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ABSTRACT

This report focuses on the supply/demand of mathematics/science (M/S) teachers in Illinois, evaluating four major assumptions made about these teachers. Each assumption is identified and examined in terms of whether the Illinois data support/reject the assumption. These assumptions are: (1) Supply of M/S teachers is insufficient to meet demand; (2) Turnover rate is higher for M/S teachers, and these teachers leave the profession to take jobs in private industry; (3) As a result of the critical shortage of M/S teachers, schools have vacancies; (4) Shortage of M/S teachers has resulted in local district administrators using minimally/poorly trained personnel to fill teaching positions. Analyses indicate that the shortage in Illinois is moderate and that turnover rates for M/S teachers are lower than the average turnover rate for all teachers. Of those mathematics teachers who leave, approximately one-fifth resign to take different employment. Data do not show that physics, chemistry, or higher-level mathematics teachers leave teaching at a greater rate than other M/S teachers. Furthermore, information obtained does not support the belief that there are many vacant M/S positions. Lastly, the quality of staff used to fill M/S positions is not known but it can be assumed that persons hired have valid teaching certificates. (JN)

THE SUPPLY AND DEMAND FOR ILLINOIS MATHEMATICS AND SCIENCE TEACHERS

ILLINOIS STATE BOARD OF EDUCATION

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FOREWORD

Illinois teacher supply and demand information is collected and analyzed annually by the Illinois State Board of Educaton. Such information provides descriptive statistics regarding the number of educational personnel being prepared and being employed by Illinois education institutions. During the past year, supply and demand information for mathematics and science teachers has been given prominent attention by the news media nationwide because of a perceived critical shortage in these teaching areas. This report focuses upon the supply and demand for mathematics and science teachers in Illinois and evaluates four major assumptions made about mathematics and science teachers.

Inquiries regarding this report should be directed to Dr. Lee Bartolini, Research and Statistics Section.

In recent months, a great deal has been written about a critical shortage of mathematics and science teachers in the nation's public schools.[1] It has been been argued in several national reports that this perceived critical shortage has affected the quality of education.[2] Widespread publicity about shortages of mathematics and science teachers has resulted in an abundance of proposed legislation designed to address the problem in one way or another.[3] In Illinois, Public Act 83-421, signed into law in September, 1983, provides for tuition scholarships for teachers who return to school to qualify to teach science or mathematics at the secondary school level. The purpose of this paper is to identify the supply and demand for mathematics and science teachers in Illinois for the past five years and to evaluate the appropriateness of certain beliefs about supply and demand to Illinois.

The supply of teachers consists of newly prepared educational personnel who have never taught and experienced teachers reentering the profession after having left for at least one year. The demand for teachers includes persons hired by local districts each year. Demand consists of beginning teachers, persons hired for the first time with no previous experience, and reentering teachers -- people who have taught in the past, left teaching, and are again employed as teachers. Another component of demand is the number of vacant positions which exist because of a lack of qualified candidates. Teacher turnover represents the number of teachers who leave the profession at the end of a given year. Illinois supply, demand, and turnover data presented here are for the years 1977-78 through 1982-83.

There are four widely held beliefs regarding the supply and demand for mathematics and science teachers. Each belief or assumption will be identified and then examined in terms of whether the Illinois data support or reject the assumption.

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1. Thomas Robinson, "House Passes $425 Million Emergency Math/Science Education Bill," Education Times, March 14, 1983. Page 1.

2. A Nation at Risk: The Imperative for Educational Reform, by the National Commission on Excellence in Education, David Pierpont Gardner, Chairman (Washington, D.C.: Government Printing Office, April, 1983), pp. 22,23; Making the Grade, by the Twentieth Century Fund Task Force on Federal Elementary and Secondary Education Policy (New York: Twientieth Century Fund, May, 1983) pp. 7-9; and Paul DeHart Hurd, "State of Precollege Education in Mathematics and Science," paper presented at the National Convocation on Precollege Education in Mathematics and Science, National Academy of Sciences and National Academy of Engineering, Washington, D.C., May 12-13, 1982.

3. "Federal Legislation: 'It Looks Like Having a Math and Science Bill Has Become a Requirement for Membership In the U.S. Senate," Education Times, April 11, 1983.

