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ABSTRACT

Provided are results of a study (which is replicated annually) designed to identify specific areas of science and mathematics teacher supply/demand inconsistencies in the State of Iowa. Data are summarized on the number of graduates from teacher education institutions in Iowa completing preparation for a teaching certificate for the years 1970-82. Additional data (in table format) are provided for the years 1973-74 and 1978-79 on science teacher distribution by subject area taught, educational background, and school district size, and on teachers (by subject area and school district size) with undergraduate/graduate majors in their area of teaching responsibility. Major findings indicate a decline in mathematics/science teacher supply from 1970-82, a change in the job market due to competition in hiring from business and industry, critical shortages in sciences (especially earth science, physics, and chemistry) and mathematics, and serious long range consequences of continued critical shortages on the total educational system. Also presented are results of a national telephone survey on the estimated supply of secondary biology, chemistry, physics, general science, earth science, and mathematics teachers by state (1980-1982). (JN)

NATIONAL STUDY of the ESTIMATED SUPPLY and DEMAND of SECONDARY SCIENCE and MATHEMATICS TEACHERS 1980-1982

by

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NATIONAL STUDY of the ESTIMATED SUPPLY and DEMAND of SECONDARY SCIENCE and MATHEMATICS TEACHERS

Introduction

In a September 1980 editorial in Science, Young stated that a high priority for both scientists and engineers should be directed toward improving the understanding of science and engineering . . . This can be achieved by educating those already in place . . . and by placing more emphasis on science and engineering in high school and college, where minimal standards of technical literacy should be required of all who aspire to graduate.[1]

A 1980 Science and Engineering Education report to the President warns that the U.S. faces immediate shortages of engineers and computer professionals, as well as a trend "toward virtual scientific and technological illiteracy" in the population at large. The declining emphasis on science and mathematics in our schools runs in marked contrast to other industrialized countries.[2]

A report by E. Walsh and J. Walsh (1980) indicates that schools are not getting and keeping the excellent teachers in science and math that are needed. Many of the quality math and science people are being drained from the education field. They also report that the National Science Teachers Association lost 1,000 of its 10,000 members in 1980. However, science educators perceive the problem to be a lack of serious commitment by government and the science establishment.[3]

In 1982 the Association for School, College and University Staffing (ASCUS) reported shortages of teachers by region of the country. Teacher shortages were recognized in the following disciplines and geographic regions of the country: Mathematics - considerable shortages in Alaska, South

Central and Southeast U.S.; Chemistry - considerable shortages in Alaska, and the South Central U.S.; Physics - considerable shortages in the South Central U.S.[4]

In July 1980 the American Association of Colleges for Teacher Education (AACTE) released a study indicating critical shortages of physics teachers in 14 states, slight shortages in 23 states and no shortages in 2 states.[5] Conflicting reports were discussed concerning the supply and demand for teachers of mathematics. It was reported that accurate predictions could not be made, due to unavailability of representative national studies.

From this background study, it appeared that two needs had to be addressed in order to alleviate the teacher supply/demand problem. First, change the public's apathetic attitude and poor understanding of science; and second, compile complete data which identifies the specific areas of supply/demand inconsistencies by science discipline and state. This study will focus upon the latter, through analyses and application of an Iowa study.[6]

REPORT ON IOWA'S EARLY INITIATIVES

Introduction

In August 1978, the Curriculum Division of the Iowa Department of Public Instruction (DPI) began receiving an inordinate number of inquiries into the availability of secondary mathematics and science teachers. Such requests are generally made to the DPI only after all other resources (college/university placement offices, peer exchange, media advertisements, etc.) have been exhausted. Many of the requests for secondary physics, chemistry, earth and physical science, and mathematics teachers could not be filled.

Background

Each spring the teacher education graduates from the twenty-seven institutions in Iowa begin their job search. For many years this was not a major task for most candidates. However, to the surprise of many, the thirty year period of teacher shortages ended abruptly with the 1970-71 school year.

This situation coupled with inflation, major changes in the economy, national unemployment, lower birth rates, and declining school enrollments further complicated the teacher placement outlook. The need for additional information led to the current investigations concerning the elementary and secondary teacher supply and demand in all areas for the public schools in Iowa for the years 1971-82.

The first teacher vacancy study was designed in the spring of 1971 as a cooperative survey planned and carried out jointly by the College of Education at Iowa State University and the State Department of Public Instruction. Each year since then, two studies have been conducted,

one in the spring and a second in the fall.

Purpose

The purpose of the studies was to investigate the problems of teacher supply and demand, with emphasis in math and science, in Iowa's public schools.

