

THE BAYER FACTS OF SCIENCE EDUCATION X:

*Are the Nation's Colleges and Universities
Adequately Preparing
Elementary Schoolteachers of Tomorrow
to Teach Science?*

EXECUTIVE SUMMARY

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Research Methods

Introduction and Methodology

The following report is based on the findings of a survey of deans of education at U.S. colleges and universities and America's newest generation of K-5 schoolteachers. The *Bayer Facts of Science Education X* survey, conducted by Market Research Institute, Inc., was commissioned by Bayer Corporation as part of its *Making Science Make Sense* program.

The decade-long *Bayer Facts of Science Education* survey series is an ongoing annual public opinion research project that examines various science literacy and science education issues. It is one component of Bayer's companywide *Making Science Make Sense* initiative that seeks to advance science literacy across the U.S. through hands-on, inquiry-based science learning, employee volunteerism and public education.

This year's study probes the two audiences to uncover whether or not the nation's colleges and universities are adequately preparing elementary schoolteachers of tomorrow to teach science to young students. Among other things, it asks both the new teachers and deans to evaluate their pre-service (college/university) training programs in science teaching compared to those for other core subjects, as well as the emphasis placed on science versus other subjects.

And, while the survey asks new teachers to look back to their college years, it also asks them to shed light on their current science teaching practices in the classroom. These questions are designed to see if and how attitudes about science teaching communicated to them in their pre-service training programs may have influenced how and to what extent they teach science today.

By eliciting the opinions of two different groups, the study is able to look at these issues from two different perspectives and provide something of a progress report on K-5 science education.

Results of both the education school deans' and new teachers' surveys are based on telephone interviews conducted between March 10, 2004, and April 2, 2004. To ensure the teacher sample was representative, MRI used random digit dialing to contact K-5 teachers included in a national list of K-12 teachers. The deans, too, were contacted via random digit dialing and identified from a national list of colleges and universities that have schools of education.

To ensure that elementary teachers have had enough time to evaluate their college pre-service preparation for teaching, but not so much time that they would forget their training, Marketing Research Institute interviewed elementary teachers with no less than three and no more than five years of teaching experience. In addition, all teachers must have indicated they teach multiple subjects to the same class of students all or most of the day, hold an undergraduate or graduate

degree and have taken at least one general teaching methods course. The following summarizes the profile of teachers interviewed.

100 % hold a bachelor's degree and, of those, an additional 28 % hold a master's degree.

The majority of the degrees earned were in elementary education (59%).

90% teach in public schools.

21% of the teachers taught kindergarten, 22% taught first grade, 14% second grade, 13% third grade, 13% fourth grade, 11% fifth grade and 6% taught multiple grades.

41% teach in rural areas, 35% in the suburbs, and 24% in urban schools.

19% of the teachers were located in the East, 30% in the Midwest, 36% in the South, and 15% in the West.

92% of the teachers surveyed were female.

59% were 22 to 34 years of age, 37% 35 to 49 and 4% were over 50.

To qualify for the dean survey, respondents must have been currently employed at an accredited four-year college or university and hold the title of Dean of School of Education or an equivalent primary leadership position which includes responsibility for their institutions' K-5 teacher education program. The following summarizes the profile of deans interviewed.

The titles held by respondents were: 54% Dean of School of Education, 25% Chair of the School of Education, and 21% Director of Education.

68% were from public colleges or universities and 32% from private.

74% were from universities and 26% from colleges.

46% graduate more than 100 teacher candidates each year. Also, the 250 deans represent better than 40,000 of the teacher candidates graduated each year.

51% of the respondents were male, 49% female.

A total of 1,000 interviews were conducted with elementary teachers which provides a confidence level of 95 percent, with a margin of error of +/- three percent. The 250 completed deans' interviews provides a confidence level of 95 percent, with a margin of error of +/- seven percent.

Combined, the surveys have a confidence level of 95 percent, with a margin of error of +/- three percent.

Key Findings

A PEEK INTO TODAY'S K-5 CLASSROOM

- Regardless of region of the country or type of school they teach in, overall elementary schoolteachers report they are three times more likely to teach English (95 %) and math (93%) every day than they are to teach science (35 %) and social studies (33 %). Roughly one-third (29 %) say they teach science twice a week or less.

More than eight in 10 teachers (82 %) say, overall, English receives the most emphasis, while science and social studies vie for least emphasis (25 % and 60 %, respectively) in their schools. Despite this, slightly more than half (53 %) believe science should be the “fourth R,” and have the same emphasis as reading, writing and math.

- Even more of the deans than teachers believe science should be the fourth R, with 77 % saying it should have the same emphasis as reading, writing and math.
- Most (57 %) of the teachers describe themselves as being very comfortable answering their students’ science questions, while the deans are not nearly as confident about teachers’ comfort levels. Only 31 % of the deans surveyed indicate they believe their elementary teacher graduates are very comfortable answering questions about science.

