of Biology Teachers (NABT)
National Association of Elementary School Principals (NAESP)
National Association of Geology Teachers (NAGT)
National Association of Secondary School Principals (NASSP)
National Catholic Education Association (NCEA)
National Council of Teachers of Mathematics (NCTM)
National Earth Science Teachers Association (NESTA)
National Education Association (NEA)
National Science Supervisors Association (NSSA)
National Science Teachers Association (NSTA)
School Science and Mathematics Association (SSMA)

# SECTION A: BACKGROUND INFORMATION

1. **Indicate your sex:**

| | (Circle one.) |
|---|---|
| Male | 1 |
| Female | 2 |

2. **Are you:**

| | (Circle one.) |
|---|---|
| White (not of Hispanic origin) | 1 |
| Black (not of Hispanic origin) | 2 |
| Hispanic | 3 |
| American Indian or Alaskan Native | 4 |
| Asian or Pacific Islander | 5 |
| Other *(please specify* ______________________*)* | 6 |

3. **How old are you?** __________

4. **How many years have you taught prior to this school year?** ________

5. **Indicate the number of years you have taught each of the following in any of grades 7-12 prior to this school year.**
   **If none, check here ☐ and go on to Question 6.**

   Mathematics, grades 7-12 ________

   Science, grades 7-12 ________

6. **Which of the following subjects have you taught** ***in the last three years?***
   **If you have not taught mathematics or science in the last three years, check here ☐ and go on to Question 7.**

| MATHEMATICS/COMPUTER SCIENCE | (Circle all that apply.) |
|---|---|
| Mathematics, grades 7-8 | 1 |
| Remedial, business, consumer, or general mathematics | 2 |
| Pre-algebra | 3 |
| Algebra, 1st year | 4 |
| Algebra, 2nd year | 5 |
| Geometry | 6 |
| Calculus, advanced mathematics | 7 |
| Computer literacy, programming | 8 |
| **SCIENCE** | |
| General science | 9 |
| Biology, environmental, life sciences | 10 |
| Chemistry | 11 |
| Physics | 12 |
| Physical science | 13 |
| Earth/space sciences | 14 |

## SECTION B: SCIENCE INSTRUCTION IN YOUR SCHOOL

7. Do you teach in a self-contained classroom, i.e., are you responsible for teaching all or most academic subjects to one class?

(Circle one.)

Yes ........................ 1 *Specify grade level(s)* ________ *then go to Question 8*

No ......................... 2 — *Go to Question 9*

8. We are interested in knowing how much time your students spend studying various subjects. In a typical week, how many days do you have lessons on each of the following subjects, and how many minutes long is an average lesson? (Please write "0" if you do not teach a particular subject to this class.)

| | Number of Days per Week | Approximate Number of Minutes per Day |
|---|---|---|
| 1. Mathematics | ____ | ____ |
| 2. Science | ____ | ____ |
| 3. Social studies | ____ | ____ |
| 4. Reading | ____ | ____ |

*Go to Question 10*

9. For each class period you are currently teaching, indicate the course title and the enrollment by grade. Then indicate the code number from the enclosed blue "List of Course Titles" that best describes the content of each course.

| Class | Course Title | Number of Students in Class by Grade | | | | | | | Course Code Number |
|---|---|---|---|---|---|---|---|---|---|
| | | 7 | 8 | 9 | 10 | 11 | 12 | Total | |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |

10. Are you currently teaching any course(s) that are outside your major area of certification? If yes, write in the course code number(s) from the blue list.

(Circle one.) Course Code No.

Yes ........................ 1 *Please specify:* a. ____________

No ......................... 2

b. ____________

c. ____________

11. **Are you currently teaching any course(s) that you *do not feel adequately qualified* to teach? If yes, write in the course code number(s) from the blue list.**

**(Circle one.)** **Course Code No.**

Yes .......................... 1 *Please specify:* a. ____________

No .......................... 2 b. ____________

c. ____________

12. a. **In the last year, have you received any assistance (e.g., curriculum materials, guest speakers, support to attend workshops, etc.) *from private industry?***

**(Circle one.)**

Yes .......................... 1 → *Go to Question 12b*

No .......................... 2 } → *Go to Question 13*

Not sure .......................... 3 }

b. **Indicate the type(s) of assistance you have received.**

**(Circle all that apply.)**

Curriculum materials .......................... 1

Equipment .......................... 2

Guest speakers .......................... 3

Travel/stipends to attend professional meetings .......................... 4

Teacher awards/scholarships .......................... 5

Teacher summer employment .......................... 6

Other *(please specify* ____________ *)* .......................... 7

13. **The following factors may affect science instruction *in your school as a whole.* In your opinion, how great a problem is caused by each of the following?**

**(Circle one on each line.)**

| | | Serious Problem | Somewhat of a Problem | Not a Significant Problem |
|---|---|---|---|---|
| a. | Belief that science is less important than other subjects | 1 | 2 | 3 |
| b. | Inadequate facilities | 1 | 2 | 3 |
| c. | Insufficient funds for purchasing equipment and supplies | 1 | 2 | 3 |
| d. | Lack of materials for individualizing instruction | 1 | 2 | 3 |
| e. | Insufficient numbers of textbooks | 1 | 2 | 3 |
| f. | Poor quality of textbooks | 1 | 2 | 3 |
| g. | Inadequate access to computers | 1 | 2 | 3 |
| h. | Lack of student interest in science | 1 | 2 | 3 |
| i. | Inadequate student reading abilities | 1 | 2 | 3 |
| j. | Lack of teacher interest in science | 1 | 2 | 3 |
| k. | Teachers inadequately prepared to teach science | 1 | 2 | 3 |
| l. | Student absences | 1 | 2 | 3 |
| m. | Lack of teacher planning time | 1 | 2 | 3 |
| n. | Not enough time to teach science | 1 | 2 | 3 |
| o. | Class sizes too large | 1 | 2 | 3 |
| p. | Difficulty in maintaining discipline | 1 | 2 | 3 |
| q. | Inadequate articulation of instruction across grade levels | 1 | 2 | 3 |
| r. | Inadequate diversity of science electives | 1 | 2 | 3 |
| s. | Low enrollments in science courses | 1 | 2 | 3 |

## SECTION C: YOUR SCIENCE TEACHING IN A PARTICULAR CLASS

The questions in Sections C and D relate to *your science teaching* in a particular class. Please consult the label on the front of this questionnaire to determine the randomly selected science class for which these questions should be answered.

**14. a. What is the title of this course?** ______________________

**b. Using the blue "List of Course Titles," indicate the code number that best describes the content of this course.**

__________

**15. a. How many students are there in this class?** ________

**b. Please indicate the number of students in this class in each race/sex category:**

| | Male | Female |
|---|---|---|
| White (not of Hispanic origin) | ______ | ______ |
| Black (not of Hispanic origin) | ______ | ______ |
| Hispanic | ______ | ______ |
| American Indian or Alaskan Native | ______ | ______ |
| Asian or Pacific Islander | ______ | ______ |
| Other *(please specify* ______________) | ______ | ______ |
| Total | ______ | ______ |

Note: The total number of males and females should be the same as the number of students in Question 15a.

**16. What is the duration of this course?**

**(Circle one.)**

- Year ........ 1
- Semester ........ 2
- Quarter ........ 3
- Other *(please specify* ______________) ........ 4

**17. Which best describes the content of this course?**

**(Circle one.)**

- General science ........ 1
- Biology, life sciences, environmental science ........ 2
- Chemistry, physics, physical sciences ........ 3
- Earth/space sciences ........ 4
- Other *(please specify* ______________) ........ 5

**18. Which of the following best describes the ability makeup of this class? (Comparison should be with the average student in the grade.)**

**(Circle one.)**

- Primarily high ability students ........ 1
- Primarily low ability students ........ 2
- Primarily average ability students ........ 3
- Students of widely differing ability levels ........ 4

**19. On the average, how many minutes of science homework do you expect the typical student in this class to complete each day?**

_______ minutes/day

**20. Are there any professional magazines or journals which you find particularly helpful in teaching science to this class?**

**(Circle one.)**

Yes ........................ 1 *Please specify:* a. ____________________

No ........................ 2 b. ____________________

c. ____________________

**21. Are you using one or more published textbooks or programs for teaching science to this class?**

**(Circle one.)**

Yes ........................ 1 → *Go to Question 23*

No ........................ 2 → *Go to Question 22*

**22. Why did you choose not to use a textbook?**

**(Circle all that apply.)**

| | |
|---|---|
| I prefer to teach without a textbook | 1 |
| I did not like the textbook assigned to this class | 2 |
| Available textbooks were not appropriate for this class | 3 |
| There were insufficient funds to purchase textbooks | 4 |
| Other *(specify* ______________________________ ______________________________*)* | 5 |

*Go to Question 28*

**23. Indicate the publisher of the *one* textbook/program used most often by the students in this class.**

**(Circle one.)**

| | | | |
|---|---|---|---|
| Addison-Wesley | 01 | Janus | 15 |
| Allyn & Bacon | 02 | Laidlaw Brothers | 16 |
| American Book | 03 | Little, Brown | 17 |
| Wm. C. Brown | 04 | Macmillan | 18 |
| College Entrance | 05 | McGraw Hill | 19 |
| Coronado | 06 | Merrill | 20 |
| Follett | 07 | National Science Program | 21 |
| Ginn | 08 | Prentice Hall | 22 |
| Globe | 09 | Rand McNally | 23 |
| Harcourt, Brace, & Jovanovich | 10 | Saunders | 24 |
| Harper & Row | 11 | Scott, Foresman | 25 |
| D. C. Heath | 12 | Silver Burdett | 26 |
| Holt, Rinehart, Winston | 13 | Wiley | 27 |
| Houghton Mifflin | 14 | Other *(please specify* ____________*)* | 28 |

24. **Indicate the title, author, and most recent copyright date of this textbook/program.**

Title: ______________________________

Author: ______________________________

Most recent copyright date: __________

25. **Approximately what percentage of the textbook will you "cover" in this course?**

(Circle one.)

| | |
|---|---|
| Less than 25% | 1 |
| 25-49% | 2 |
| 50-74% | 3 |
| 75-90% | 4 |
| More than 90% | 5 |

26. **Please give us your opinion about each of the following statements related to the textbook you are using most often in this class.**

(Circle one on each line.)