Methodology

Teacher Demand

The target population consisted of Iowa's 441 public school districts who cooperated by supplying information to be used as base line data. Local school districts were designated as the sampling unit. This report contains summary data from the fall surveys conducted over the past ten years.

Teacher Supply

There are 27 institutions in Iowa that have approved teacher education programs. These four year colleges or universities recommend graduates for certification to the Department of Public Instruction. The recent bachelor degree graduate who has completed the preparation for a teaching certificate is the primary source of new teachers in Iowa, accounting for approximately 82% of the new hires.

After studying several alternatives, a survey of the 27 institutions was conducted to ascertain the supply of beginning teachers (i.e., the number of students completing preparation for a teaching certificate with a bachelor's degree). All institutions returned their completed questionnaires.

Since data on the number of graduates were available from an earlier study for the years of 1970 through 1973, the questionnaire for this study was designed to be compatible and to collect information for the years

1974 to the present. The study is being replicated annually to obtain the number of current bachelor degree candidates.

Findings

One of the variables directly effecting the demand for teachers is declining enrollments. Lower birth rates over the past several years have been reported nationally as well as within the state. It appears that the downward trend "bottomed out" in the mid 1970's.

Trends in Iowa public school enrollments in grades K-12 as well as projections may be seen by examination of Table 1. The actual public school enrollments are presented for the 1972-73 school year through 1981-82. Total enrollments have declined 130,116 students in ten years. The projected enrollments are expected to drop 31,444 students in the next five years. Obviously the implication is a reduction in the number of teaching positions at both the elementary and secondary levels over the next several years. However, current data indicated that teacher supply is decreasing more rapidly than student enrollment.

Currently there are 29,739 elementary and secondary teachers employed in the 441 school districts in Iowa. In 1971 there were 93 school districts in Iowa with less than 500 students in grades K-12; currently there are 181 such school districts. Analysis of the data revealed that school size is a factor in teacher turnover. Schools with smaller enrollments appear to have almost three times as many secondary vacancies each year proportionately to the number of teachers employed. This is also true in the next two of the seven school size stratums.

Mathematics

The supply of mathematics teachers as evidenced by the number of certificated bachelor degree graduates from the 27 teacher education

TABLE 1

Department of Public Instruction
Grimes State Office Building
Des Moines, Iowa 50319

Actual Enrollments for 1972-73 Thru 1981-82
Estimates for 1982-83 Thru 1986-87

Public School Enrollments - State

Year	K	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	Ungraded Special Educ.*	GRAND TOTAL
72-73	46220	44075	45330	40250	49903	51192	51736	52530	51770	49822	49921	48250	45099	634915	10474	645389
73-74	44592	42879	42156	44705	47744	49049	50572	52541	51854	52342	48658	47722	45249	620063	10632	630695
74-75	44635	41379	41123	41496	44364	46977	48093	51290	52190	52481	51140	46138	44326	606432	10649	617081
75-76	46235	42108	40218	40702	41570	44020	47136	49708	51104	53128	51699	49162	43616	600406	10409	610815
76-77	45118	43307	40814	39617	40494	41374	44546	47747	49653	51800	52012	49199	46126	591897	11699	603596
77-78	41130	42629	42032	40201	39328	40119	41467	44669	47665	50260	50808	49809	46311	576437	10676	587113
78-79	37954	39188	40699	41291	39837	38835	39744	41677	44332	48442	49488	48461	46701	556649	10894	567543
79-80	37759	35994	37442	40172	40360	39388	38681	40522	41475	45198	47134	46927	45635	537187	10012	547199
80-81	39202	35747	34492	36910	39867	40318	39068	39372	40263	42570	44179	45571	44726	522285	10308	532683
81-82	37551	37021	34154	33009	36272	39282	39707	39640	38597	41083	41659	42572	43452	504799	10157	514956
ESTIMATED ENROLLMENT																
82-83	39623	35358	35577	33643	33534	35842	39132	40233	39355	39238	40226	39841	40100	491702	9893	501595
83-84	40421	37309	33980	35046	33370	33136	35705	39650	39944	40009	38420	38470	37527	402987	9718	492705
84-85	41649	38061	35855	33472	34761	32975	33010	36178	39366	40608	39174	36743	36237	478089	9619	487708
85-86	43160	39217	36577	35319	33200	34349	32849	33448	35919	40020	39781	37465	34610	475894	9575	485469
86-87	41433	40640	37688	36030	35032	32807	34218	33284	33207	36515	39185	38026	35290	473355	9524	482879

All enrollments are as of the second Friday in September. The public school enrollment projections are based upon the trends observed in the number of students moving from grade to grade. This trend calculated as an average cohort survival ratio was used to estimate 1st through 12th grade enrollments. Kindergarten enrollments were estimated from actual births five years prior.

