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The Academic Preparation of Idaho Science Teachers Based on School District Size

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The certification records of 435 of the 632 teachers who taught science in Idaho during the 1983-84 school year were examined. Data recorded included subject endorsed to teach, highest degree held, and science credits taken at the college level. The academic preparation of Idaho science teachers was examined by subject taught and size of school district. Significant differences were found for the following when analyzed by school district size. Physiology, earth science, and chemistry I teachers in the largest school districts had more credits in the subjects they taught. Earth science and chemistry I teachers in the largest districts had a higher frequency of a major in the subject taught and those teachers in the smallest school districts had a higher frequency of having neither a major or minor in the subject taught. A larger percentage of physiology, earth science, and chemistry I teachers in the largest school districts had endorsements to teach the subjects they were assigned. Science teachers in the smaller school districts had significantly more different subjects to prepare to teach.

The shortage of qualified science teachers has been well documented [3; 4; 5; 8; 9; 10]. The result of this shortage has been the widespread use of unqualified teachers in science classrooms [12]. A study of midwestern states suggests the shortage of science teachers has been particularly difficult for small/rural school districts [3].

A survey of science teachers in Idaho indicated that 25% were teaching in areas in which they were not endorsed [7]. Idaho's colleges and universities were filling about half of the need for new science teachers [6]. Forty-four percent of Idaho school districts reported difficulty filling science positions [1].

Idaho is a rural state by most standards. It has only one metropolitan area as defined by the United States census. The population density for the state is 11.4 people/square mile. Sixty-eight percent of the counties have a population density of less than 15 people/square mile and 46% of the population lives in rural areas [11]. The rural nature of the state is also reflected in its schools. Sixty-six of the state's 116 school districts (57%) have fewer than 1000 students and 44 of these districts (38% of all districts) have fewer than 500 students [2].

Although many studies have pointed out the shortage of qualified science teachers, little research has been conducted on the qualifications of those who are currently teaching science, particularly those teaching in small schools. In the study reported here, the academic preparation of Idaho's secondary science teachers was analyzed by school district size.

DATA COLLECTION

The data used in this study were available only in the certification files of the State Department of Education in Boise, Idaho. The Idaho State Department of Education supplied the following data for all teachers teaching science during the 1983/84 school year: name, school district, subject(s) taught, and the number of classes taught, including the number of classes taught in each subject. The State Department of Education also gave permission to gather the following information from the certification files of each science teacher: subjects endorsed to teach, highest degree held, and science credits taken at the college level.

Two researchers were able to examine the records of 435 of the 632 Idaho science teachers in the four days allocated to data collection. In order to examine as many files as possible in the allotted time, an alphabetical list of science teachers names was used to select the sample. On the first day files were examined in alphabetical order starting at the beginning of the list and continuing until the end of the day. The size of the sample for a given day was always determined by the time available. The sample for the second day was chosen by starting at the end of the list and working toward the start. For the third and fourth days the list was divided in half. The sample for the third day was chosen by working from the middle toward the start of the list. On the fourth day, the sample selection proceeded from the middle of the list toward the end.

College science credits were categorized as: biological science, physics, chemistry, earth science, and other science. In general, courses offered by science departments were counted as science courses. Exceptions were agricultural courses titled Plant Science or Animal Science, which were counted as biological science. Astronomy appeared under a variety of department designations including physics, astronomy, space science, earth science, and mathematics. Astronomy credits were categorized as physics for teachers having a physics major or minor. Astronomy courses were categorized as earth science for all other teachers. Courses devoted to the teaching of science were not counted as science credits. Courses such as history of science, philosophy of science,

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TABLE 1

School District Size Categories and Number of Science Teachers in Each Category

Category	Range of Student Population in District	Number of Districts	Total Students	Total Science Teachers	Science Teachers in Sample
1	over 5000	9	87,354	220	148
2	2500–4999	12	44,748	134	91
3	1000–2499	29	47,859	164	102
4	500–999	22	16,414	82	44
5	under 499	44	10,289	70	50

TABLE 2

Preparation of Teachers of Science Subjects by School District Size

Subject Taught	District Size Category	Teachers in Sample	Average Credits in Subject Taught	Percent Endorsed in Subject Taught	Percent with Major	Percent with Minor	Percent with Fewer than 20 Credits
General Science	1	62	46.6	70.5	66.1	21.0	12.9
	2	18	47.9	63.2	77.8	11.1	11.1
	3	42	44.0	54.5	59.5	26.2	14.3
	4	17	34.5	70.6	41.2	47.1	11.8
	5	24	43.5	62.5	50.5	33.3	16.7
Life Science	1	10	38.5	70.0	50.0	20.0	30.0
	2	7	26.7	50.0	42.9	0.0	57.1
	3	4	44.8	100.0	75.0	25.0	0.0
	4	6	29.7	83.3	16.7	50.0	33.3
	5	5	50.6	80.0	80.0	0.0	20.0
Biology One	1	39	40.9	92.3	71.8	17.9	10.3
	2	24	35.0	79.2	62.5	12.5	25.0
	3	29	38.6	82.8	72.4	6.9	20.7
	4	17	34.4	76.5	47.1	29.4	23.5
	5	21	37.6	90.5	61.9	23.8	14.3
Biology Two	1	8	48.9	87.5	87.5	0.0	12.5
	2	6	36.2	83.3	66.6	0.0	33.5
	3	12	46.8	91.7	91.7	0.0	8.3
	4	4	45.8	100.0	75.0	25.0	0.0
	5	3	41.3	100.0	100.0	0.0	0.0
Physiology	1	6	49.7	100.0*	83.3	16.5	0.0
	2	3	7.3	0.0	0.0	0.0	100.0
	3	4	36.0	50.0	75.0	0.0	25.0
	4	4	32.0	75.0	50.0	25.0	25.0
	5	2	7.5	0.0	0.0	0.0	100.0
Physical Science	1	13	16.1	35.7	30.8	7.7	61.5
	2	19	18.0	31.6	10.5	21.1	68.4
	3	20	17.3	42.9	25.0	15.0	60.0
	4	3	15.0	0.0	0.0	0.0	100.0
	5	5	18.0	20.0	20.0	0.0	80.0
Chemistry One	1	10	22.2	54.5*	30.0*	30.0*	40.0*
	2	11	32.2	72.7	45.5	36.4	18.2
	3	18	20.6	26.3	16.7	11.1	72.2