| This textbook: | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| a. Is at an appropriate reading level for most of my students | 1 | 2 | 3 | 4 | 5 |
| b. Is not very interesting to my students | 1 | 2 | 3 | 4 | 5 |
| c. Is unclear and disorganized | 1 | 2 | 3 | 4 | 5 |
| d. Helps develop problem-solving skills | 1 | 2 | 3 | 4 | 5 |
| e. Needs more examples to reinforce concepts | 1 | 2 | 3 | 4 | 5 |
| f. Explains concepts clearly | 1 | 2 | 3 | 4 | 5 |
| g. Provides good suggestions for activities and assignments | 1 | 2 | 3 | 4 | 5 |
| h. Lacks examples of the use of science in daily life | 1 | 2 | 3 | 4 | 5 |
| i. Shows the applications of science in careers | 1 | 2 | 3 | 4 | 5 |
| j. Has high quality supplementary materials | 1 | 2 | 3 | 4 | 5 |

27. **Indicate the persons or groups who helped determine that you would use this particular textbook in this science class.**

(Circle all that apply.)

| | |
|---|---|
| I did | 1 |
| The principal | 2 |
| A group of teachers from this school | 3 |
| A district-wide textbook adoption committe | 4 |
| A state-wide textbook adoption committee | 5 |
| Other *(please specify* ______________________) | 6 |

28. **If you are using any materials instead of, or in addition to, a published textbook or program, briefly describe below.**

______________________________

______________________________

______________________________

**29. Do you use calculators in this science class?**

**(Circle one.)**

Yes ........................ 1 — *Go to Question 30*
No ......................... 2 — *Go to Question 31*

**30. How are calculators used in this science class?**

**(Circle all that apply.)**

Checking answers ............ 1
Doing computations ........... 2
Solving problems ............. 3
Taking tests .................. 4

**31. Which best describes the availability of computers (microcomputers or terminals to mini/mainframe) for use with this science class?**

**(Circle one.)**

Not available ................................................ 1 — *Skip to Question 34*
Available but quite difficult to access ............................. 2
Available but somewhat difficult to access .......................... 3
Readily available ............................................ 4

**32. How does this science class use computers?**
**If not used, check here ☐ and skip to Question 34.**

**(Circle all that apply.)**

Teacher demonstrating computer use ................................ 1
Writing programs .............................................. 2
Learning science content ........................................ 3
Laboratory tool ............................................... 4
Drill and practice .............................................. 5
Using simulations ............................................. 6
Problem solving ............................................... 7
Using computer graphics ........................................ 8
Games ....................................................... 9
Testing and evaluation ......................................... 10
Other *(please specify* ______________________*)* ......... 11

**33. During the *last week* of instruction, how many minutes did a typical student spend working with computers as part of this science class?**

**(Circle one.)**

None ....................... 1
1-14 minutes ................. 2
15-29 minutes ................ 3
30-44 minutes ................ 4
45-60 minutes ................ 5
More than 60 minutes ......... 6

34. **Think about your plans for this science class for the entire course. How much emphasis will each of the following *objectives* receive?**

(Circle one on each line.)

| | None | | Minimal Emphasis | | Moderate Emphasis | | Very Heavy Emphasis |
|---|---|---|---|---|---|---|---|
| a. Become interested in science | 1 | | 2 | 3 | 4 | 5 | 6 |
| b. Learn basic science concepts | 1 | | 2 | 3 | 4 | 5 | 6 |
| c. Prepare for further study in science | 1 | | 2 | 3 | 4 | 5 | 6 |
| d. Develop inquiry skills | 1 | | 2 | 3 | 4 | 5 | 6 |
| e. Develop a systematic approach to solving problems | 1 | | 2 | 3 | 4 | 5 | 6 |
| f. Learn to effectively communicate ideas in science | 1 | | 2 | 3 | 4 | 5 | 6 |
| g. Become aware of the importance of science in daily life | 1 | | 2 | 3 | 4 | 5 | 6 |
| h. Learn about applications of science in technology | 1 | | 2 | 3 | 4 | 5 | 6 |
| i. Learn about the career relevance of science | 1 | | 2 | 3 | 4 | 5 | 6 |
| j. Learn about the history of science | 1 | | 2 | 3 | 4 | 5 | 6 |
| k. Develop awareness of safety issues in lab | 1 | | 2 | 3 | 4 | 5 | 6 |
| l. Develop skill in lab techniques | 1 | | 2 | 3 | 4 | 5 | 6 |

## SECTION D: YOUR MOST RECENT SCIENCE LESSON IN THIS CLASS

Please answer the following questions specific to *your most recent science lesson* in this class. Do not be concerned if this lesson was not typical of instruction in this class.

35. **a. How many minutes were allocated for that science lesson?** ____________

**b. Of these, how many were spent on the following:**

Daily routines, interruptions, and other non-instructional activities ............. __________

Lecture ............................................................. __________

Working with hands-on, manipulative, or laboratory materials ................ __________

Reading about science ............................................... __________

Test or quiz ........................................................ __________

Other science instructional activities .............................. __________

Total __________

(Should be the same as Question 35a)

36. **Did that lesson take place on the most recent day your school was in session?**

(Circle one.)

Yes ........................ 1

No ......................... 2

**37. Indicate the activities that took place during that science lesson.**

| | **(Circle all that apply.)** |
|---|---|
| Lecture | 1 |
| Discussion | 2 |
| Teacher demonstration | 3 |
| Student use of hands-on or laboratory materials | 4 |
| Student use of calculators | 5 |
| Student use of computers | 6 |
| Students working in small groups | 7 |
| Students doing seatwork assigned from textbook | 8 |
| Students completing supplemental worksheets | 9 |
| Assigning homework | 10 |

## SECTION E: TEACHER PREPARATION

**38. Indicate the degrees you hold. Then indicate your major area of study for each degree using the list of code numbers to the right. Space has been provided for you to enter a code number for a second bachelor's or master's degree. Enter more than one code number on the same line only if you had a double major.**

**If no degree, check here ☐ and go on to Question 39.**

| **Degree** | **(Circle all that apply.)** | **Specify Major Area Code No.** |
|---|---|---|
| Associate | 1 | ______ |
| Bachelor's | 2 | ______ |
| 2nd Bachelor's | | ______ |
| Master's | 3 | ______ |
| 2nd Master's | | ______ |
| Specialist or 6-year certificate | 4 | ______ |
| Doctorate | 5 | ______ |

**MAJOR AREA CODE NUMBERS**

**EDUCATION**
- 11 Elementary education
- 12 Middle school education
- 13 Secondary education
- 14 Mathematics education
- 15 Science education
- 16 Other education

**MATHEMATICS/COMPUTER SCIENCE**
- 21 Mathematics
- 22 Computer science

**SCIENCE**
- 31 Biology, environmental, life sciences
- 32 Chemistry
- 33 Physics
- 34 Physical science
- 35 Earth/space sciences

**OTHER DISCIPLINES**
- 41 History, English, foreign language, etc.

39. Indicate the categories in which you have completed one or more college courses.

(Circle all that apply.)

| | |
|---|---|
| **EDUCATION** | |
| General methods of teaching | 1 |
| Methods of teaching elementary school science | 2 |
| Methods of teaching middle school science | 3 |
| Methods of teaching secondary school science | 4 |
| Supervised student teaching | 5 |
| Instructional uses of computers | 6 |
| Psychology, human development | 7 |
| **MATHEMATICS/COMPUTER SCIENCE** | |
| College algebra, trigonometry, elementary functions | 8 |
| Calculus | 9 |
| Differential equations | 10 |
| Probability and statistics | 11 |
| Computer programming | 12 |
| **LIFE SCIENCES** | |
| Introductory biology | 13 |
| Botany, plant physiology, etc. | 14 |
| Cell biology | 15 |
| Ecology, environmental science | 16 |
| Genetics, evolution | 17 |
| Microbiology | 18 |
| Physiology | 19 |
| Zoology, animal behavior, etc. | 20 |
| **CHEMISTRY** | |
| General chemistry | 21 |
| Analytical chemistry | 22 |
| Organic chemistry | 23 |
| Physical chemistry | 24 |
| Biochemistry | 25 |
| **PHYSICS** | |
| General physics | 26 |
| Electricity and magnetism | 27 |
| Heat and thermodynamics | 28 |
| Mechanics | 29 |
| Modern or nuclear physics | 30 |
| Optics | 31 |
| **EARTH/SPACE SCIENCES** | |
| Astronomy | 32 |
| Geology | 33 |
| Meteorology | 34 |
| Oceanography | 35 |
| Physical geography | 36 |
| **OTHER** | |
| History of science | 37 |
| Science and society | 38 |
| Engineering | 39 |

40. **For each of the following subject areas, indicate the number of courses you have completed. Count each course you have taken, regardless of whether it was a semester hour, quarter hour, graduate, or undergraduate course. If your transcripts are not available, provide your best estimates.**

| **Subject Area** | **Circle the number of courses you have completed.** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Life sciences | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ≥8 |
| Chemistry | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ≥8 |
| Physics/physical science | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ≥8 |
| Earth/space sciences | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ≥8 |
| Calculus | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ≥8 |
| Computer science | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ≥8 |

41. **What type of state teaching certification do you have?**

**(Circle one.)**

Not certified . . . . . . . . . . 1 — *Skip to Question 43*

Provisional (lacking some requirements) . . . . . . . . . . 2

Regular, lifetime, or other certification in *any* subject . . . . . . . . . . 3

42. **In which subject areas do you have state teaching certification?**

**(Circle all that apply.)**

Elementary education *(please specify grades: ______)* . . . . . . . . . . 1

Middle school education *(please specify grades: ______)* . . . . . . . . . . 2

General science . . . . . . . . . . 3

Biology, environmental, life sciences . . . . . . . . . . 4

Earth/space sciences . . . . . . . . . . 5

Physical sciences . . . . . . . . . . 6

Chemistry . . . . . . . . . . 7

Physics . . . . . . . . . . 8

Mathematics . . . . . . . . . . 9

Computer science . . . . . . . . . . 10

Business . . . . . . . . . . 11

English, language arts, reading . . . . . . . . . . 12

Physical education, health . . . . . . . . . . 13

Social studies, history . . . . . . . . . . 14

Foreign language . . . . . . . . . . 15

Other *(please specify ______)* . . . . . . 16

## SECTION F: IN-SERVICE EDUCATION IN SCIENCE

**43. During the *last 12 months*, what is the *total* amount of time you have spent on in-service education in science or the teaching of science? (Include attendance at professional meetings, workshops, and conferences, but do *not* include formal courses for which you received college credit.)**