*Ungraded special education refers to those students who are not associated with a given grade level. This is not a count of the number of special education students in the state.

TABLE 2

COMPARISON OF THE NUMBER OF FALL VACANCIES IN MATHEMATICS AND SCIENCE IN THE PUBLIC SCHOOLS OF IOWA WITH THE NUMBER OF BACHELOR DEGREE GRADUATES CERTIFICATED TO TEACH FROM THE TWENTY-SEVEN IOWA INSTITUTIONS FOR THE YEARS INDICATED

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
MATH												
Vacancies			196	214	217	189	221	185	189	165	177	102
Graduates	234	218	228	207	166	95	104	75	60	46	49	38
SCIENCE												
Vacancies			172	261	248	176	217	176	156	159	110	67
Graduates	269	255	190	212	192	185	187	190	155	117	100	128

institutions has declined sharply. Examination of Table 2 reflects the trend and the severity of the drop. There were 234 graduates in 1970 and only 38 in 1981.

Until 1980, the demand for mathematics teachers had fluctuated around 200 per year, with a low of 165 and a high of 221 for the years studied. For comparison, in 1972 there were 196 vacancies and in 1981 there were 102.

Although the information on demand for mathematics teachers is high, as evidenced by the number of vacancies reported in Table 2, many additional vacancies have been reported as a combination of assignments requiring the teaching of mathematics plus various other science subjects. This is particularly true of the smaller school districts with limited enrollments and small class sizes. In Iowa the number of teachers with math/science combination of teaching assignments increased from 245 to 282 in five years.[7] Therefore, the full time math vacancies reported in Table 2 are underestimates since the combinations are not shown.

Science

A summary of the number of bachelor degree graduates prepared in Iowa for all science areas is reported in Table 3. The supply of science teachers was obtained by tabulating the number of certificated bachelor degree graduates from the 27 teacher education institutions. There were 269 science teacher graduates in 1970 and only 87 graduates in 1982.

Even though the information requested from the institutions separated the science subject areas, most institutions prepared teachers as generalists to teach combinations of several science areas. Therefore, in Table 3 the number of graduates is indicated for each subject area and those with combined science. This detailed analysis was useful in identifying areas with critical shortages. These were general science, earth science, physics, and chemistry.

TABLE 3

SUMMARY OF THE NUMBER OF GRADUATES FROM THE TWENTY-SEVEN TEACHER EDUCATION INSTITUTIONS IN IOWA COMPLETING PREPARATION FOR A TEACHING CERTIFICATE WITH A BACHELOR DEGREE BY SUBJECT AREA FOR THE YEARS 1970-82

	Number of Graduates by Year												
Subject Area	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
SCIENCE													
Combined	57	56	29	24	60	61	77	71	56	42	49	35	18
Biology	137	129	107	119	84	77	66	66	61	52	36	59	41
Chemistry	17	15	19	17	16	13	11	16	13	7	5	8	6
Earth Science	0	0	0	0	7	4	12	6	7	2	3	1	2
General Science	43	40	16	34	7	7	7	14	5	12	5	16	15
Physical Science	0	0	0	0	9	14	7	11	8	0	0	6	3
Physics	15	15	19	18	9	9	7	6	5	2	2	3	2
TOTALS	269	255	190	212	192	185	187	190	155	117	100	128	87

The demand for science teachers was obtained by analyzing the reported vacancies ranging from a high of 261 in 1973 to a low of 67 in 1981, which is atypical because of the current recession (see Table 2). During most of the period studied the vacancies exceeded the number of graduates. However, these figures included all science vacancies. There appears to be an adequate or balanced supply of biology teachers but a critical shortage of teachers in the physical sciences.

Characteristics of Mathematics and Science Teachers

A profile of the staff characteristics of all teachers of mathematics and science in Iowa public schools was made from the computer analysis of the Basic Educational Data Survey (BEDS) tape maintained by the Department of Public Instruction. Characteristics examined were age, experience, education, and teaching assignment.