1. The supply of mathematics and science teachers is insufficient to meet demand. It is believed that there is a critical shortage of teachers in these subject areas.

The nationwide critical shortage of math and science teachers which is believed to exist may not be as severe in Illinois. Available information suggests that when compared to other subject/teaching areas, there is a relative shortage of mathematics and science teachers in Illinois. (See Table 1). When the number of newly prepared teachers is compared to the number of first time teachers hired in 1982-83, the ratio of supply to demand is lowest in mathematics, ranking fourteenth out of 14 selected subject areas. Natural science ranks tenth. All subject areas, however, show that more new teachers are being prepared than new teachers are being hired. While the supply/demand index is 1.17 for mathematics, it is 2.09 for natural science and is as high as 5.13 for regular elementary teachers. This means that slightly more than one math teacher is being prepared for each new, first time teacher hired. More than two science teachers are prepared for each new, first time science teacher hired. For elementary teachers, five teachers are prepared for each new person hired.

Table 2 compares supply and demand information for mathematics teachers, and Table 3 compares information for science teachers from 1977-78 to 1982-83. Both tables show the number of persons prepared (new supply), the number of persons hired (demand), and the turnover of teachers for the last six years. Demand and turnover data are presented for teachers in all public high schools in Illinois, excluding Chicago. Data by main assignment for teachers in the City of Chicago are not available for the last six years and, therefore, are not included. In 1982-83, however, it was reported that 10 science teachers were hired by the Chicago Public School system, all reentering teachers. Thirteen mathematics teachers were hired in Chicago 12 of whom were reentering teachers. In other words, only 1 new, first time teacher was hired by the Chicago Public School system in math or science in 1982-83 according to personnel information submitted to the State Board of Education.

For both mathematics and science teachers, the number of persons completing preparation for the first time was close (sometimes slightly higher and sometimes slightly lower) to the total number of persons hired in Illinois downstate schools during the last six years. Nevertheless, in every case, the number of new teachers prepared was considerably higher than the number of new, first time, teachers hired. While it is true that the supply of mathematics and science teachers has been decreasing, it is also true that demand has been decreasing. In mathematics, supply decreased by 35.5% from 1977-78 to 1982-83 while demand for mathematics teachers decreased by 35.4% during the same time period. The supply of science teachers decreased by 36.2% from 1977-78 to 1982-83 while demand decreased by 47.9%. In Illinois, the new supply and the reserve pool of previously prepared teachers seem to be keeping up with demand. Therefore, the supply of mathematics and science teachers cannot be perceived as a critical shortage at this time but rather as a moderate shortage.

2. The turnover rate is higher for mathematics and science teachers, and these teachers leave the profession to take jobs in private industry. It is believed that the exodus of teachers is especially prominent for those who teach chemistry, physics, and higher level mathematics, thus creating an acute shortage in these areas.

Tables 2 and 3 show that the rates of turnover (the percentage of those persons who leave teaching) for math and science teachers (5.4% and 5.5%, respectively) do not differ substantially from the rates of turnover for most other teaching specialities (averaging 6.7% in 1982-83). The turnover rates for mathematics and science teachers have, in fact, been lower than the average rate of turnover for all other teachers during each of the last six years.

Teachers leave the profession for a variety of reasons other than to take different employment. Turnover numbers and rates presented in Tables 2 and 3 include those who retire (16.5%), those who are laid off or asked to resign (15.5%), those who leave for reasons of domestic responsibility (11.9%), those who return to school (4.3%), those who leave because of health or who die (3.0%), those on professional leave (14.0%), and those who leave for the unknown reasons (14.1%). Approximately one-fifth (20.7%) of those who leave do so to take positions other than as educators. It is not known whether these individuals leave to take positions only in private industry. Regardless of reason, however, the data show that the turnover number was greater than the number of persons hired in mathematics and science for every year shown.

The fact that more people leave than are hired suggests that the need for newly prepared staff is continous. This need depends, however, on student enrollment in math and science courses. A State Board of Education study has documented that relative enrollment in mathematics courses has increased by 4% during the last five years, but that enrollment is science courses decreased by 2%. Amended legislation signed in September, 1983 (H.B. 1179), which will require that high school students take two years of math and one year of science to receive a diploma, may result in increased student enrollment in these subject areas, thus increasing the need for more teachers. The potential impact of the legislation, however, is not yet known since 80% of high schools already require one year each of math and science to graduate. However, only 10.5% of high schools require two years of mathematics.