(Circle one.)

| | | |
|---|---|---|
| None | 1 | → *Skip to Question 45* |
| Less than 6 hours | 2 | |
| 6-15 hours | 3 | |
| 16-35 hours | 4 | |
| More than 35 hours | 5 | |

**44. What type(s) of support have you received?**

(Circle all that apply.)

| | |
|---|---|
| None | 1 |
| Released time from teaching | 2 |
| Travel and/or per diem expenses | 3 |
| Stipends | 4 |
| Professional growth credits | 5 |
| Other *(please specify ____________________)* | 6 |

**45. If an in-service program that interested you were available, how likely would you be to attend if it were offered at the following times?**

(Circle one on each line.)

| | Not Likely | Somewhat Likely | Very Likely |
|---|---|---|---|
| a. After school | 1 | 2 | 3 |
| b. Evenings | 1 | 2 | 3 |
| c. Saturdays | 1 | 2 | 3 |
| d. Summers | 1 | 2 | 3 |
| e. Teacher work days | 1 | 2 | 3 |

**46. In what year did you last take a course *for college credit* in science or the teaching of science?** ____________

**47. Think about a specific science topic that you would find difficult to teach.**

**a. What is this topic?** ______________________________

**b. Which would be the *most* useful in helping you to teach that topic?**

(Circle one.)

| | |
|---|---|
| Learning more about the basic concepts | 1 |
| Learning more about applications of those concepts in daily life, technology, and careers | 2 |
| Learning more about instructional materials/techniques | 3 |

48. **Suppose you wanted to find out about the research related to a topic (e.g., discovery learning, science anxiety, or sex differences in learning). How likely would you be to use each of the following sources of information?**

**(Circle one on each line.)**

| | Not Likely | Somewhat Likely | Very Likely |
|---|---|---|---|
| a. Other teacher(s) | 1 | 2 | 3 |
| b. Principals | 1 | 2 | 3 |
| c. Local science specialists/coordinators | 1 | 2 | 3 |
| d. State Department personnel | 1 | 2 | 3 |
| e. Consultants | 1 | 2 | 3 |
| f. College courses | 1 | 2 | 3 |
| g. In-service programs | 1 | 2 | 3 |
| h. Meetings of professional organizations | 1 | 2 | 3 |
| i. Journals | 1 | 2 | 3 |
| j. Research reviews | 1 | 2 | 3 |
| k. Newspapers/magazines | 1 | 2 | 3 |
| l. Television/radio | 1 | 2 | 3 |
| m. Publishers and sales representatives | 1 | 2 | 3 |

49. **How adequately prepared do you feel to teach science in a class that includes the following types of children with special needs?**

**(Circle one on each line.)**

| | Totally Unprepared | Somewhat Unprepared | Adequately Prepared | Well Prepared | Very Well Prepared |
|---|---|---|---|---|---|
| a. Physically handicapped | 1 | 2 | 3 | 4 | 5 |
| b. Mentally retarded | 1 | 2 | 3 | 4 | 5 |
| c. Learning disabled | 1 | 2 | 3 | 4 | 5 |

50. **What training have you received in educating handicapped children in the regular science classroom?**

**(Circle all that apply.)**

| | |
|---|---|
| None | 1 |
| College course(s) | 2 |
| In-service workshop(s) | 3 |
| Other *(please specify* ______________________) | 4 |

51. **How adequately prepared do you feel to use computers as an instructional tool with your science classes?**

**(Circle one.)**

| | |
|---|---|
| Totally unprepared | 1 |
| Somewhat unprepared | 2 |
| Adequately prepared | 3 |
| Well prepared | 4 |
| Very well prepared | 5 |

52. **What training have you received in the *instructional uses* of computers?**

**(Circle all that apply.)**

| | |
|---|---|
| None | 1 |
| College coursework | 2 |
| Less than 3 days' in-service education | 3 |
| Three or more days' in-service education | 4 |
| Self-taught | 5 |
| Other *(please specify* ______________________) | 6 |

53. To which of the following professional organizations do you currently belong?

If none, check here ☐ and go on to Question 54.

| | (Circle all that apply.) |
|---|---|
| American Association of Physics Teachers | 1 |
| American Chemical Society | 2 |
| National Association of Biology Teachers | 3 |
| National Association of Geology Teachers | 4 |
| National Earth Science Teachers Association | 5 |
| National Science Teachers Association | 6 |
| School Science and Mathematics Association | 7 |
| State-level science education organization | 8 |
| Association for Computing Machinery | 9 |
| Association for Educational Data Systems | 10 |
| Mathematical Association of America | 11 |
| National Council of Teachers of Mathematics | 12 |
| Society of Industrial and Applied Mathematics | 13 |
| State-level mathematics education organization | 14 |
| American Federation of Teachers | 15 |
| National Education Association | 16 |
| Other *(please specify)* ______________________________) | 17 |

54. Please give us your opinion about each of the following statements.

(Circle one on each line.)

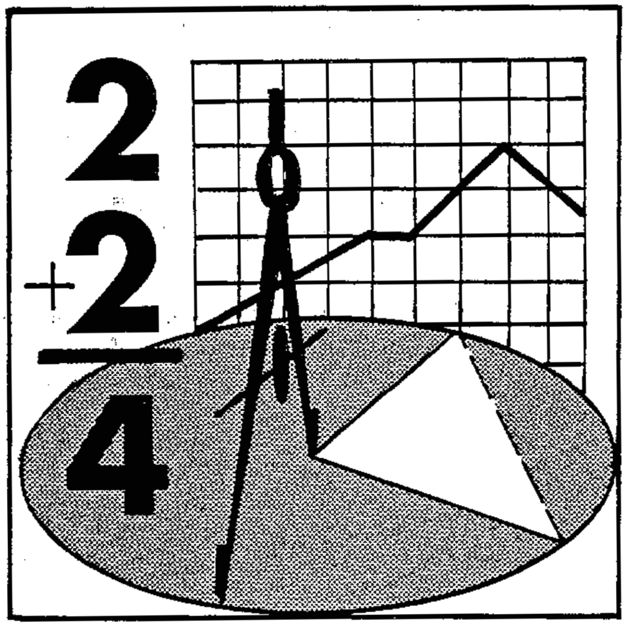
| | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| a. I am in favor of differential pay for teachers in shortage areas such as science | 1 | 2 | 3 | 4 | 5 |
| b. Science is a difficult subject for children to learn | 1 | 2 | 3 | 4 | 5 |
| c. Prospective teachers should have to pass competency tests in science | 1 | 2 | 3 | 4 | 5 |
| d. Hands-on science experiences aren't worth the time and expense | 1 | 2 | 3 | 4 | 5 |
| e. I would like an 11-month contract | 1 | 2 | 3 | 4 | 5 |
| f. My principal really does not understand the problems of teaching science | 1 | 2 | 3 | 4 | 5 |
| g. Experienced teachers should be required to pass competency tests in science | 1 | 2 | 3 | 4 | 5 |
| h. I enjoy teaching science | 1 | 2 | 3 | 4 | 5 |
| i. Laboratory-based science classes are more effective than non-laboratory classes | 1 | 2 | 3 | 4 | 5 |
| j. Industry scientists should be allowed to teach in the public schools | 1 | 2 | 3 | 4 | 5 |
| k. I consider myself a "master" science teacher | 1 | 2 | 3 | 4 | 5 |

55. When did you complete this questionnaire? __________ (Month) __________ (Day) __________ (Year)

*THANK YOU FOR YOUR COOPERATION!*

PINK

# 1985 NATIONAL SURVEY SCIENCE & MATHEMATICS EDUCATION




## Teacher Questionnaire

Conducted by Research Triangle Institute
P.O. Box 12194 Research Triangle Park, NC 27709

If you have any questions, call Jennifer McNeill 800-334-8571

EM

Many educators have raised questions about how best to prepare young people for the challenges they will face in our increasingly technological society.

To help collect information on the status of science and mathematics education in our schools, the National Science Foundation sponsored a 1977 survey of teachers and principals. The purpose of the current study is to identify trends that have emerged since that time, and to suggest improvements that might be made in the future.

The topics to be covered in this study include science and mathematics course offerings and enrollments, availability of facilities and equipment, instructional techniques, textbook usage, teacher background, and needs for in-service education. Information will be collected from selected teachers and principals by printed questionnaire only—no classroom visits will be involved. Data will be kept strictly confidential, and will be reported only in aggregate form, such as by grade level, and by region. No individually identifying information will be released.

The 1985 National Survey of Science and Mathematics Education has been coordinated with the data collection efforts of the Department of Education, the National Assessment of Educational Progress, and the International Assessments of Science and Mathematics in order to avoid unnecessary duplication. The survey has also been endorsed by more than 20 professional organizations, whose names appear below.

Endorsed by:

American Association for the Advancement of Science (AAAS)
American Association of School Administrators (AASA)
American Association of Physics Teachers (AAPT)
American Chemical Society (ACS)
American Federation of Teachers (AFT)
American Institute of Biological Sciences (AIBS)
Association for Computing Machinery (ACM)
Association of State Supervisors of Mathematics (ASSM)
Council of Chief State School Officers (CCSSO)
Council of State Science Supervisors (CSSS)
National Association for Research in Science Teaching (NARST)
National Association of Biology Teachers (NABT)
National Association of Elementary School Principals (NAESP)
National Association of Geology Teachers (NAGT)
National Association of Secondary School Principals (NASSP)
National Catholic Education Association (NCEA)
National Council of Teachers of Mathematics (NCTM)
National Earth Science Teachers Association (NESTA)
National Education Association (NEA)
National Science Supervisors Association (NSSA)
National Science Teachers Association (NSTA)
School Science and Mathematics Association (SSMA)

## SECTION A: BACKGROUND INFORMATION

1. **Indicate your sex:**

(Circle one.)

Male ........................ 1
Female ...................... 2

2. **Are you:**

(Circle one.)

White (not of Hispanic origin) ........................................ 1
Black (not of Hispanic origin) ........................................ 2
Hispanic .............................................................. 3
American Indian or Alaskan Native ..................................... 4
Asian or Pacific Islander ............................................. 5
Other *(please specify ______________________________)* ............ 6

3. **How old are you?** ___________

4. **How many years have you taught prior to this school year?** _______

## SECTION B: MATHEMATICS INSTRUCTION IN YOUR SCHOOL

5. **Do you teach in a self-contained classroom, i.e., are you responsible for teaching all or most academic subjects to one class?**

(Circle one.)