Results seemed to indicate that the smaller school districts were employing primarily beginning teachers, who were recent bachelor degree candidates with no teaching experience in science. Teachers with the masters degree and additional teaching experience were common in the larger school districts (see Tables 4 & 5). Table 6 provides comparison of those teachers who were teaching science in their major and non-major in 1973-74. A change is evident when the same data are examined for teachers currently teaching science on temporary certification because of shortages of qualified personnel. Another interesting aspect of the analysis was that 13% of the teachers in all districts were in the 51-60 year old category suggesting the need for replacement in the future in the areas of mathematics and science.

Summary

There were many factors effecting the teacher supply and demand during

the 1970's. These were inflation, major changes in the economy, a period of recession 1973-75 and again in 1980-82, national unemployment, lack of federal support for education, lower birth rates, and declining school enrollments.[8,9,10]

Major findings of the investigation:

(1) Over the 12 year period (1970-82) the supply of secondary math and science teachers, who have been certificated, have declined 80% and 68% respectively.

(2) Competition in hiring from business and industry, especially in 1977, 78 and 79, has dramatically changed the job market. Prospective math and science teacher education candidates are being attracted by higher paying jobs in business. Teachers with one to five years of experience are also leaving for higher salaries in the business sector.

(3) There are critical shortages of teachers in the areas of mathematics and science. In the science area, there are shortages in earth science, physics, and chemistry.

(4) Long-range consequences of continued critical shortages on the total education system can be extremely serious. Many math and science courses are being taught by less qualified teachers with minimal preparation; this threatens the quality of instruction in these subjects. Many schools will be forced to drop some mathematics and science offerings because of staff shortages.

In conclusion, the prospects for an easy or immediate solution to the mathematics and science teacher shortage in Iowa seems improbable and will probably worsen in the next few years. In years when the economy remains stable, the competition from business and industry for the service of people with these skills remains high. Starting salaries paid by industry are approximately 50% to 60% higher than those for comparably trained science teachers. In the present recessionary period, the opportunities for alternative employment in the private sector have decreased significantly. However, the demand for technically trained scientists and mathematicians continues to increase. The problem is further compounded when

public schools are experiencing declining enrollment and staff reductions. Projections will be highly dependent on the state of the economy. As the economy improves, and enrollments begin to increase again, teacher shortages will undoubtedly occur.

TABLE 4 · Iowa Public High School Science Teachers by Subject Area, Education and School District Size (1973-74)

K-12 District Enrollment	Biology			Chemistry			Physics			Physical Science			Earth Science			Conservation			General Science		
	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL
Less than 500	116	22	138	72	24	96	60	25	86[e]	49	9	58	49	10	59	2	1	3	100	18	118
500-749	112	30	143[a]	60	32	94[d]	59	31	91[f]	49	13	63[g]	43	11	55[i]	4	2	6	112	22	135[j]
750-999	79	37	116	43	27	70	41	27	68	38	26	64	37	9	46	8	1	9	90	28	118
1,000-1,499	66	24	90	22	27	49	20	29	49	33	16	49	30	11	41	2	2	4	77	18	95
1,500-1,999	38	15	54[b]	8	15	23	7	16	23	14	13	27	15	9	24	2	3	5	40	16	56
2,000-2,999	47	50	97	12	24	36	15	23	38	27	25	52	24	22	46	4	4	8	86	41	127
3,000 or more	109	140	252[c]	20	49	69	5	43	48	72	71	146[h]	43	52	95	7	11	18	205	126	334[k]
TOTAL	567	318	890	237	198	437	207	194	403	282	173	459	241	124	366	29	24	53	710	269	983

Key:
a - 2 specialists
b - 1 doctorate
c - 1 doctorate
d - 2 doctorates
e - 1 specialist
f - 1 doctorate
g - 1 doctorate
h - 1 specialist, 2 doctorates
i - 1 doctorate
j - 1 doctorate
k - 1 specialist, 2 doctorates

TABLE 5 Iowa Public High School Science Teachers by Subject Area, Education and School District Size (1978-79)

2 District ollment	Biology			Chemistry			Physics			Physical Science			Earth Science			Conservation			General Science		
	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL
s than 500	179	37	216	103	33	136	88	27	116[d]	61	14	75	60	9	69	13	3	16	130	32	162
-749	100	27	127	59	29	89[b]	52	26	79[e]	36	19	56[f]	45	7	52	10	2	12	96	15	111
-999	88	27	115	42	22	64	29	27	56	30	24	54	36	7	43	10	1	11	85	25	111[g]
00-1,499	58	26	84	14	23	37	15	21	36	25	12	37	27	7	34	5	3	8	57	16	73
00-1,999	42	22	64	11	17	28	13	15	28	21	15	36	12	15	27	6	4	10	42	16	58
00-2,999	45	37	82	10	19	30[c]	10	20	30	18	14	32	19	9	28	4	2	6	52	18	70
00 or more	108	140	250[a]	21	47	68	11	36	47	54	65	119	45	41	86	14	17	31	163	135	298
AL	620	316	938	260	190	452	218	172	392	245	163	409	244	95	339	62	32	94	625	257	883

a - 1 specialist, 1 doctorate
b - 1 specialist
c - 1 doctorate
d - 1 specialist
e - 1 specialist
f - 1 specialist
g - 1 specialist

