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ABSTRACT

A review of available research emphasizes a need for a more reliable, systematic collection and interpretation of data on science teacher production. The currently reported "crisis" in science education is not a new phenomenon nor a surprise to educators in the field, as it was predicted as early as 1976 by researchers noting a decline in newly certified mathematics and science teachers and an enrollment drop in teaching programs. Generalizations have been made from research results implying a high percentage of surplus teachers, yet when broken down by geographic and/or subject area, a critical shortage of math and science teachers is evident. Supply and demand is affected by such factors as geographic area, birth rate, economy, military requirements, changes in social conditions and use of new technologies in school curriculums. Existing positions are held, in many cases, by older teachers with continuing contracts and outdated science content backgrounds, with new position openings occurring only through attrition. A list of references is included. (JW)

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Science Education Fact Sheet No. 1 1983

SCIENCE TEACHER SUPPLY AND DEMAND

In 1982 our clearinghouse produced a fact sheet focused on mathematics teacher supply and demand (mathematics education, no 3). Reader interest has been such that the production of a fact sheet about science teacher supply and demand seemed appropriate. This fact sheet has been designed to serve as a companion to a 1983 information bulletin on science teacher preparation and certification.

Some Background Information

In recent days and weeks the general public has been alerted to the "crisis" in science education by the media: newspaper articles, television news reports, and features in weekly newsmagazines. When the television special "I Leonardo" was broadcast in May, IBM gave up its advertising time so that Walter Cronkite could do a narration on the crisis in science education.

Crisis is defined by the authors of the *Random House College Dictionary*, 1975 revised edition, as "a stage in a sequence of events at which the trend of all future events is determined; turning point" (p. 317). Many individuals appear to seize on the shortest part of this definition: turning point. They deplore the condition and appear to forget that portion of the definition that indicates the condition is a stage in a sequence of events. It did not just simply occur without warning.

In terms of teacher supply and demand, the sequence of events began years ago. After World War II there was a baby boom. As these children came of school age, the need for more schools and teachers to staff them arose. However, by the 1970s there was a decline in birth rate. This decline produced, eventually, an enrollment drop which hit the elementary schools and then the high schools (Hausman and Livermore, 1976).

Colleges and universities preparing teachers got geared up to meet the demands for teachers in the 1960s. Young people graduated from preservice programs in large numbers. By the early 1970s the popular press emphasized a "teacher surplus." This generalization highlighted the overall situation but failed to point out that the surplus situation did not apply equally to all content areas. A report on the status of teacher supply and demand in Wisconsin, 1970-1980 (Wisconsin, 1971) contained the finding that "chronic shortages" persisted in certain selected and specialized fields and services. On a national basis the teacher shortage in mathematics, natural and physical sciences continued. The authors of the report stated that the teacher surplus did not affect all subject areas nor was the supply of teacher candidates evenly distributed geographically.

Hausman and Livermore (1976), in a paper designed for an audience composed of members of the Association for the Education of Teachers in Science (AETS), warned their listeners that the crisis situation decried in 1983 would come about. They cited economic conditions as another important factor. As budgets in schools increase, based in large part on teachers' salaries, and support for schools fails to increase proportionately, adjustments have to be made to keep the schools open. Younger teachers with fewer years of service are released and older teachers with continuing contracts are kept on while class size is increased. In some areas teachers' salaries make up some 80 percent of the school budget (Wisconsin, 1971). (Yet these salaries are noncompetitive with industry.)

Hausman and Livermore also cited a study conducted by the RAND Corporation to analyze the educational personnel system in the United States in 1973-74. They reported several findings from the RAND study: (1) teacher production in the United States declined each year from 1966 through 1972 and was projected to continue to decline; (2) there is a demonstrable lag between the identification of a surplus or shortage of teachers and undergraduate students' career decisions, so preservice enrollment will continue to decrease (in 1974 only 7.7 percent of the freshmen students surveyed by RAND wanted to teach); (3) the teacher surplus situation will end in 1980 but the decline in teacher production will continue for two to four years after that; (4) teacher retirements will increase after 1980; (5) teachers not at retirement age will stay in the profession; (6) reliable data on the number of new teachers produced are needed; and (7) also needed is information on the number of new teachers by subject area as well as better estimates on the teacher pool (1976, pp. 4-5).

Hausman and Livermore predicted, in 1976, that the crisis of the 1980s was coming. They stressed that, not only would there be a science teacher shortage, another factor was also important. In the 1980s the inservice teachers who had graduated from school some time ago would have outdated science content backgrounds, assuming they had not been reading widely in their science content areas or returning to school for refresher courses.

Supply and Demand Factors

Some factors influencing the demand for teachers are the state of the economy, military requirements, unforeseen changes in social conditions, as well as the possible development of new materials and processes for use in the school curriculum. Some factors influencing the supply of teachers are the career choice of students following news of a surplus or shortage of teachers, the availability of financial aid for students preparing to teach, the increasing availability or deletion of academic programs, and changing conditions within the various career fields. The birth rate is another important factor. A factor that is frequently overlooked is the enrollment of students in nonpublic schools. Some private schools do not require that their teachers be certificated.