Yes ........................ 1 *Specify grade level(s) _________ then go to Question 6*
No ......................... 2 *→ Go to Question 7*

6. **We are interested in knowing how much time your students spend studying various subjects. In a typical week, how many days do you have lessons on each of the following subjects, and how many minutes long is an average lesson? (Please write "0" if you do not teach a particular subject to this class.)**

| | Number of Days per Week | Approximate Number of Minutes per Day |
|---|---|---|
| 1. Mathematics | _____ | _____ |
| 2. Science | _____ | _____ |
| 3. Social studies | _____ | _____ |
| 4. Reading | _____ | _____ |

*Go to Question 8*

7. **For each class you are currently teaching, please indicate the average number of minutes the students spend per week on each of the following subjects.**

| Class Number | Number of Minutes per Week: Mathematics | Number of Minutes per Week: Science |
|---|---|---|
| 1 | ________ | ________ |
| 2 | ________ | ________ |
| 3 | ________ | ________ |
| 4 | ________ | ________ |
| 5 | ________ | ________ |
| 6 | ________ | ________ |
| 7 | ________ | ________ |
| 8 | ________ | ________ |
| 9 | ________ | ________ |
| 10 | ________ | ________ |

8. **Many teachers feel better qualified to teach some subject areas than others. How qualified do you feel to teach each of the following (whether or not they are currently included in your curriculum)?**

**(Circle one on each line.)**

| | Not Well Qualified | Adequately Qualified | Very Well Qualified |
|---|---|---|---|
| a. Mathematics | 1 | 2 | 3 |
| b. Life sciences | 1 | 2 | 3 |
| c. Physical sciences | 1 | 2 | 3 |
| d. Earth/space sciences | 1 | 2 | 3 |
| e. Social studies, history | 1 | 2 | 3 |
| f. Reading, language arts, English | 1 | 2 | 3 |

9. a. **In the last year, have you received any assistance (e.g., curriculum materials, guest speakers, support to attend workshops, etc.) *from private industry?***

**(Circle one.)**

Yes ........................ 1 — *Go to Question 9b*
No ........................ 2 } — *Go to Question 10*
Not sure .................... 3 }

b. **Indicate the type(s) of assistance you have received.**

**(Circle all that apply.)**

Curriculum materials .................................... 1
Equipment .................................... 2
Guest speakers .................................... 3
Travel/stipends to attend professional meetings .................... 4
Teacher awards/scholarships .................................... 5
Teacher summer employment .................................... 6
Other *(please specify* ____________________*)* .......... 7

**10. The following factors may affect mathematics instruction *in your school as a whole*. In your opinion, how great a problem is caused by each of the following?**

**(Circle one on each line.)**

| | | Serious Problem | Somewhat of a Problem | Not a Significant Problem |
|---|---|---|---|---|
| a. | Belief that mathematics is less important than other subjects | 1 | 2 | 3 |
| b. | Inadequate facilities | 1 | 2 | 3 |
| c. | Insufficient funds for purchasing equipment and supplies | 1 | 2 | 3 |
| d. | Lack of materials for individualizing instruction | 1 | 2 | 3 |
| e. | Insufficient numbers of textbooks | 1 | 2 | 3 |
| f. | Poor quality of textbooks | 1 | 2 | 3 |
| g. | Inadequate access to computers | 1 | 2 | 3 |
| h. | Lack of student interest in mathematics | 1 | 2 | 3 |
| i. | Inadequate student reading abilities | 1 | 2 | 3 |
| j. | Lack of teacher interest in mathematics | 1 | 2 | 3 |
| k. | Teachers inadequately prepared to teach mathematics | 1 | 2 | 3 |
| l. | Student absences | 1 | 2 | 3 |
| m. | Lack of teacher planning time | 1 | 2 | 3 |
| n. | Not enough time to teach mathematics | 1 | 2 | 3 |
| o. | Class sizes too large | 1 | 2 | 3 |
| p. | Difficulty in maintaining discipline | 1 | 2 | 3 |
| q. | Inadequate articulation of instruction across grade levels | 1 | 2 | 3 |
| r. | Inadequate diversity of mathematics electives | 1 | 2 | 3 |
| s. | Low enrollments in mathematics courses | 1 | 2 | 3 |

## SECTION C: YOUR MATHEMATICS TEACHING IN A PARTICULAR CLASS

The questions in Sections C and D relate to *your mathematics teaching* in a particular class. If you teach mathematics to more than one class per day, please consult the label on the front of this questionnaire to determine the randomly selected mathematics class for which these questions should be answered.

**11. a. How many students are there in this class?** ________

**b. Please indicate the number of students in this class in each race/sex category:**

| | Male | Female |
|---|---|---|
| White (not of Hispanic origin) | ____ | ____ |
| Black (not of Hispanic origin) | ____ | ____ |
| Hispanic | ____ | ____ |
| American Indian or Alaskan Native | ____ | ____ |
| Asian or Pacific Islander | ____ | ____ |
| Other *(please specify* ________________) | ____ | ____ |
| Total | ____ | ____ |

Note: The total number of males and females should be the same as the number of students in Question 11a.

12. **What is the most common grade designation of the students in this class?**

**(Circle one.)**

K
1
2
3
4
5
6
Multi-grade *(specify* __________*)*

13. **Which of the following best describes the ability makeup of this class? (Comparison should be with the average student in the grade.)**

**(Circle one.)**

Primarily high ability students .................................... 1
Primarily low ability students ..................................... 2
Primarily average ability students ................................. 3
Students of widely differing ability levels ......................... 4

14. **How does the amount of time spent on mathematics in this class compare to the amount of time spent on mathematics in a similar class *three years ago*?**

**(Circle one.)**

I did not teach this grade level three years ago ...................... 1
More time is spent on mathematics now ............................. 2
About the same amount of time is spent on mathematics now as three years ago ................................................. 3
Less time is spent on mathematics now ............................. 4

15. **On the average, how many minutes of mathematics homework do you expect the typical student in this class to complete each week?**

_______ minutes/week

16. **Are there any professional magazines or journals which you find particularly helpful in teaching mathematics to this class?**

**(Circle one.)**

Yes ........................ 1 *Please specify:* a. ____________________
No ........................ 2
b. ____________________
c. ____________________

17. **Are you using one or more published textbooks or programs for teaching mathematics to this class?**

**(Circle one.)**

Yes ........................ 1 — *Go to Question 19*
No ........................ 2 — *Go to Question 18*

**18. Why did you choose not to use a textbook?**

**(Circle all that apply.)**

I prefer to teach without a textbook . . . . . . . . . . 1
I did not like the textbook assigned to this class . . . . . . . . . . 2
Available textbooks were not appropriate for this class . . . . . . . . . . 3
There were insufficient funds to purchase textbooks . . . . . . . . . . 4
Other *(specify* ______________________ . . . . . . . . . . 5
______________________*)*

*Go to Question 24*

**19. Indicate the publisher of the *one* textbook/program used most often by the students in this class.**

**(Circle one.)**

Addison-Wesley . . . . . . . . . . 01
Allyn & Bacon . . . . . . . . . . 02
American Book . . . . . . . . . . 03
Educational Teaching Aids . . . . . . . . . . 04
Ginn . . . . . . . . . . 05
Harcourt, Brace, & Jovanovich . . . . . . . . . . 06
D. C. Heath . . . . . . . . . . 07
Holt, Rinehart, Winston . . . . . . . . . . 08
Houghton Mifflin . . . . . . . . . . 09
Laidlaw Brothers . . . . . . . . . . 10
Macmillan . . . . . . . . . . 11
McGraw Hill . . . . . . . . . . 12
Merrill . . . . . . . . . . 13
Scott, Foresman . . . . . . . . . . 14
Silver Burdett . . . . . . . . . . 15
Open Court . . . . . . . . . . 16
Prentice Hall . . . . . . . . . . 17
Riverside . . . . . . . . . . 18
Other *(please specify* ______________*)* . . . 19

**20. Indicate the title, author, and most recent copyright date of this textbook/program.**

Title: ______________________

Author: ______________________

Most recent copyright date: __________

**21. Approximately what percentage of the textbook will you "cover" in this course?**

**(Circle one.)**

Less than 25% . . . . . . . . . . 1
25-49% . . . . . . . . . . 2
50-74% . . . . . . . . . . 3
75-90% . . . . . . . . . . 4
More than 90% . . . . . . . . . . 5

22. **Please give us your opinion about each of the following statements related to the textbook you are using most often in this class.**

**(Circle one on each line.)**

| **This textbook:** | **Strongly Agree** | **Agree** | **No Opinion** | **Disagree** | **Strongly Disagree** |
|---|---|---|---|---|---|
| a. Is at an appropriate reading level for most of my students | 1 | 2 | 3 | 4 | 5 |
| b. Is not very interesting to my students | 1 | 2 | 3 | 4 | 5 |
| c. Is unclear and disorganized | 1 | 2 | 3 | 4 | 5 |
| d. Helps develop problem-solving skills | 1 | 2 | 3 | 4 | 5 |
| e. Needs more exercises for practice of skills | 1 | 2 | 3 | 4 | 5 |
| f. Explains concepts clearly | 1 | 2 | 3 | 4 | 5 |
| g. Provides good suggestions for activities and assignments | 1 | 2 | 3 | 4 | 5 |
| h. Needs more examples of the applications of mathematics | 1 | 2 | 3 | 4 | 5 |
| i. Provides good suggestions for use of calculators | 1 | 2 | 3 | 4 | 5 |
| j. Provides good suggestions for use of computers | 1 | 2 | 3 | 4 | 5 |
| k. Has high quality supplementary materials | 1 | 2 | 3 | 4 | 5 |

23. **Indicate the persons or groups who helped determine that you would use this particular textbook in this mathematics class.**

**(Circle all that apply.)**

I did .......... 1
The principal .......... 2
A group of teachers from this school .......... 3
A district-wide textbook adoption committe .......... 4
A state-wide textbook adoption committee .......... 5
Other *(please specify* ______________________*)* ... 6

24. **If you are using any materials instead of, or in addition to, a published textbook or program, briefly describe below.**