TABLE 6 Iowa Science Teachers with Undergraduate or Graduate Majors in their Teaching Area by Subject and School District Size

1973-74

K-12 District Enrollment	Biology		Chemistry		Physics		Physical Science	
	Major	Non Major	Major	Non Major	Major	Non Major	Major	Non Major
Less than 500	81	57	23	73	11	75	7	51
500-749	80	63	24	70	17	74	3	60
750-999	59	57	30	40	15	53	9	55
1,000-1,499	55	35	18	31	14	35	1	48
1,500-1,999	35	19	12	11	8	15	4	23
2,000-2,999	78	19	16	20	14	24	9	43
3,000 or more	170	82	32	37	19	29	11	135
TOTAL	558	332	155	282	98	305	44	415

1978-79

K-12 District Enrollment	Biology		Chemistry		Physics		Physical Science	
	Major	Non Major	Major	Non Major	Major	Non Major	Major	Non Major
Less than 500	133	83	36	100	13	103	8	67
500-749	70	57	31	58	19	60	10	46
750-999	65	50	30	34	13	43	3	51
1,000-1,499	47	37	14	23	7	29	3	34
1,500-1,999	45	19	14	14	10	18	7	29
2,000-2,999	54	28	9	21	8	22	5	27
3,000 or more	173	77	37	31	20	27	15	104
TOTAL	587	351	171	281	90	302	51	358

THE NATIONAL STUDY

Problem

Historically Iowa has imported approximately 25% of its teachers from out of state, and about the same percentage go out of state to teach. It was decided that knowing the status of the states contiguous to Iowa might assist in alleviating teacher shortage problems. Following telephone surveys with State Departments in Minnesota, Illinois, Missouri, North Dakota, South Dakota, Nebraska, and Wisconsin, it was concluded that these states were also experiencing similar shortages. This information prompted the authors of this study to pursue the investigation on a national scale.

In the early 1960's, inadequate supplies of science teachers precipitated a series of actions and overreactions that, with proper planning and data, might have been averted. In an attempt to ascertain if this surge of requests represented the beginnings of such a repeat shortage, certain data needed to be examined. This study was designed to first ascertain the availability of such data.

The purpose of this study was to investigate the problems of supply and demand of secondary mathematics and science teachers for all states in the United States.

Methodology

A major concern in the initial planning stages was the availability of information for a national survey to determine the supply and demand of secondary mathematics and science teachers. Supply, as reflected by certification, was used as a criteria in each of the states. Demand is best reflected by the school hirings to fill vacancies each year.

Preliminary Telephone Survey

The decision was made to conduct a preliminary telephone survey by

contacting the director of teacher education and certification in each state. The 1979-80 directory of the National Association of State Directors of Teacher Education and Certification was used for contacting each director.

An instrument was developed to standardize the communication and phrasing of the questions used in the telephone survey. Between January and April 1980, the Iowa State University Education Placement Office and the Iowa Department of Public Instruction conducted a telephone survey. Each state department of teacher certification division or data control division was contacted to assess the availability of math and science teacher supply/demand information.

Telephone calls were made and interviews completed for a sample of Directors of Teacher Education and Certification in the State Departments of Public Instruction for each of the thirty states responding (see Table 7). Telephone calls were made at least once to all states. However, in some states the director was not immediately available on the first or second telephone call. It was decided for this preliminary survey to report on only the sample of states where interviews had been completed.

Two major problems developed during the assessment of state departments. One was concerned with costs for computer runs or the hand tabulation of data to be requested and the second was time involved to collect information that was not currently available. These two factors--time and money--appeared to be beyond our present resources to conduct the study as originally planned. Alternative approaches to assess supply and demand were then explored.

State Science Supervisors Questionnaire

The feasibility of contacting the supervisor or consultant in science education for each state department of education emerged as a reasonable

approach for obtaining information.

Dr. Jack Gerlovich, Consultant, Science Education for the State Department of Public Instruction in Iowa, contacted Lonnie Love, the President of the Council of State Science Supervisors (CS^3). He requested and received permission for time on the program at their national meeting at Anaheim, California in late March 1980.