Table 4 compares the number of persons prepared by major area of concentration with the main assignments of teaching staff hired in 1982-83. While this comparison does not reflect minor areas of preparation of new graduates, it provides a relative supply/demand index by specific teaching assignment.

Table 4 shows that, relative to demand, supply is greatest for biology and chemistry teachers. The number of new graduates prepared to teach these subjects is far greater than the total number hired, both beginning and reentering teachers. In the areas of earth science, general science, physical science, and physics, however, the number of teachers prepared is less than the total number hired. These data suggest that the need for teachers is greater in these latter areas, even though a substantial number of teachers are hired from the reserve pool, i.e., the reentering teachers. Turnover number, those leaving teaching, is higher than the total number hired in all areas of science except physical science and physics.

Table 4 shows that most mathematics teachers hired are reported to be assigned to teach algebra or basic/general math. Turnover number, however,

is greater than the number of teachers hired in algebra and geometry but is less than the number of teachers hired in general math and other math courses.

Data presented in Table 4 show that within the general area of science, shortages are more acute in physics, as well as earth science, general science, and physical science, but that supply is greater than the number of teachers hired in chemistry. Relative shortage among specific assignments in mathematics cannot be determined.

In summary, turnover of math and science teachers is not greater in these subject areas than in other specialties when all teachers within a broad teaching area are grouped together, but rather, turnover is lower. The data also do not show that the exodus of chemistry, physics, and higher level mathematics teachers is greater than for teachers of other subjects. Of those math and science teachers who do leave, approximately one-fifth find employment in other sectors of the economy, including private industry.

3. As a result of the critical shortage of math and science teachers, schools have vacancies. The supply of math and science teachers is so low, it is believed, that available positions go unfilled.

This belief is related to the first, that supply is insufficent to meet demand. College and university placement personnel in Illinois generally agree with this statement according to reports to the State Board of Education. Based upon their ability to place recent graduates into teaching positions, as well as their ability to find qualified candidates for known vacancies, placement directors report a moderate shortage of teachers in most natural science areas and a more severe shortage of mathematics teachers. (See Table 5). A State Board of Education study has not been able to document this perceived shortage, however.

In a study of vacant teaching positions in 1982-83, only one mathematics and two science positions were reported vacant. In 1981-82, four mathematics and five science positions were reported vacant.

4. The shortage of mathematics and science teachers has resulted in local district administrators using minimally trained or poorly trained personnel to fill teaching positions. Data presented in this report do not address the issue of quality of staff. It can be assumed that persons prepared and hired are minimally qualified - that is, have valid teaching certificates.

Some Illinois deans of education, as well as some placement personnel report that the quality of staff is a more important issue than the quantity of staff or whether the number prepared is sufficient to meet the number hired. It is believed that some stop-gap measures used in local districts to fill available positions have resulted in the use of poorly trained personnel. There are no data to support or refute this contention, however.

Summary

In summary, there is a shortage of teachers in mathematics and science in Illinois. The shortage can be described as moderate. The turnover rates for mathematics and science teachers are lower than the average turnover rate for all other teachers. Of those mathematics teachers who leave, approximately one-fifth resign to take different employment. Data do not show that physics, chemistry or higher level math teachers leave teaching at a greater rate than other science or math teachers. Furthermore, information obtained from Illinois public school districts does not support the belief that there are many vacant math and science teaching positions. Last, the quality of staff used to fill math and science positions is not known, but it can be assumed that persons hired have valid teaching certificates.

Table 1

A COMPARISON OF THE NUMBER OF GRADUATES PREPARED TO TEACH IN SELECTED SUBJECT AREAS DURING 1981-82 WITH THE NUMBER OF BEGINNING TEACHERS EMPLOYED IN ILLINOIS PUBLIC SCHOOLS IN 1982-83