IS TODAY'S K-5 SCIENCE EDUCATION MAKING THE GRADE?

- Although the large majority (88 %) of teachers indicate they feel confident that their students are getting a good science education, with 44 % saying they are very confident and 44 % somewhat confident, deans don’t share this view. In fact, a mere 7 % of the deans say they are very confident that today’s K-5 students are getting a good science education and more than half (56 %) report being a little or not at all confident. A little more than one-third (37 %) say they are somewhat confident.

- Still, when teachers are asked not about their own students getting a good science education, but rather the more general question about their school's overall science education program, teachers' responses are not as positive. When asked to rate the quality of their school's science education overall, only 14 % assigned an A and nearly one-third (30 %) assigned a C or D. Fifty-six percent gave it a B or good rating.

QUALIFIED TO TEACH SCIENCE?

- Only 61% of teachers feel they are very qualified to teach science. They feel much more qualified to teach English and math. Perhaps this is not surprising since 71% of all teachers surveyed indicate they feel they are only somewhat, a little, or not at all science literate.
- Deans share this view and believe their graduating teacher candidates are more qualified to teach English (90%), math (78%), and social studies (69%) than they are science (60%).
- While 61 % of teachers say they are very qualified to teach science, only 44% say they are very confident that today's students are getting a good science education.

REPORT CARD ON PRE-SERVICE PREPARATION TO TEACH CORE SUBJECTS

- Overall, deans are much more positive than teachers about their institutions' performance in all areas of teacher preparation. However, when it comes to science preparation both deans and teachers are less positive than they are about other subjects. Specifically, many more deans give an A grade to their English and math teacher preparation (76 % and 56 %, respectively) than they do their science teaching preparation (40 %). Likewise, many more new teachers give an A grade to their English and math teacher preparation (39 % and 28 %, respectively) than they do to their science teaching preparation (18 %).

	K-5 Schoolteachers	Deans of Schools of Education
A	39 %	76 %
B	38 %	23 %
C, D or F	23 %	1 %

MATH

	K-5 Schoolteachers	Deans of Schools of Education
A	28 %	56 %
B	44 %	37 %
C, D or F	66 %	4 %

SCIENCE

	K-5 Schoolteachers	Deans of Schools of Education
A	18 %	40 %
B	41 %	53 %
C, D or F	42 %	7 %

SOCIAL STUDIES

	K-5 Schoolteachers	Deans of Schools of Education
A	15 %	44 %
B	36 %	48 %
C, D or F	49 %	8 %

PRE-SERVICE TEACHER EDUCATION AND SCIENCE

- The emphasis elementary teachers place on subjects in their classrooms today mirrors their experience in college/university. For example, in pre-service training programs, elementary teachers and deans agree that most of the time spent in general teaching methods courses was on English, followed by math, then science and lastly social studies. Specifically, 86% of teachers indicate they spent more time in their general teaching methods courses on English, then math (53%), then science third (53%) and lastly social studies (56%).

Nearly three-quarters (72 %) of deans say, overall, English receives the most emphasis, while science and social studies vie for least emphasis (26 % and 45 %, respectively) in their teacher preparation programs. However, teachers would like to have had more emphasis placed on science. In fact, science is cited by the most teachers (63 %) as the subject they wish had been given more emphasis during their pre-service training as compared to English (48 %), math (49 %) and social studies (60 %).

- In order to graduate with a major in elementary education, colleges and universities require their students to take additional courses over and above general bachelor's degree requirements in all the core subjects. However, more deans report requiring additional courses in Math (79 %) and English (76 %) than in science (68 %) and social studies (68 %).
- Both teachers (72 %) and deans (84 %) overwhelmingly agree that elementary teacher education programs should require their undergraduates to take more coursework both in science itself and in science teaching methods.
- While science clearly takes a back seat to English and math in pre-service training programs, six in 10 (62 %) of the deans report that at their institutions the emphasis on science education has increased in the last five years, and another six in 10 (61 %) predict it will continue to increase in the coming five years.

- Slightly more than one-third (35%) of new teachers indicate that when teaching their students science, they rely more on what they learned in their high school science courses than from their college science courses.

HANDS-ON SCIENCE LEARNING VS. TEXT-BOOK SCIENCE LEARNING

- What is the most effective way for K-5 students to learn science? Both deans and teachers overwhelmingly agree that it is NOT the traditional textbook-based, rote memorization approach. On the contrary, nearly all the deans (95 %) and teachers (93 %) concur that inquiry science learning is most effective, that is, having students conduct experiments, form opinion and discuss and defend their conclusions with others.
- Both deans and new teachers report that this method is the one taught most often in pre-service teacher training programs today. More than eight in 10 deans (83 %) say their institution most often emphasizes a hands-on, inquiry-based approach to train its teacher candidates to teach science. That finding is confirmed by the new teachers, eight in 10 (84 %) of whom say this is the method that was most often emphasized in their pre-training programs.
- Further, almost eight in 10 deans (79 %) believe the emphasis on hands-on, inquiry-based science teaching should increase in U.S. elementary schools.