______________________________________________

______________________________________________

______________________________________________

25. **Do you use calculators in this mathematics class?**

**(Circle one.)**

Yes .......... 1 → *Go to Question 26*
No .......... 2 → *Go to Question 27*

26. **How are calculators used in this mathematics class?**

**(Circle all that apply.)**

Checking answers .......... 1
Doing computations .......... 2
Solving problems .......... 3
Taking tests .......... 4

**27. Which best describes the availability of computers (microcomputers or terminals to mini/mainframe) for use in teaching mathematics to this class?**

**(Circle one.)**

Not available ........ 1 → *Skip to Question 30*

Available but quite difficult to access ........ 2

Available but somewhat difficult to access ........ 3

Readily available ........ 4

**28. How does this class use computers in its mathematics lessons?**
**If not used, check here ☐ and skip to Question 30.**

**(Circle all that apply.)**

Teacher demonstrating computer use ........ 1

Writing programs ........ 2

Learning mathematics content ........ 3

Drill and practice ........ 4

Using simulations ........ 5

Problem solving ........ 6

Using computer graphics ........ 7

Games ........ 8

Testing and evaluation ........ 9

Other *(please specify ____________________)* ........ 10

**29. During the *last week* of instruction, how many minutes did a typical student spend working with computers as part of this mathematics class?**

**(Circle one.)**

None ........ 1

1-14 minutes ........ 2

15-29 minutes ........ 3

30-44 minutes ........ 4

45-60 minutes ........ 5

More than 60 minutes ........ 6

30. **Think about your plans for this mathematics class for the entire year. How much emphasis will each of the following *objectives* receive in your mathematics instruction?**

**(Circle one on each line.)**

| | None | Minimal Emphasis | | Moderate Emphasis | | Very Heavy Emphasis |
|---|---|---|---|---|---|---|
| a. Become interested in mathematics | 1 | 2 | 3 | 4 | 5 | 6 |
| b. Know mathematical facts, principles, algorithms, or procedures | 1 | 2 | 3 | 4 | 5 | 6 |
| c. Prepare for further study in mathematics | 1 | 2 | 3 | 4 | 5 | 6 |
| d. Develop inquiry skills | 1 | 2 | 3 | 4 | 5 | 6 |
| e. Develop a systematic approach to solving problems | 1 | 2 | 3 | 4 | 5 | 6 |
| f. Learn to effectively communicate ideas in mathematics | 1 | 2 | 3 | 4 | 5 | 6 |
| g. Perform computations with speed and accuracy | 1 | 2 | 3 | 4 | 5 | 6 |
| h. Become aware of the importance of mathematics in daily life | 1 | 2 | 3 | 4 | 5 | 6 |
| i. Learn about applications of mathematics in technology | 1 | 2 | 3 | 4 | 5 | 6 |
| j. Learn about the career relevance of mathematics | 1 | 2 | 3 | 4 | 5 | 6 |
| k. Learn about the history of mathematics | 1 | 2 | 3 | 4 | 5 | 6 |

## SECTION D: YOUR MOST RECENT MATHEMATICS LESSON IN THIS CLASS

Please answer the following questions specific to *your most recent mathematics lesson* in this class. Do not be concerned if this lesson was not typical of instruction in this class.

31. a. **How many minutes were allocated for that mathematics lesson?** ________

b. **Of these, how many were spent on the following:**

Daily routines, interruptions, and other non-instructional activities ________

The teacher working with the entire class as a group (e.g., lecture, test, etc.) ________

The teacher working with small groups of students ________

The teacher supervising students working on individual activities ________

Total ________

(Should be the same as Question 31a)

32. **Did that lesson take place on the most recent day your school was in session?**

**(Circle one.)**

Yes ........ 1
No ........ 2

**33. Indicate the activities that took place during that mathematics lesson.**

**(Circle all that apply.)**

| | |
|---|---|
| Lecture | 1 |
| Discussion | 2 |
| Student use of calculators | 3 |
| Student use of computers | 4 |
| Student use of hands-on or manipulative materials | 5 |
| Students doing seatwork assigned from textbook | 6 |
| Students completing supplemental worksheets | 7 |
| Assigning homework | 8 |
| Test or quiz | 9 |

## SECTION E: TEACHER PREPARATION

**34. Indicate the degrees you hold. Then indicate your major area of study for each degree using the list of code numbers to the right. Space has been provided for you to enter a code number for a second bachelor's or master's degree. Enter more than one code number on the same line only if you had a double major.**

**If no degree, check here ☐ and go on to Question 35.**

| Degree | (Circle all that apply.) | Specify Major Area Code No. |
|---|---|---|
| Associate | 1 | ______ |
| Bachelor's | 2 | ______ |
| 2nd Bachelor's | | ______ |
| Master's | 3 | ______ |
| 2nd Master's | | ______ |
| Specialist or 6-year certificate | 4 | ______ |
| Doctorate | 5 | ______ |

**MAJOR AREA CODE NUMBERS**

**EDUCATION**
- 11 Elementary education
- 12 Middle school education
- 13 Secondary education
- 14 Mathematics education
- 15 Science education
- 16 Other education

**MATHEMATICS/COMPUTER SCIENCE**
- 21 Mathematics
- 22 Computer science

**SCIENCE**
- 31 Biology, environmental, life sciences
- 32 Chemistry
- 33 Physics
- 34 Physical science
- 35 Earth/space sciences

**OTHER DISCIPLINES**
- 41 History, English, foreign language, etc.

35. **Indicate the categories in which you have completed one or more college courses.**

**EDUCATION** **(Circle all that apply.)**

| | |
|---|---|
| General methods of teaching | 1 |
| Methods of teaching elementary school mathematics | 2 |
| Methods of teaching middle school mathematics | 3 |
| Methods of teaching secondary school mathematics | 4 |
| Supervised student teaching | 5 |
| Instructional uses of computers | 6 |
| Psychology, human development | 7 |

**SCIENCE**

| | |
|---|---|
| Biology, environmental, life sciences | 8 |
| Chemistry | 9 |
| Physics | 10 |
| Physical science | 11 |
| Earth/space sciences | 12 |
| Engineering | 13 |

**MATHEMATICS/COMPUTER SCIENCE**

| | |
|---|---|
| Mathematics for elementary school teachers | 14 |
| Mathematics for middle school teachers | 15 |
| Geometry for elementary or middle school teachers | 16 |
| College algebra, trigonometry, elementary functions | 17 |
| Calculus | 18 |
| Upper division geometry | 19 |
| Probability and statistics | 20 |
| Computer programming | 21 |

36. **What type of state teaching certification do you have?**

**(Circle one.)**

| | | |
|---|---|---|
| Not certified | 1 | → *Skip to Question 38* |
| Provisional (lacking some requirements) | 2 | |
| Regular, lifetime, or other certification in *any* subject | 3 | |

37. **In which subject areas do you have state teaching certification?**

**(Circle all that apply.)**

| | |
|---|---|
| Elementary education *(please specify grades: __________)* | 1 |
| Middle school education *(please specify grades: __________)* | 2 |
| General science | 3 |
| Biology, environmental, life sciences | 4 |
| Earth/space sciences | 5 |
| Physical sciences | 6 |
| Chemistry | 7 |
| Physics | 8 |
| Mathematics | 9 |
| Computer science | 10 |
| Business | 11 |
| Reading, language arts, English | 12 |
| Physical education, health | 13 |
| Social studies, history | 14 |
| Foreign language | 15 |
| Other *(please specify ____________________)* | 16 |

## SECTION F: IN-SERVICE EDUCATION IN MATHEMATICS

**38. During the *last 12 months*, what is the *total* amount of time you have spent on in-service education in mathematics or the teaching of mathematics? (Include attendance at professional meetings, workshops, and conferences, but do *not* include formal courses for which you received college credit.)**

**(Circle one.)**

None ........................ 1 — *Skip to Question 40*
Less than 6 hours ............. 2
6-15 hours ................... 3
16-35 hours .................. 4
More than 35 hours ........... 5

**39. What type(s) of support have you received?**

**(Circle all that apply.)**

None ............................................ 1
Released time from teaching ..................... 2
Travel and/or per diem expenses ................. 3
Stipends ........................................ 4
Professional growth credits ..................... 5
Other (*please specify* ______________________) ...... 6

**40. If an in-service program that interested you were available, how likely would you be to attend if it were offered at the following times?**

**(Circle one on each line.)**

| | Not Likely | Somewhat Likely | Very Likely |
|---|---|---|---|
| a. After school | 1 | 2 | 3 |
| b. Evenings | 1 | 2 | 3 |
| c. Saturdays | 1 | 2 | 3 |
| d. Summers | 1 | 2 | 3 |
| e. Teacher work days | 1 | 2 | 3 |

**41. In what year did you last take a course *for college credit* in mathematics or the teaching of mathematics?** ______

**42. Think about a specific mathematics topic that you would find difficult to teach.**

**a. What is this topic?** ______________________________

**b. Which would be the *most* useful in helping you to teach that topic?**

**(Circle one.)**

Learning more about the basic concepts .................. 1
Learning more about applications of those concepts in daily life, technology, and careers ........ 2
Learning more about instructional materials/techniques .................. 3

43. **Suppose you wanted to find out about the research related to a topic (e.g., mathematics anxiety or sex differences in learning). How likely would you be to use each of the following sources of information?**

**(Circle one on each line.)**

| | Not Likely | Somewhat Likely | Very Likely |
|---|---|---|---|
| a. Other teacher(s) | 1 | 2 | 3 |
| b. Principals | 1 | 2 | 3 |
| c. Local mathematics specialists/coordinators | 1 | 2 | 3 |
| d. State Department personnel | 1 | 2 | 3 |
| e. Consultants | 1 | 2 | 3 |
| f. College courses | 1 | 2 | 3 |
| g. In-service programs | 1 | 2 | 3 |
| h. Meetings of professional organizations | 1 | 2 | 3 |
| i. Journals | 1 | 2 | 3 |
| j. Research reviews | 1 | 2 | 3 |
| k. Newspapers/magazines | 1 | 2 | 3 |
| l. Television/radio | 1 | 2 | 3 |
| m. Publishers and sales representatives | 1 | 2 | 3 |

44. **How adequately prepared do you feel to teach mathematics in a class that includes the following types of children with special needs?**