Subject Area	Rank	Newly Prepared Teachers (Supply)	Full-time & Part-time Beginning Teachers (Demand)	Supply/ Demand Index
Elementary-Regular Instruction	1	1,972	350	5.63
Health Education	2	55	10	5.50
Social Sciences	3	268	52	5.15
Physical Education	4	651	150	4.34
Art	5	175	62	2.82
Business Education	6	126	46	2.74
Home Economics	7	108	43	2.51
Music	8	340	150	2.27
Special Education	9	1,337	612	2.18
Natural Science	10	157	75	2.09
Foreign Languages	11	79	42	1.88
English-language Arts	12	252	143	1.76
Industrial/Vocational Education	13	156	103	1.51
Mathematics	14	129	110	1.17

NOTE: The new supply of teachers was taken from the "New Supply of Illinois Instructional Personnel" forms which were completed by Illinois colleges and universities preparing teachers and collected by the Illinois State Board of Education. The number of beginning teachers was taken from the Teacher Service Record forms which are collected by the Illinois State Board of Education and include part-time and full-time teachers in all Illinois public school districts, including the Chicago Public School System.

Table 2

SUPPLY AND DEMAND FOR MATHEMATICS TEACHERS

Year	Number of Persons Completing Preparation in Illinois (New Supply)	Number of Persons Hired in Illinois Downstate Public High Schools (Demand) Beginning	+	Reentering	=	Total	Math Turnover No.	(%)	Other Subjects Turnover (%)
1977-78	197	72	+	103	=	175	217	(8.3%)	(9.6%)
1978-79	155	79	+	108	=	187	216	(8.3%)	(9.5%)
1979-80	123	62	+	89	=	151	199	(7.7%)	(10.1%)
1980-81	123	58	+	93	=	151	195	(7.5%)	(8.2%)
1981-82	129	54	+	76	=	130	180	(7.0%)	(8.2%)
1982-83	127	48	+	65	=	113	138	(5.4%)	(7.0%)

Table 3

SUPPLY AND DEMAND FOR SCIENCE TEACHERS

Year	Number of Persons Completing Preparation in Illinois (New Supply)	Number of Persons Hired in Illinois Downstate Public High Schools (Demand) Beginning	+	Reentering	=	Total	Science Turnover No.	(%)	Other Subjects Turnover (%)
1977-78	218	103	+	91	=	194	211	(7.9%)	(9.6%)
1978-79	185	88	+	99	=	187	205	(7.7%)	(9.5%)
1979-80	156	70	+	107	=	177	248	(9.5%)	(10.1%)
1980-81	142	64	+	84	=	148	192	(7.5%)	(8.2%)
1981-82	157	54	+	59	=	113	157	(6.2%)	(8.2%)
1982-83	139	39	+	62	=	101	137	(5.5%)	(7.0%)

NEW SUPPLY New teacher graduates prepared by Illinois colleges and universities.

NEW (BEGINNING) DEMAND Persons hired as teachers for the first time (with no previous experience).

REENTERING DEMAND Persons hired as teachers who have taught in the past, have left teaching for at least one year, and are again employed as teachers.

TOTAL DEMAND Estimated total incoming teachers (beginning and reentering) in Illinois public schools.

TURNOVER refers to that group of individuals which for any reason terminated their employment with a public school district between May and September, and did not undertake employment in another Illinois public school district.

Table 4.

SUPPLY AND DEMAND FOR MATHEMATICS AND SCIENCE TEACHERS
BY MAIN ASSIGNMENT: 1982-83

Major Area of Preparation	Number of Persons Completing Preparation in Illinois (New Supply)	No. of Persons Hired in Illinois Public High Schools (Demand) Begin	+	Reenter	=	Total	Turnover No.	(%)
SCIENCE:								
Biology	83	15	+	22	=	37	50	(4.8%)
Chemistry	27	4	+	13	=	17	27	(5.4%)
Earth Science	3	3	+	8	=	11	14	(8.2%)
General Science	4	9	+	10	=	19	27	(9.1%)
Physical Science	5	4	+	4	=	8	7	(5.4%)
Physics	7	4	+	4	=	8	7	(3.5%)
Other	10	0	+	1	=	1	5	(3.4%)
Total Science	139	39	+	62	=	101	137	(5.5%)
MATHEMATICS:								
Algebra	*	30	+	29	=	59	81	(5.4%)
Geometry	*	1	+	8	=	9	22	(5.3%)
Basic/Gen. Math	*	16	+	22	=	38	29	(6.6%)
Other Math	*	1	+	6	=	7	6	(3.3%)
Total Math	127	48	+	65	=	113	138	(5.4%)

*Only the total supply of mathematics teachers is known. Major area of preparation in mathematics is not designated by specific course or subject.