Job openings in schools occur when teachers retire, die, leave the profession for another job, leave for family reasons, take an administrative position, or go to graduate school. Jobs are also created when new positions are added, either through an increase in enrollment of pupils or from requirements that mandate the implementation of some new program or requirement.

The supply and demand situation varies with the type of community being considered. The 1971 Wisconsin report cited earlier in this fact sheet contains a discussion of this situation. A study conducted by the National Education Association was used for purposes of illustration. The NEA study involved 41 states. Thirty-eight of these states reported teacher shortages in rural areas; 20, in small cities; 16, in central cities or large urban centers; 7, in suburban communities.

Also a consideration in the supply and demand situation is the fact that not all graduates of preservice programs enter teaching. The NEA published data indicating that, for the period of 1960-1970, only 67 percent of the graduates from secondary education programs actually took teaching jobs (Wisconsin, 1971). If this situation has persisted, there may be a pool of persons qualified and certified to teach

who are not teaching. How current their knowledge of both subject matter content and methodology is, as well as the degree of their satisfaction with their present careers have not been investigated.

Studies of Teacher Supply and Demand

One of the themes that runs through the literature reviewed for this fact sheet is the need for the systematic, reliable collection of data related to the production of teachers. Another is that, while some areas may show a surplus of teacher candidates, there is a critical shortage of mathematics teachers as well as a shortage of natural and physical science teachers.

Some states have been gathering data on teacher supply and demand but this has not always been done on a regular basis. Discrepancies between publicized surpluses and unfilled teaching positions have caused some people to collect data in order to project needs within their specific state. Lindeman and Boehm, at a conference convened in Albany, New York, to discuss the effects of technology on mathematics and science teachers, again illustrated how generalizations about teacher supply can mask demand areas. They discussed findings from a 1973-1978 survey of teacher supply and demand in Missouri. When supply and demand were compared in general terms, Missouri had a 57 percent teacher surplus. However, when subject matter areas were examined, there was a 12 percent shortage of mathematics teachers and a 16 percent shortage of science teachers. These shortages were hidden by the 196 percent surplus of teachers of physical education and the 132 percent surplus of social studies teachers (1982, p. 7).

New York. Lindeman and Boehm reported that, in New York state, a survey of the data for 1975-1979 revealed a 43 percent decline in biology teacher graduates, a 54 percent decline in chemistry teacher graduates, a 50 percent decline in prospective physics teachers, and a 49 percent decline in future teachers of earth science. They anticipate this decline trend will continue through 1985.

Iowa. Howe and Gerlovich, in an article published in *School Science and Mathematics* (1981), reported on the situation in Iowa. When the thirty year period of teacher shortages ended in 1970-71, Howe and Gerlovich decided to investigate the problems of teacher supply and demand, with an emphasis in mathematics and science, in Iowa's public schools (1981, p. 26). Iowa contains 27 institutions that prepare teachers and 447 public school districts. Local public school districts were designated as the sampling unit for the study. Data were also collected from the colleges and universities about the number of teacher graduates for 1974-1979 as these were projected, and the projected data were combined with data already collected for 1970-1973 on teacher production. Howe and Gerlovich found that school enrollment had declined, with this decline projected to continue for the next five years. However, the number of teacher graduates had also declined. In 1970, 269 prospective science teachers were graduated from Iowa schools. In 1979, this number was 142.

Howe and Gerlovich found that schools with smaller enrollments had almost twice as many vacancies each year proportionately to the number of teachers employed as did other sized districts (1981, p. 27). When they looked at the age, experience, and education of mathematics and science teachers, the investigators also found that smaller schools primarily employed beginning teachers with a recent bachelor's degree and no teaching experience. Teachers with a master's degree and experience were employed by the larger districts. Thirteen percent of the teachers in all Iowa school districts were in the 51-60 year age bracket, forecasting the need for replacements in the future. However, in 1971, there was a 14 percent drop in the freshmen enrollment in Iowa teacher education programs. As a result, Howe and Gerlovich concluded that ". . . the prospect for an easy or immediate solution to the mathematics and science teacher shortage seems improbable and will probably worsen in the next few years. . ." (1981, p. 32).

Washington. Olstad and Beal decided to investigate science teacher supply and demand in Washington state. They contacted school districts for information about vacancies for either full-time science teaching or teaching assignments that include science. They asked institutions preparing teachers for the number of graduates by field and year of completion, including both major and minor teaching endorsements.

Olstad and Beal found that, combining science major and minor certification areas, the number of graduates in science in 1978 was 30 percent fewer than in 1974. Eighty-seven percent of the 253 school districts employing secondary teachers responded to their questionnaire. Questionnaire data showed that the number of vacancies for science teachers had steadily increased. When full and partial science teaching assignments were combined, there was a 35 percent increase in demand for science teachers over the period of their study (1974-1979). Two-thirds of the vacancies in science were at the junior high/middle school level.

Olstad and Beal concluded that (1) the number of vacancies in science had steadily increased from 1974-1979, (2) the number of majors and minors recommended for secondary science certification had steadily decreased from 1973-1978, and (3) the supply of science majors was insufficient to meet the demand for full-time science teachers. As a consequence, there probably will be a number of minimally qualified teachers filling science teaching positions.

These surveys provide information for three states. Readers of this fact sheet who wish information for their own state should contact their state department of education, local education units, or nearby colleges and universities.

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