**(Circle one on each line.)**

| | Totally Unprepared | Somewhat Unprepared | Adequately Prepared | Well Prepared | Very Well Prepared |
|---|---|---|---|---|---|
| a. Physically handicapped | 1 | 2 | 3 | 4 | 5 |
| b. Mentally retarded | 1 | 2 | 3 | 4 | 5 |
| c. Learning disabled | 1 | 2 | 3 | 4 | 5 |

45. **What training have you received in educating handicapped children in the regular mathematics classroom?**

**(Circle all that apply.)**

| | |
|---|---|
| None | 1 |
| College course(s) | 2 |
| In-service workshop(s) | 3 |
| Other *(please specify* ______________________*)* | 4 |

46. **How adequately prepared do you feel to use computers as an instructional tool in teaching mathematics?**

**(Circle one.)**

| | |
|---|---|
| Totally unprepared | 1 |
| Somewhat unprepared | 2 |
| Adequately prepared | 3 |
| Well prepared | 4 |
| Very well prepared | 5 |

47. **What training have you received in the _instructional uses_ of computers?**

**(Circle all that apply.)**

| | |
|---|---|
| None | 1 |
| College coursework | 2 |
| Less than 3 days' in-service education | 3 |
| Three or more days' in-service education | 4 |
| Self-taught | 5 |
| Other *(please specify* ______________________*)* | 6 |

**48. To which of the following professional organizations do you currently belong?**
**If none, check here ☐ and go on to Question 49.**

**(Circle all that apply.)**

National Science Teachers Association . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1
State-level science education organization . . . . . . . . . . . . . . . . . . . . . . . . . . . 2
National Council of Teachers of Mathematics . . . . . . . . . . . . . . . . . . . . . . . . . 3
State-level mathematics education organization . . . . . . . . . . . . . . . . . . . . . . 4

International Reading Association . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5
National Association of Elementary School Teachers . . . . . . . . . . . . . . . . . . . 6
American Federation of Teachers . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7
National Education Association . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 8

Other *(please specify)* ______________________) . . . . . . . . . . . . . 9

**49. Please give us your opinion about each of the following statements.**

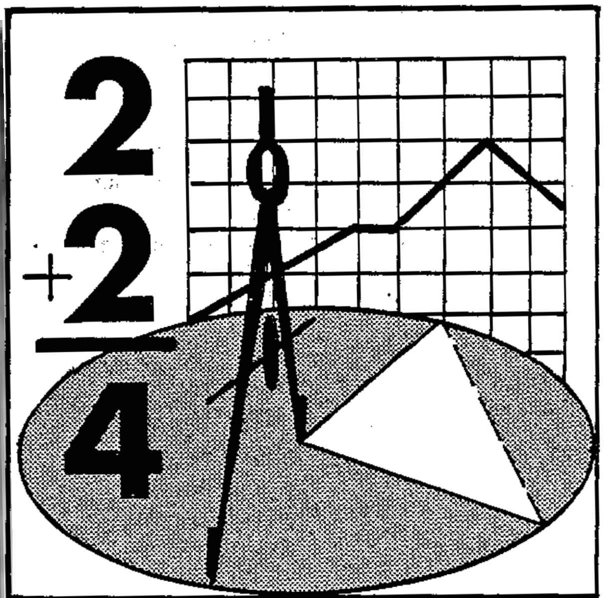
**(Circle one on each line.)**

| | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| a. I am in favor of differential pay for teachers in shortage areas such as mathematics | 1 | 2 | 3 | 4 | 5 |
| b. Mathematics is a difficult subject for children to learn | 1 | 2 | 3 | 4 | 5 |
| c. Prospective teachers should have to pass competency tests in the subjects they will teach | 1 | 2 | 3 | 4 | 5 |
| d. I would like an 11-month contract | 1 | 2 | 3 | 4 | 5 |
| e. My principal really does not understand the problems of teaching mathematics | 1 | 2 | 3 | 4 | 5 |
| f. Experienced teachers should be required to pass competency tests in the subjects they teach | 1 | 2 | 3 | 4 | 5 |
| g. I enjoy teaching mathematics | 1 | 2 | 3 | 4 | 5 |
| h. Industry mathematicians should be allowed to teach in the public schools | 1 | 2 | 3 | 4 | 5 |
| i. I consider myself a "master" mathematics teacher | 1 | 2 | 3 | 4 | 5 |

**50. When did you complete this questionnaire?** ________ (Month) ________ (Day) ________ (Year)

*THANK YOU FOR YOUR COOPERATION!*

# 1985 NATIONAL SURVEY SCIENCE & MATHEMATICS EDUCATION




## Teacher Questionnaire

Conducted by Research Triangle Institute
P.O. Box 12194 Research Triangle Park, NC 27709

If you have any questions, call Jennifer McNeill 800-334-8571

SM

Many educators have raised questions about how best to prepare young people for the challenges they will face in our increasingly technological society.

To help collect information on the status of science and mathematics education in our schools, the National Science Foundation sponsored a 1977 survey of teachers and principals. The purpose of the current study is to identify trends that have emerged since that time, and to suggest improvements that might be made in the future.

The topics to be covered in this study include science and mathematics course offerings and enrollments, availability of facilities and equipment, instructional techniques, textbook usage, teacher background, and needs for in-service education. Information will be collected from selected teachers and principals by printed questionnaire only—no classroom visits will be involved. Data will be kept strictly confidential, and will be reported only in aggregate form, such as by grade level, and by region. No individually identifying information will be released.

The 1985 National Survey of Science and Mathematics Education has been coordinated with the data collection efforts of the Department of Education, the National Assessment of Educational Progress, and the International Assessments of Science and Mathematics in order to avoid unnecessary duplication. The survey has also been endorsed by more than 20 professional organizations, whose names appear below.

Endorsed by:

American Association for the Advancement of Science (AAAS)
American Association of School Administrators (AASA)
American Association of Physics Teachers (AAPT)
American Chemical Society (ACS)
American Federation of Teachers (AFT)
American Institute of Biological Sciences (AIBS)
Association for Computing Machinery (ACM)
Association of State Supervisors of Mathematics (ASSM)
Council of Chief State School Officers (CCSSO)
Council of State Science Supervisors (CSSS)
National Association for Research in Science Teaching (NARST)
National Association of Biology Teachers (NABT)
National Association of Elementary School Principals (NAESP)
National Association of Geology Teachers (NAGT)
National Association of Secondary School Principals (NASSP)
National Catholic Education Association (NCEA)
National Council of Teachers of Mathematics (NCTM)
National Earth Science Teachers Association (NESTA)
National Education Association (NEA)
National Science Supervisors Association (NSSA)
National Science Teachers Association (NSTA)
School Science and Mathematics Association (SSMA)

## SECTION A: BACKGROUND INFORMATION

1. **Indicate your sex:**

| | (Circle one.) |
|---|---|
| Male . . . . . . . . . . . . . . . . . . . . . . . | 1 |
| Female . . . . . . . . . . . . . . . . . . . . . | 2 |

2. **Are you:**

| | (Circle one.) |
|---|---|
| White (not of Hispanic origin) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 1 |
| Black (not of Hispanic origin) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 2 |
| Hispanic . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 3 |
| American Indian or Alaskan Native . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 4 |
| Asian or Pacific Islander . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 5 |
| Other *(please specify* ______________________________ *)* . . . . . . . . . . . | 6 |

3. **How old are you?** __________

4. **How many years have you taught prior to this school year?** ________

5. **Indicate the number of years you have taught each of the following in any of grades 7-12 prior to this school year.**
   **If none, check here ☐ and go on to Question 6.**

   Mathematics, grades 7-12 ________

   Science, grades 7-12 ________

6. **Which of the following subjects have you taught *in the last three years?***
   **If you have not taught mathematics or science in the last three years, check here ☐ and go on to Question 7.**

| MATHEMATICS/COMPUTER SCIENCE | (Circle all that apply.) |
|---|---|
| Mathematics, grades 7-8 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 1 |
| Remedial, business, consumer, or general mathematics . . . . . . . . . . | 2 |
| Pre-algebra . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 3 |
| Algebra, 1st year . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 4 |
| Algebra, 2nd year . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 5 |
| Geometry . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 6 |
| Calculus, advanced mathematics . . . . . . . . . . . . . . . . . . . . . . . . . . | 7 |
| Computer literacy, programming . . . . . . . . . . . . . . . . . . . . . . . . . . | 8 |
| **SCIENCE** | |
| General science . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 9 |
| Biology, environmental, life sciences . . . . . . . . . . . . . . . . . . . . . . . | 10 |
| Chemistry . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 11 |
| Physics . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 12 |
| Physical science . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 13 |
| Earth/space sciences . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 14 |

## SECTION B: MATHEMATICS INSTRUCTION IN YOUR SCHOOL

7. Do you teach in a self-contained classroom, i.e., are you responsible for teaching all or most academic subjects to one class?

(Circle one.)

Yes ........................ 1 *Specify grade level(s) ________ then go to Question 8*

No ........................ 2 *→ Go to Question 9*

8. We are interested in knowing how much time your students spend studying various subjects. In a typical week, how many days do you have lessons on each of the following subjects, and how many minutes long is an average lesson? (Please write "0" if you do not teach a particular subject to this class.)

| | Number of Days per Week | Approximate Number of Minutes per Day |
|---|---|---|
| 1. Mathematics | ____ | ____ |
| 2. Science | ____ | ____ |
| 3. Social studies | ____ | ____ |
| 4. Reading | ____ | ____ |

*Go to Question 10*

9. For each class period you are currently teaching, indicate the course title and the enrollment by grade. Then indicate the code number from the enclosed blue "List of Course Titles" that best describes the content of each course.

| Class | Course Title | Number of Students in Class by Grade: 7 | 8 | 9 | 10 | 11 | 12 | Total | Course Code Number |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |

10. Are you currently teaching any course(s) that are outside your major area of certification? If yes, write in the course code number(s) from the blue list.

(Circle one.) Course Code No.