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Table 5

TEACHER SUPPLY AND DEMAND AS RATED BY PLACEMENT DIRECTORS FROM ILLINOIS COLLEGES AND UNIVERSITIES: 1982-83

RATING CODE

A zero means the supply equals the demand.
A -1 through -5 represents an increasing degree of teacher shortage.
A 1 through 5 represents an increasing degree of teacher oversupply.

Extreme Teacher Shortage -5	-4	-3	-2	Slight Teacher Shortage -1	Supply Equals Demand 0	Slight Teacher Oversupply 1	2	3	4	Extreme Teacher Oversupply 5

AREA OF PREPARATION AND NUMBER OF RATERS	RANK ORDER 1982-83	AVERAGE (MEAN) RATING* 1982-83	1981-82	1980-81	1979-80
ELEMENTARY SCHOOL TEACHERS					
Physical Education - (29)	1	+2.9	+2.3	+1.6	+1.5
Regular Elem. Instruction - (49)	2	+2.2	+1.9	+1.5	+1.6
Health Education (K-8) - (15)	3	+2.0	+1.6	+1.5	+1.6
Art (K-8) - (28)	4	+1.9	+1.8	+1.5	+1.6
Foreign Languages - (24)	5	+1.0	+0.7	+0.4	+0.8
Music (K-8) - (35)	6	+0.7	+0.3	+0.5	+0.2
Early Childhood (Pre-Kindergarten) - (27)	7	+0.6	+1.0	+0.3	+0.5
JUNIOR HIGH SCHOOL TEACHERS					
Social Science - (40)	1	+1.9	+2.2	+1.7	+1.4
Home Economics - (18)	2	+1.8	+1.1	+0.2	-0.4
Language Arts - (37)	3	+0.6	+0.3	+0.6	+0.1
Industrial Arts - (14)	4	-1.0	-1.9	-3.8	-4.0
Natural Science - (39)	5	-2.1	-1.9	-2.1	-2.5
Mathematics - (40)	6	-3.0	-2.7	-2.6	-3.6
HIGH SCHOOL TEACHERS					
Sociology - (26)	1	+3.0	+2.3	+2.1	+1.9
Psychology - (23)	2	+2.9	+2.6	+2.4	+1.9
Physical Education - (36)	3	+2.8	+2.4	+2.0	+1.7
History - (45)	4	+2.3	+2.3	+2.0	+1.8
Government, Civics & Political Science - (28)	5	+2.3	+2.0	+1.8	+1.7
Economics - (20)	6	+2.3	+1.5	+1.3	+0.9
Geography - (19)	7	+1.7	+2.0	+1.0	+1.4
Art - (33)	8	+1.7	+1.6	+1.7	+1.5
Speech and Drama - (30)	9	+1.6	+1.0	+1.2	+0.5
Journalism - (17)	10	+1.4	+0.6	+0.5	+0.4
Driver and Safety Ed. - (13)	11	+1.4	+1.0	+0.1	+0.6
Health Education - (16)	12	+1.4	+1.1	+0.7	+0.9
Home Economics - (17)	13	+1.2	+0.4	+0.0	-0.4
"Other" H.S. Teachers - (4)	14	+1.0	-1.0	+0.0	+0.8
German - (28)	15	+0.9	+0.7	+0.7	+0.9
French - (34)	16	+0.9	+0.7	+1.0	+0.8
Health Occupations - (7)	17	+0.9	+0.9	+0.4	+0.4
Music - (35)	18	+0.5	+0.4	+0.5	+0.2
English - (49)	19	+0.5	+0.2	+0.3	-0.0
Business Education - (20)	20	+0.3	-0.3	-0.6	-0.8
Spanish - (35)	21	+0.1	+0.1	+0.3	-0.1
Latin - (12)	22	+0.1	-1.3	-0.2	+0.0
Russian - (12)	23	-0.1	-0.5	-0.5	+0.6
Industrial Occupations - (8)	24	-0.5	-1.4	-3.0	-3.6
Earth Science - (24)	25	-0.8	-1.1	-1.4	-1.4
Biology - (43)	26	-1.0	-1.5	-1.4	-1.6
General Science - (30)	27	-1.3	-1.3	-1.8	-1.9
Industrial Arts (General) - (11)	28	-1.5	-2.8	-3.4	-3.9
Coop. Voc. Ed. Program - (8)	29	-1.9	-1.6	-2.2	-2.3
Agriculture - (8)	30	-2.5	-3.4	-3.9	-4.1
Chemistry - (40)	31	-2.6	-2.7	-2.8	-3.0
Physics - (38)	32	-2.8	-3.0	-3.1	-3.1
Mathematics - (48)	33	-3.4	-2.9	-3.4	-3.4