The preliminary results of the telephone survey were presented by Dr. Gerlovich at the national meeting. He then presented the proposed study and received unanimous approval and endorsement from the members present to proceed with the questionnaire survey. They expressed a deep concern and willingness to cooperate.

Copies of the cover letters of request from Lonnie Love (President, CS^3), Trevor Howe (Director, Education Placement, ISU) and Jack Gerlovich (Iowa DPI) were mailed to each state science supervisor.

The questionnaires were initially mailed to all state science supervisors on April 15, 1980. The same survey procedure was replicated in 1981 and 1982.

Findings

Telephone Survey

Results of the preliminary telephone survey for the thirty states in which contacts were made can best be summarized as follows:

Supply as indicated by certification;

(1) Is information available on the number of current bachelor degree graduates recommended for certification from July 1, 1978 to July 1, 1979 in mathematics and science?

Responses: 15 - Yes, 15 - No

(2) Is information available on the number of temporaries granted in mathematics and science?

Responses: 17 - Yes, 12 - No

The number of temporaries granted in mathematics and science was considered as another indication of shortages, but some states do not issue temporaries.

Demand as indicated by vacancies or hirings by fall 1979;

(1) Is information available on the number of teachers who are in their first year of teaching in all school districts in the state for 1979-80?

Responses: 23 - Yes, 7 - No

(2) Can they be identified as beginning teachers or experienced?

Responses: 16 - Yes, 13 - No, 1 - ?

Other

All states indicated that they would need financial assistance to provide the information previously discussed. Six states indicated that they were fully computerized. Several others indicated that they were in the process of computerizing the data, and it would probably take another year to complete. The estimated costs varied from fifty dollars per computer run to five hundred dollars for the information requested. Others indicated they would have to charge for personnel time to hand tabulate the information requested, this could be estimated by an hourly charge. Some individual staff persons at colleges or universities were identified in a few states as having conducted state teacher supply and demand surveys.

State Science Supervisor's Questionnaire

Information obtained from the State Science Supervisors, in response to the mailed questionnaires, served as a cross reference to establish the validity of the information obtained from the earlier preliminary telephone survey. An extremely high degree of consistency was found between responses using the two approaches.

The mailed questionnaire was used to collect information from the science supervisors in each state. Science supervisors in 30 states and the U.S. territory of American Samoa indicated that they could supply reliable quantitative data concerning teacher supply, while in 23 states information could be supplied for demand.

The most useful and complete information obtained was the perceptions of the state science supervisors. The information was obtained by asking the supervisors to respond to a five point rating scale. They were asked to circle the number that best describes the available supply of teachers for each of the majors listed. The rating key was (1) Surplus, (2) Slight Surplus, (3) Adequate, (4) Shortage, and (5) Critical Shortage.

Inspection of Table 7 provides a summary of the "Estimated Supply of Secondary Biology, Chemistry, Physics, General Science, Earth Science and Mathematics Teachers by State 1980 Thru 1982."

Comparisons for the three years revealed a progressively worsening condition in the available supply of physics, chemistry and mathematics teachers. In 1980 the national average rating for physics teachers was 4.15, by 1982 it had increased to 4.43. In chemistry, the mean rose from 3.71 to 4.16 for the same period. In mathematics the mean rose from 3.92 to 4.37.

Summary

This summary encompasses the results of the telephone survey of the Directors of State Teacher Certification Divisions and the perceptions of the State Science Supervisors on the supply and demand of science and mathematics teachers in the United States.

Supply and demand are directly effected and correlate highly with economic conditions of the country. During a recessionary period, the

TABLE 7

Estimated Supply of Secondary Biology, Chemistry, Physics, General Science, Earth Science and Mathematics Teachers by State 1980 thru 1982