Yes ........................ 1 *Please specify:* a. ____________

No ........................ 2

b. ____________

c. ____________

## List of Course Titles

| Subject Area | Code Number | Course Title |
|---|---|---|
| Science | 101 | Life science |
| | 102 | Earth science |
| | 103 | Physical science |
| | 104 | General science, grade 7 |
| | 105 | General science, grade 8 |
| | 106 | General science, grade 9 |
| | 107 | General science, grades 10-12 |
| | 108 | Biology, 1st year |
| | 109 | Chemistry, 1st year |
| | 110 | Physics, 1st year |
| | 111 | Biology, 2nd year |
| | 112 | Chemistry, 2nd year |
| | 113 | Physics, 2nd year |
| | 114 | Astronomy |
| | 115 | Anatomy |
| | 116 | Physiology |
| | 117 | Zoology |
| | 118 | Ecology, environmental science |
| | 119 | Other science |
| Mathematics | 201 | Mathematics, grade 7 |
| | 202 | Mathematics, grade 8 |
| | 203 | General mathematics, grade 9 |
| | 204 | General mathematics, grades 10-12 |
| | 205 | Business mathematics |
| | 206 | Consumer mathematics |
| | 207 | Remedial mathematics |
| | 208 | Pre-algebra/introduction to algebra |
| | 209 | Algebra, 1st year |
| | 210 | Algebra, 2nd year |
| | 211 | Geometry |
| | 212 | Trigonometry |
| | 213 | Probability/statistics |
| | 214 | Advanced senior mathematics, not including calculus |
| | 215 | Advanced senior mathematics, including some calculus |
| | 216 | Calculus |
| | 217 | Advanced placement calculus |
| | 218 | Other mathematics |
| Computer Science | 301 | Computer awareness or literacy |
| | 302 | Applications and implications of computers |
| | 303 | Introductory computer programming |
| | 304 | Advanced computer programming |
| | 305 | Advanced placement computer science |
| | 306 | Other computer science |
| Other | 401 | Social studies, history |
| | 402 | English, language arts, reading |
| | 403 | Business, vocational education |
| | 404 | Foreign languages |
| | 405 | Health, physical education |
| | 406 | Art, music, drama |
| | 407 | Other subject |

11. **Are you currently teaching any course(s) that you *do not feel adequately qualified* to teach? If yes, write in the course code number(s) from the blue list.**

(Circle one.) — Course Code No.

Yes ........................ 1 *Please specify:* a. ____________

No ........................ 2 b. ____________

c. ____________

12. a. **In the last year, have you received any assistance (e.g., curriculum materials, guest speakers, support to attend workshops, etc.) *from private industry?***

(Circle one.)

Yes ........................ 1 → *Go to Question 12b*

No ........................ 2 } → *Go to Question 13*

Not sure .................... 3 }

b. **Indicate the type(s) of assistance you have received.**

(Circle all that apply.)

Curriculum materials ........................ 1

Equipment ........................ 2

Guest speakers ........................ 3

Travel/stipends to attend professional meetings ........................ 4

Teacher awards/scholarships ........................ 5

Teacher summer employment ........................ 6

Other *(please specify* ____________ *)* .......... 7

13. **The following factors may affect mathematics instruction *in your school as a whole.* In your opinion, how great a problem is caused by each of the following?**

(Circle one on each line.)

| | | Serious Problem | Somewhat of a Problem | Not a Significant Problem |
|---|---|---|---|---|
| a. | Belief that mathematics is less important than other subjects | 1 | 2 | 3 |
| b. | Inadequate facilities | 1 | 2 | 3 |
| c. | Insufficient funds for purchasing equipment and supplies | 1 | 2 | 3 |
| d. | Lack of materials for individualizing instruction | 1 | 2 | 3 |
| e. | Insufficient numbers of textbooks | 1 | 2 | 3 |
| f. | Poor quality of textbooks | 1 | 2 | 3 |
| g. | Inadequate access to computers | 1 | 2 | 3 |
| h. | Lack of student interest in mathematics | 1 | 2 | 3 |
| i. | Inadequate student reading abilities | 1 | 2 | 3 |
| j. | Lack of teacher interest in mathematics | 1 | 2 | 3 |
| k. | Teachers inadequately prepared to teach mathematics | 1 | 2 | 3 |
| l. | Student absences | 1 | 2 | 3 |
| m. | Lack of teacher planning time | 1 | 2 | 3 |
| n. | Not enough time to teach mathematics | 1 | 2 | 3 |
| o. | Class sizes too large | 1 | 2 | 3 |
| p. | Difficulty in maintaining discipline | 1 | 2 | 3 |
| q. | Inadequate articulation of instruction across grade levels | 1 | 2 | 3 |
| r. | Inadequate diversity of mathematics electives | 1 | 2 | 3 |
| s. | Low enrollments in mathematics courses | 1 | 2 | 3 |

## SECTION C: YOUR MATHEMATICS TEACHING IN A PARTICULAR CLASS

The questions in Sections C and D relate to *your mathematics teaching* in a particular class. Please consult the label on the front of this questionnaire to determine the randomly selected mathematics class for which these questions should be answered.

**14. a. What is the title of this course?** ______________________________

**b. Using the blue "List of Course Titles," indicate the code number that best describes the content of this course.**

__________

**15. a. How many students are there in this class?** ________

**b. Please indicate the number of students in this class in each race/sex category:**

| | **Male** | **Female** |
|---|---|---|
| White (not of Hispanic origin) | ________ | ________ |
| Black (not of Hispanic origin) | ________ | ________ |
| Hispanic | ________ | ________ |
| American Indian or Alaskan Native | ________ | ________ |
| Asian or Pacific Islander | ________ | ________ |
| Other *(please specify* ______________________) | ________ | ________ |
| Total | ________ | ________ |

Note: The total number of males and females should be the same as the number of students in Question 15a.

**16. What is the duration of this course?**

**(Circle one.)**

Year . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1
Semester . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2
Quarter . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3
Other *(please specify* ______________________) . . . . . . . . . 4

**17. Which of the following best describes the ability makeup of this class? (Comparison should be with the average student in the grade.)**

**(Circle one.)**

Primarily high ability students . . . . . . . . . . . . . . . . . . 1
Primarily low ability students . . . . . . . . . . . . . . . . . . 2
Primarily average ability students . . . . . . . . . . . . . . . 3
Students of widely differing ability levels . . . . . . . . . . 4

**18. On the average, how many minutes of mathematics homework do you expect the typical student in this class to complete each day?**

________ minutes/day

**19. Are there any professional magazines or journals which you find particularly helpful in teaching mathematics to this class?**

**(Circle one.)**

Yes . . . . . . . . . . . . . . . . . . . . . . . . 1 *Please specify:* a. ____________

No . . . . . . . . . . . . . . . . . . . . . . . . . 2 b. ____________

c. ____________

**20. Are you using one or more published textbooks or programs for teaching mathematics to this class?**

**(Circle one.)**

Yes . . . . . . . . . . . . . . . . . . . . . . . . 1 → *Go to Question 22*

No . . . . . . . . . . . . . . . . . . . . . . . . . 2 → *Go to Question 21*

**21. Why did you choose not to use a textbook?**

**(Circle all that apply.)**

I prefer to teach without a textbook . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1

I did not like the textbook assigned to this class . . . . . . . . . . . . . . . . . . . . . . 2

Available textbooks were not appropriate for this class . . . . . . . . . . . . . . . . . . 3

There were insufficient funds to purchase textbooks . . . . . . . . . . . . . . . . . . . 4

Other *(specify* ______________________________ . . . . . . . . . . . . . 5

______________________________*)*

*Go to Question 27*

**22. Indicate the publisher of the <u>one</u> textbook/program used most often by the students in this class.**

**(Circle one.)**

Addison-Wesley . . . . . . . . . . . . . . . . . . . . . . . . . . . . 01

Allyn & Bacon . . . . . . . . . . . . . . . . . . . . . . . . . . . . 02

American Book . . . . . . . . . . . . . . . . . . . . . . . . . . . . 03

Anaheim . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 04

Educational Teaching Aids . . . . . . . . . . . . . . . . . . . 05

Ginn . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 06

Harcourt, Brace, & Jovanovich . . . . . . . . . . . . . . . . 07

D. C. Heath . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 08

Holt, Rinehart, Winston . . . . . . . . . . . . . . . . . . . . . 09

Houghton Mifflin . . . . . . . . . . . . . . . . . . . . . . . . . . 10

Laidlaw Brothers . . . . . . . . . . . . . . . . . . . . . . . . . . 11

Macmillan . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 12

McGraw Hill . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 13

Merrill . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 14

Open Court . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15

Prentice Hall . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 16

Riverside . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 17

Scott, Foresman . . . . . . . . . . . . . . . . . . . . . . . . . . . 18

Silver Burdett . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 19

Wadsworth . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 20

Other *(please specify* ______________*)* . . . 21

**23. Indicate the title, author, and most recent copyright date of this textbook/program.**

Title: ______________________________

Author: ______________________________

Most recent copyright date: ____________

24. **Approximately what percentage of the textbook will you "cover" in this course?**

(Circle one.)

| | |
|---|---|
| Less than 25% | 1 |
| 25-49% | 2 |
| 50-74% | 3 |
| 75-90% | 4 |
| More than 90% | 5 |

25. **Please give us your opinion about each of the following statements related to the textbook you are using most often in this class.**

(Circle one on each line.)

| This textbook: | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| a. Is at an appropriate reading level for most of my students | 1 | 2 | 3 | 4 | 5 |
| b. Is not very interesting to my students | 1 | 2 | 3 | 4 | 5 |
| c. Is unclear and disorganized | 1 | 2 | 3 | 4 | 5 |
| d. Helps develop problem-solving skills | 1 | 2 | 3 | 4 | 5 |
| e. Needs more exercises for practice of skills | 1 | 2 | 3 | 4 | 5 |
| f. Explains concepts clearly | 1 | 2 | 3 | 4 | 5 |
| g. Provides good suggestions for activities and assignments | 1 | 2 | 3 | 4 | 5 |
| h. Needs more examples of the applications of mathematics | 1 | 2 | 3 | 4 | 5 |
| i. Provides good suggestions for use of calculators | 1 | 2 | 3 | 4 | 5 |
| j. Provides good suggestions for use of computers | 1 | 2 | 3 | 4 | 5 |
| k. Has high quality supplementary materials | 1 | 2 | 3 | 4 | 5 |

26. **Indicate the persons or groups who helped determine that you would use this particular textbook in this mathematics class.**

(Circle all that apply.)

| | |
|---|---|
| I did | 1 |
| The principal | 2 |
| A group of teachers from this school | 3 |
| A district-wide textbook adoption committe | 4 |
| A state-wide textbook adoption committee | 5 |
| Other *(please specify* ______________________) | 6 |

27. **If you are using any materials instead of, or in addition to, a published textbook or program, briefly describe below.**