Table 5 (Continued)
TEACHER SUPPLY AND DEMAND AS RATED BY PLACEMENT DIRECTORS
FROM ILLINOIS COLLEGES AND UNIVERSITIES: 1982-83

RATING CODE

A zero means the supply equals the demand.
A -1 through -5 represents an increasing degree of teacher shortage.
A 1 through 5 represents an increasing degree of teacher oversupply.

Extreme Teacher Shortage -5	-4	-3	-2	Slight Teacher Shortage -1	Supply Equals Demand 0	Slight Teacher Oversupply 1	2	3	4	Extreme Teacher Oversupply 5

AREA OF PREPARATION AND NUMBER OF RATERS	RANK ORDER 1982-83	AVERAGE (MEAN) RATING* 1982-83	1981-82	1980-81	1979-80
SPECIALIZED PERSONNEL					
Guidance Counselor - (17)	1	+1.7	1.3	+0.9	+0.6
Career/Voc. Counselor - (10)	2	+1.4	+0.4	-0.4	+0.2
School Psychologist - (15)	3	+0.7	-0.5	-0.7	-2.2
School Social Worker - (10)	4	+0.5	+0.3	-1.0	-1.8
Librarian - (11)	5	+0.3	-0.1	-0.2	-0.3
Instructional Media Coordinator - (11)	6	+0.2	+0.7	-0.2	+0.4
School Nurse - (9)	7	-1.1	-0.3	-1.3	-1.0
SPECIAL EDUCATION TEACHERS					
Gifted Ed. Teacher - (8)	1	+0.2	-0.3	-0.8	-0.6
Remedial Reading - (18)	2	+0.1	-0.9	-1.3	-1.3
Educable Mentally Handicapped - (18)	3	0.0	-0.8	-0.9	-1.8
Deaf & Hard of Hearing - (8)	4	-0.4	-1.6	-2.5	-2.5
Trainable Mentally Handicapped - (16)	5	-0.8	-1.1	-1.3	-2.2
Visually Impaired - (6)	6	-1.0	-2.4	-3.1	-2.9
Speech and Language Impaired - (13)	7	-1.1	-2.4	-3.0	-3.9
Learning Disabilities - (25)	8	-1.1	-1.2	-1.7	-2.4
Physically Handicapped - (6)	9	-1.2	-2.6	-2.7	-2.9
Emotional and Soc. Disorders - (20)	10	-1.4	-1.8	-2.3	-2.9
Bilingual Teacher - (21)	11	-1.7	-2.0	-2.1	-1.6
Severe/Profound Handicapped - (12)	12	-1.8	-2.1	-2.3	-2.8
"Other" Special Education - (7)	13	-1.9	-1.1	-1.8	-1.0
ADMINISTRATORS					
Personnel Director - (11)	1	+1.7	+1.7	+1.3	+2.2
Principal - (20)	2	+1.6	+1.7	+1.3	+1.1
Curriculum Director - (14)	3	+1.5	+1.3	+0.8	+1.7
Superintendent - (17)	4	+1.1	+1.4	+1.4	+0.9
Research Director - (9)	5	+0.9	+0.7	-0.2	+0.9
Business Manager - (12)	6	+0.1	-0.5	-0.4	+0.3
Voc. Ed. Administrators - (10)	7	-0.6	-0.3	-0.7	-1.1

* The mean ratings were calculated from individual ratings supplied by placement directors. Placement directors were asked to rate only those areas in which their institutions prepared certificated school personnel for which they had a definite opinion. The number of persons rating each speciality area is provided in parenthesis.

All information was provided by Illinois university and college placement personnel on the "Teacher Supply and Demand Rating Scale" form collected annually by the Illinois State Board of Education.