STATE	Biology			Chemistry			Physics			General Science			Earth Science			Math		
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
Alabama	2	2	2	3	3.5	4	5	5	5	3	3	3	4	4	4	NR	4	NR
Alaska	1	2	NR	1	2	NR	1	2	NR	1	2	NR	1	2	NR	1	2	NR
Arizona	NR	3	3	NR	4	3	NR	5	3	NR	5	3	NR	3	3	NR	4	3
Arkansas	3	3	3	4	4	4	4	4	4	3	3	4	3	3	4	4	4	5
California	2	3	4	2	4	4	4	4	4	3	3	4	4	4	4	2	4	4
Colorado	3	3	4	3.5	4	4	3.5	4	4	3.5	4	4	3.5	4	4	3.5	4	4
Connecticut	3	3	3	3	4	4	4	5	5	3	4	4	3	4	4	4	5	4
Delaware	3	1	2	3	3	4	3	4	4	3	1	1	3	1	2	3	4	4
District of Columbia	3	3	3	3	3	3	4	4	4	2	3	3	3	3	3	4	5	5
Florida	3	3	3	5	5	4	5	5	5	4	4	3	5	5	4	4	4	4
Georgia	1	2.5	3	1	3.5	4	1	4	4	1	5	4	1	4	3	1	5	5
Hawaii	2	3	3	4	4	4	4	5	5	3	3	3	4	4	4	3	4	4
Idaho	1	1	3	4	4	4	4	4	5	3	3	2	4	3	4	4	4	5
Illinois	3	3	3	5	5	4.5	5	5	5	4	4	3	4	4	3	5	5	5
Indiana	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Iowa	2	2	2	5	4	4	5	5	5	3	3	4	4	4	4.5	5	5	5
Kansas	2	3	3	4	4	5	4	4	5	4	3	3	4	3	3	4	5	5
Kentucky	3	3	3	4	4	4	5	5	5	3	3	5	4	4	5	5	5	5

Rating Key: (1) Surplus, (2) Slight Surplus, (3) Adequate, (4) Shortage, (5) Critical Shortage NR - No response

Update 9/1/82 "National Study of the Estimated Supply and Demand of Secondary Science and Mathematics Teachers" by Dr. Trevor G. Howe and Dr. Jack A. Gerlovich

Source: Special acknowledgement to members of the Council of State Science Supervisors.

Continued

Estimated Supply of Secondary Biology, Chemistry, Physics, General Science, Earth Science and Mathematics Teachers by State 1980 thru 1982

STATE	Biology			Chemistry			Physics			General Science			Earth Science			Math		
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
Louisiana	3	3	3	4	4	4	5	5	5	3	3	3	4	4	4	4	4	4
Maine	3	3	3	3.5	5	4.5	3.5	5	4.5	3.5	3	3.5	3.5	3	3.5	4	4	4.5
Maryland	3	2	3	4	4	4	4	4	5	4	4	4	4	4	5	4	5	5
Massachusetts	1	NR	1	1	NR	3	1	NR	3	1	NR	1	1	NR	1	1	NR	3
Michigan	3	NR	3.5	4	NR	4	4	NR	5	3	NR	3	3	NR	4	4	NR	NR
Minnesota	2	2	2	3	3	4	4	4	4	3	3	3	3	3	4	NR	4	4
Mississippi	1	1	2	2	2	4	4	4	4	1	1	3	4	4	3	NR	3	3
Missouri	4	4	4	5	5	4	5	5	4	4	4	4	4	4	4	5	5	5
Montana	NR	NR	4	NR	NR	4	NR	NR	4	NR	NR	4	NR	NR	3	NR	NR	4
Nebraska	3	3	3	4	4	4	4	4	4	3	3	3	4	3	4	3	4	4
Nevada	3	3	3	4	4	5	5	5	5	3	3	2	3	3	4	4	4	5
New Hampshire	2	3	3	5	5	5	5	5	5	4	4	4	5	5	4	5	5	5
New Jersey	3	NR	NR	3.5	NR	NR	4	NR	NR	3	NR	NR	3	NR	NR	3	NR	NR
New Mexico	2	NR	2	3	NR	2	4	NR	2	2	NR	2	3	NR	2	4	NR	4
New York	3	3	3	4	4	5	5	5	5	3	3	3	4	4	4	5	5	5
North Carolina	4	2	1	5	4	4	5	5	5	4	3	4	4	5	5	5	5	4
North Dakota	3	3	4	4	4	5	4	4	5	4	NR	3	4	4	3	4	4	5
Ohio	2	3	3	4	4	5	5	5	5	3	3	3	2	3	3	3	3	4

Rating Key: (1) Surplus, (2) Slight Surplus, (3) Adequate, (4) Shortage, (5) Critical Shortage
NR - No response

Continued

Estimated Supply of Secondary Biology, Chemistry, Physics, General Science, Earth Science and Mathematics Teachers by State 1980 thru 1982