______________________________________________

______________________________________________

______________________________________________

**28. Do you use calculators in this mathematics class?**

**(Circle one.)**

Yes ........................ 1 – *Go to Question 29*

No ........................ 2 – *Go to Question 30*

**29. How are calculators used in this mathematics class?**

**(Circle all that apply.)**

Checking answers ............ 1

Doing computations ........... 2

Solving problems ............. 3

Taking tests .................. 4

**30. Which best describes the availability of computers (microcomputers or terminals to mini/mainframe) for use with this mathematics class?**

**(Circle one.)**

Not available ............................................ 1 – *Skip to Question 33*

Available but quite difficult to access ............................ 2

Available but somewhat difficult to access ........................ 3

Readily available ............................................ 4

**31. How does this mathematics class use computers?**
**If not used, check here ☐ and skip to Question 33.**

**(Circle all that apply.)**

Teacher demonstrating computer use ................................ 1

Writing programs ............................................ 2

Learning mathematics content ................................ 3

Drill and practice ............................................ 4

Using simulations ............................................ 5

Problem solving ............................................ 6

Using computer graphics ...................................... 7

Games ............................................ 8

Testing and evaluation ...................................... 9

Other *(please specify* ______________________________*)* ......... 10

**32. During the *last week* of instruction, how many minutes did a typical student spend working with computers as part of this mathematics class?**

**(Circle one.)**

None ....................... 1

1-14 minutes ................. 2

15-29 minutes ................ 3

30-44 minutes ................ 4

45-60 minutes ................ 5

More than 60 minutes ......... 6

**38. Indicate the categories in which you have completed one or more college courses.**

**EDUCATION** (Circle all that apply.)

| | |
|---|---|
| General methods of teaching | 1 |
| Methods of teaching elementary school mathematics | 2 |
| Methods of teaching middle school mathematics | 3 |
| Methods of teaching secondary school mathematics | 4 |
| Supervised student teaching | 5 |
| Instructional uses of computers | 6 |
| Psychology, human development | 7 |

**MATHEMATICS/COMPUTER SCIENCE**

| | |
|---|---|
| College algebra, trigonometry, elementary functions | 8 |
| Calculus | 9 |
| Advanced calculus | 10 |
| Differential equations | 11 |
| Geometry | 12 |
| Probability and statistics | 13 |
| Abstract algebra/number theory | 14 |
| Linear algebra | 15 |
| Applications of mathematics/problem solving | 16 |
| History of mathematics | 17 |
| Other upper division mathematics | 18 |
| Computer programming | 19 |

**SCIENCE**

| | |
|---|---|
| Biological sciences | 20 |
| Chemistry | 21 |
| Physics | 22 |
| Physical science | 23 |
| Earth/space sciences | 24 |
| Engineering | 25 |

**39. For each of the following subject areas, indicate the number of courses you have completed. Count each course you have taken, regardless of whether it was a semester hour, quarter hour, graduate, or undergraduate course. If your transcripts are not available, provide your best estimates.**

| Subject Area | Circle the number of courses you have completed. | | | | | |
|---|---|---|---|---|---|---|
| Methods of teaching mathematics | 0 | 1 | 2 | 3 | 4 | ≥5 |
| Calculus | 0 | 1 | 2 | 3 | 4 | ≥5 |
| Computer science | 0 | 1 | 2 | 3 | 4 | ≥5 |

**40. What type of state teaching certification do you have?**

(Circle one.)

| | | |
|---|---|---|
| Not certified | 1 | — *Skip to Question 42* |
| Provisional (lacking some requirements) | 2 | |
| Regular, lifetime, or other certification in *any* subject | 3 | |

41. **In which subject areas do you have state teaching certification?**

**(Circle all that apply.)**

Elementary education *(please specify grades: __________)* ............ 1

Middle school education *(please specify grades: __________)* .......... 2

General science ............................................. 3
Biology, environmental, life sciences ................................ 4
Earth/space sciences ............................................. 5

Physical sciences ............................................. 6
Chemistry ............................................. 7
Physics ............................................. 8

Mathematics ............................................. 9
Computer science ............................................. 10
Business ............................................. 11

English, language arts, reading ................................ 12
Physical education, health ................................ 13
Social studies, history ................................ 14
Foreign language ................................ 15

Other *(please specify ______________________________)* ...... 16

## SECTION F: IN-SERVICE EDUCATION IN MATHEMATICS

42. **During the *last 12 months*, what is the *total* amount of time you have spent on in-service education in mathematics or the teaching of mathematics? (Include attendance at professional meetings, workshops, and conferences, but do *not* include formal courses for which you received college credit.)**

**(Circle one.)**

None ........................ 1 — *Skip to Question 44*
Less than 6 hours ............. 2
6-15 hours .................. 3
16-35 hours .................. 4
More than 35 hours ........... 5

43. **What type(s) of support have you received?**

**(Circle all that apply.)**

None ............................................. 1
Released time from teaching ................................ 2
Travel and/or per diem expenses ................................ 3
Stipends ............................................. 4
Professional growth credits ................................ 5
Other *(please specify ______________________________)* ...... 6

44. If an in-service program that interested you were available, how likely would you be to attend if it were offered at the following times?

(Circle one on each line.)

| | Not Likely | Somewhat Likely | Very Likely |
|---|---|---|---|
| a. After school | 1 | 2 | 3 |
| b. Evenings | 1 | 2 | 3 |
| c. Saturdays | 1 | 2 | 3 |
| d. Summers | 1 | 2 | 3 |
| e. Teacher work days | 1 | 2 | 3 |

45. In what year did you last take a course *for college credit* in mathematics or the teaching of mathematics? ______

46. Think about a specific mathematics topic that you would find difficult to teach.

a. What is this topic? ______________________________

b. Which would be the *most* useful in helping you to teach that topic?

(Circle one.)

| | |
|---|---|
| Learning more about the basic concepts | 1 |
| Learning more about applications of those concepts in daily life, technology, and careers | 2 |
| Learning more about instructional materials/techniques | 3 |

47. Suppose you wanted to find out about the research related to a topic (e.g., mathematics anxiety or sex differences in learning). How likely would you be to use each of the following sources of information?

(Circle one on each line.)

| | Not Likely | Somewhat Likely | Very Likely |
|---|---|---|---|
| a. Other teacher(s) | 1 | 2 | 3 |
| b. Principals | 1 | 2 | 3 |
| c. Local mathematics specialists/coordinators | 1 | 2 | 3 |
| d. State Department personnel | 1 | 2 | 3 |
| e. Consultants | 1 | 2 | 3 |
| f. College courses | 1 | 2 | 3 |
| g. In-service programs | 1 | 2 | 3 |
| h. Meetings of professional organizations | 1 | 2 | 3 |
| i. Journals | 1 | 2 | 3 |
| j. Research reviews | 1 | 2 | 3 |
| k. Newspapers/magazines | 1 | 2 | 3 |
| l. Television/radio | 1 | 2 | 3 |
| m. Publishers and sales representatives | 1 | 2 | 3 |

48. How adequately prepared do you feel to teach mathematics in a class that includes the following types of children with special needs?

(Circle one on each line.)

| | Totally Unprepared | Somewhat Unprepared | Adequately Prepared | Well Prepared | Very Well Prepared |
|---|---|---|---|---|---|
| a. Physically handicapped | 1 | 2 | 3 | 4 | 5 |
| b. Mentally retarded | 1 | 2 | 3 | 4 | 5 |
| c. Learning disabled | 1 | 2 | 3 | 4 | 5 |

**49.** **What training have you received in educating handicapped children in the regular mathematics classroom?**

**(Circle all that apply.)**

| | |
|---|---|
| None | 1 |
| College course(s) | 2 |
| In-service workshop(s) | 3 |
| Other *(please specify* ______________________) | 4 |

**50.** **How adequately prepared do you feel to use computers as an instructional tool with your mathematics classes?**

**(Circle one.)**

| | |
|---|---|
| Totally unprepared | 1 |
| Somewhat unprepared | 2 |
| Adequately prepared | 3 |
| Well prepared | 4 |
| Very well prepared | 5 |

**51.** **What training have you received in the *instructional uses* of computers?**

**(Circle all that apply.)**

| | |
|---|---|
| None | 1 |
| College coursework | 2 |
| Less than 3 days' in-service education | 3 |
| Three or more days' in-service education | 4 |
| Self-taught | 5 |
| Other *(please specify* ______________________) | 6 |

**52.** **To which of the following professional organizations do you currently belong?**
**If none, check here ☐ and go on to Question 53.**

**(Circle all that apply.)**

| | |
|---|---|
| Association for Computing Machinery | 1 |
| Association for Educational Data Systems | 2 |
| Mathematical Association of America | 3 |
| National Council of Teachers of Mathematics | 4 |
| Society of Industrial and Applied Mathematics | 5 |
| School Science and Mathematics Association | 6 |
| State-level mathematics education organization | 7 |
| American Association of Physics Teachers | 8 |
| American Chemical Society | 9 |
| National Association of Biology Teachers | 10 |
| National Association of Geology Teachers | 11 |
| National Earth Science Teachers Association | 12 |
| National Science Teachers Association | 13 |
| State-level science education organization | 14 |
| American Federation of Teachers | 15 |
| National Education Association | 16 |
| Other *(please specify)* ______________________) | 17 |

53. Please give us your opinion about each of the following statements.

(Circle one on each line.)

| | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| a. I am in favor of differential pay for teachers in shortage areas such as mathematics | 1 | 2 | 3 | 4 | 5 |
| b. Mathematics is a difficult subject for children to learn | 1 | 2 | 3 | 4 | 5 |
| c. Prospective teachers should have to pass competency tests in mathematics | 1 | 2 | 3 | 4 | 5 |
| d. I would like an 11-month contract | 1 | 2 | 3 | 4 | 5 |
| e. My principal really does not understand the problems of teaching mathematics | 1 | 2 | 3 | 4 | 5 |
| f. Experienced teachers should be required to pass competency tests in mathematics | 1 | 2 | 3 | 4 | 5 |
| g. I enjoy teaching mathematics | 1 | 2 | 3 | 4 | 5 |
| h. Industry mathematicians should be allowed to teach in the public schools | 1 | 2 | 3 | 4 | 5 |
| i. I consider myself a "master" mathematics teacher | 1 | 2 | 3 | 4 | 5 |

54. When did you complete this questionnaire? ________ (Month) ________ (Day) ________ (Year)

*THANK YOU FOR YOUR COOPERATION!*