REPORT CARD ON PRE-SERVICE TRAINING AND HANDS-ON SCIENCE

- Deans are far more positive than teachers about their institutions' ability to both expose their K-5 teacher candidates to inquiry science teaching methods and provide practical training in these methods. While eight in 10 (80 %) deans assign an A, only one-third (31 %) of teachers are as generous. Another one-third assign a C, D or F (30 %); and, the remaining one-third (38 %) give it a B.

	K-5 Schoolteachers	Deans of Schools of Education
A	40 %	80 %
B	37 %	17 %
C, D or F	22 %	6 %

Pre-Service Education’s *Practical Training* in Hands-On, Inquiry-Based Science Teaching

	K-5 Schoolteachers	Deans of Schools of Education
A	31 %	80 %
B	38%	16 %
C, D or F	30 %	7 %

- While nearly nine in 10 (87 %) teachers report that, upon graduation, they felt qualified to teach science using inquiry-based methods (46 % very qualified; 41 % somewhat), half (48 %) say their pre-service education should have done a better job preparing them to teach science using this method.

IMPORTANCE OF QUALITY OF PRE-SERVICE SCIENCE EDUCATION TRAINING

- The survey provided substantial evidence that the quality of pre-service science education training for new K-5 teachers is critical. On a number of measures, new teachers who rate their pre-service science preparation an A or B are much more positive about many aspects of science education than those who rate their preparation C, D or F. For example, they are more likely to:

- ✓ teach science every day (39 % versus 31 %).
- ✓ feel very qualified to teach science (72% versus 46%).
- ✓ feel very comfortable answering student questions about science (64 % versus 47%).
- ✓ feel very confident that their students are getting a good science education (53 % versus 32 %).
- ✓ call themselves very science literate (36 % versus 18 %).

- ✓ say their pre-service training provided excellent to good *exposure* and *practical*

- training* in hands-on methods (90 % vs. 59 % and 85 % versus 47 %, respectively).
 - ✓ feel qualified to teach science using hands-on, inquiry-based methods (97 % versus 75 %).
 - ✓ be familiar with the *National Science Education Standards* (74 % versus 53 %).
- Conversely, those who rate their pre-service science education training C, D or F are more likely than those who give it an A or B to:
 - ✓ believe pre-service training programs should require more science and science education coursework of their K-5 teacher candidates (81 % versus 67 %).
 - ✓ rely on what they learned in high school to teach science today (44 % versus 30 %).
 - ✓ say their pre-service training should have done a better job preparing them to teach science using hands-on, inquiry-based methods (70 % versus 33 %).

IMPACT OF NATIONAL SCIENCE EDUCATION STANDARDS

- Two-thirds (66 %) of the teachers and three-quarters (77 %) of the deans report they are either very or somewhat familiar with the *National Science Education Standards*.
- When asked if the science education reform efforts as exemplified in the *National Science Education Standards* would substantially strengthen science education and improve student performance, teachers and deans agree (89 % and 90 %, respectively).
- Three-quarters (74 %) of the deans report that the *Standards* have had a significant impact on their institutions' K-5 teacher education programs. And, nine in 10 (94 %) say, that within the last four years, their school conducted a comprehensive review of its K-5 science teaching preparation programs and implemented changes.

BUSINESS-EDUCATION PARTNERSHIPS

- Deans widely favor partnerships between businesses, local colleges/universities and school

districts that enhance K-5 teacher candidates' ability to teach hands-on, inquiry-based science, including having them work directly with scientists and engineers from industry. Two-thirds (67 %) of the deans report their institutions participate in these kinds of programs. Of those, almost all believe the programs have helped their K-5 teacher candidates improve their understanding of science content (95 %) and bolstered their science teaching (88 %), as well as their enthusiasm and motivation for teaching the subject (95 %).

- A little more than two-thirds (68 %) of the deans who have not yet participated in such programs say they would like to for essentially the same reasons.
- Although only one in 10 new teachers (12 %) indicate they have participated in programs that give teachers the opportunity to work directly with scientists and/or engineers on science curricula and other professional development activities, those who have are overwhelmingly positive about the experience.
- Nearly all say it helped them better understand science content (96 %), improved their teaching of science content (94 %) and bolstered their motivation and enthusiasm for teaching the subject (93 %).
- Of the 88 % of teachers who have not yet participated, six in 10 (61 %) say they would like to. Three-quarters of them believe that participating in these programs would also help them in the three key areas – science content (74 %), science teaching (73 %) and motivation/enthusiasm (76 %).

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