STATE	Biology			Chemistry			Physics			General Science			Earth Science			Math		
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
Oklahoma	2	3	3	4	4	5	5	5	4	2	2	3	5	5	4	5	4	4
Oregon	3	2	4	3	4	5	3	5	5	3	3	4	3	4	5	5	4	5
Pennsylvania	2	1	1	4	4	5	5	5	5	2	1	3	4	5	5	5	5	4
Rhode Island	NR	3	1	NR	3	3	NR	3	3	NR	3	4	NR	3	NR	NR	4	4
South Carolina	4	4	4	5	5	5	5	5	5	4	3	3	5	5	5	5	5	5
South Dakota	3	3.5	3	4	4	4	5	5	4	3	3.5	3	3	3.5	3	3	5	5
Tennessee	3	2.5	3	3.5	4	4	3.5	4	4	3	2	2	4	4	4	3.5	4	4
Texas	2	1	1	3	3	5	3	3	5	4	5	NR	5	5	5	5	5	5
Utah	3	3	3	4	4	4	4	4	4	3	3	3	4	4	4	4	5	5
Vermont	4	4	3	4	5	4	5	5	5	3	4	3	3	4	4	3	4	4
Virginia	1	1	2	3	4	4	4	3	4	2	1	2	5	4	5	4	4	4
Washington	3	NR	2	4	NR	4	4	NR	4	3	NR	3	4	NR	4	3.5	NR	4
West Virginia	3	3	NR	5	4	NR	5	5	NR	4	4	NR	4	4	NR	5	4	NR
Wisconsin	2	3	2	4	4	4	5	5	5	4	3	4	4	4	3	5	4	4
Wyoming	3	3	3	4	3	3	4	3	3	3	2	3	4	3	3	4	4	4
American Samoa	5	4	4	5	5	5	5	5	5	5	5	4	5	5	4	5	4	4
Puerto Rico	NR	2	2	NR	4	5	NR	5	5	NR	2	1	NR	5	5	NR	3	NR
TOTAL	130	126.5	140.5	182	186	208	203.5	209	221.5	151	144.5	155.5	180	180.5	187	180.5	201	205.5
MEAN	2.65	2.69	2.81	3.71	3.96	4.16	4.15	4.45	4.43	3.08	3.14	3.17	3.67	3.84	3.82	3.92	4.28	4.37

Rating Key: (1) Surplus, (2) Slight Surplus, (3) Adequate, (4) Shortage, (5) Critical Shortage
NR - No response

number of teaching vacancies are generally below normal and teachers make fewer job changes. There are usually more qualified people available during periods of depressed economic conditions. Currently the number of teacher education graduates being prepared in mathematics and science is not meeting the present educational needs, let alone future predicted shortages.

The primary source of supply for secondary math and science teachers is the number of newly certificated bachelor degree graduates each year. Supply as reflected by certification was used as a criteria in each of the states. Demand is best reflected by the school hirings each year to fill existing vacancies.

The 1980 telephone survey was designed to ascertain the availability of hard data to serve as a base line or starting point. It was discovered that such data were generally not available without considerable expenditure of staff time and funds. The perceptions of state science supervisors provided the best alternative to securing necessary mathematics and science teacher supply and demand information.

Comparisons of the science supervisors perceptions for the period 1980-82, revealed a progressively worsening condition in the available supply of secondary physics, chemistry and mathematics teachers.

RECOMMENDATIONS

The ultimate purpose of our schools is to provide a "quality" education for all students. As the effectiveness of such educational programs are directly related to the quality of teachers, it is imperative that efforts be made to assure that the individuals knowledgeable of the learning process and their respective subject areas be employed in all curriculum disciplines. To assure that quality teachers are prepared in our nations colleges/universities and they are attracted to teaching positions, the following general recommendations are proposed.

(1) National organizations such as the National Science Foundation, American Association for the Advancement of Science, and the National Science Teachers Association should work with the President and the congress to monitor science and math teacher problems in order to avoid repeated crises.

(2) States should establish advisory committees, with representation from the legislature, higher education, State Department of Education, private industry, teacher associations, and local schools to assess teacher supply/demand inconsistencies and develop plans to alleviate such problems both on a short term and long range basis.

(3) States should establish summer institutes to upgrade math and science teachers who are teaching on temporary certification approval.

(4) States should establish scholarships or loan incentives to attract talented high school students into teacher education programs in math and science.

(5) Because of the large disparity between teaching salaries and salaries paid by industry, the secondary schools are losing many of their math and physical science teachers. The salaries paid by industry are almost double those paid teachers. State, govenment, and educational organizations should work with science related industries to improve salaries of science and math teachers. This might be accomplished by:

- negotiating with beginning teachers in areas of short supply to advance them on the salary schedule.
- employed teachers in areas of short supply might renegotiate their salaries anually.
- differential pay may be negotiated with teachers in short supply.
- summer employment with local science related industries should be explored.

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