TABLE 2 Continued

Preparation of Teachers of Science Subjects by School District Size

Subject Taught	District Size Category	Teachers in Sample	Average Credits in Subject Taught	Percent Endorsed in Subject Taught	Percent with Major	Percent with Minor	Percent with Fewer than 20 Credits
	4	7	17.3	28.6	0.0	42.9	57.1
	5	16	13.2	18.8	6.3	6.3	87.5
Chemistry	1	2	42.0	100.0	100.0	0.0	0.0
Two	2	5	37.0	100.0	60.0	20.0	20.0
	3	3	37.0	66.7	66.7	0.0	33.3
	4	0					
	5	0					
Physics	1	6	14.3	16.7	20.0	0.0	80.0
	2	8	21.0	37.5	25.0	0.0	75.0
	3	14	13.5	14.3	9.1	0.0	90.9
	4	7	13.0	14.3	0.0	0.0	100.0
	5	8	20.1	37.5	16.7	0.0	83.1
Earth	1	14	25.0*	50.0*	38.5*	23.1*	38.5*
Science	2	16	7.6	6.3	0.0	6.3	93.8
	3	15	12.1	26.7	13.3	6.7	80.0
	4	14	7.2	0.0	0.0	7.1	92.9
	5	12	3.8	0.0	0.0	0.0	100.0

Note: (*) denotes where means are significantly difficult at the .05 level. The significance of differences between individual group means is discussed in the text.

photography, and engineering were not counted as science credits.

Many teachers were endorsed to teach more than one subject. A record was kept of the number and the type of endorsement. Science endorsements were recorded in the following categories: biology, chemistry, physics, physical science, earth science, general science, and other science.

Since analyses were done by subject taught, teachers were included more than once if they taught more than one science subject. The 435 teachers in this sample represented 630 different teacher/subjects. The average number of different subjects taught by each science teacher was 2.7. Of these 1.4 were different science subjects. Forty-one percent of the science teachers in this sample taught at least one non-science class.

Teachers were placed into one of five categories based on the size of the school district where they taught. The categories were those used by the Idaho State Department of Education for reporting statistical data and are based upon the school district's enrollment. Table 1 shows the categories and the number of teachers from each category included in this study.

DATA ANALYSIS

Teachers of specific science subjects (general science, earth science, physics, chemistry 1, chemistry 2, life science, biology 1, biology 2, and physiology) were categorized by school district size. The following analyses were conducted comparing school district sizes within each classification of specific science subjects: average number of credits in subject taught, endorsed in subject taught, number of different subjects to prepare to teach, percentage of teachers with less than 20 credits in the subject taught, percentage with 20 to 29 credits in the subject taught (equivalent to a minor), and the percentage with 30 or more credits in the subject taught (equivalent to a major).

Some analyses were conducted with all science teachers combined and categorized by school district size. Those comparisons were: number of subjects to prepare to teach, average number of total science credits, and degree held. When the differences were significant, the Scheffé test was used to determine which group means were statistically different.

Analysis of variance was used to compare differences in the average number of credits in subject taught, total science credits, and the number of subject preparations. Chi square was used to compare differences in endorsement, degrees held, and whether the teacher had a major, minor, or neither in the subject taught. All analyses used a $p = .05$ level to establish significance.

RESULTS

The results of these analyses were summarized in Table 2. Those analyses where differences were significant will be discussed.

TABLE 3
The Number of Preparations for Science Teachers Compared by School District Size

Subject Taught	District Size Category	Number of Preparations	Mean Separations See Note 1-2-3-4-5	*F* Ratio	*F* Probability
General Science	1	1.5		41.2090	<.0001
	2	1.8			
	3	2.0			
	4	3.3	* * *		
	5	4.0	* * *		
Life Science	1	2.6		4.7595	.0045
	2	2.1			
	3	2.0			
	4	3.3			
	5	4.2	* *		
Biology One	1	1.8		24.8324	<.0001
	2	2.0			
	3	2.7	*		
	4	3.3	* *		
	5	4.3	* * * *		
Biology Two	1	2.1		6.9530	.0005
	2	2.1			
	3	3.1			
	4	3.3			
	5	5.7	* * *		
Physiology	1	2.0	#	3.2589	.0390
	2	2.0			
	3	2.7			
	4	3.5			
	5	4.0			
Physical Science	1	2.2		6.2062	.0003
	2	1.7			
	3	2.8			
	4	3.3			
	5	4.2	* *		
Chemistry One	1	2.6		9.5731	<.0001
	2	2.5			
	3	3.7			
	4	3.7			
	5	4.6	* *		
Chemistry Two	1	2.5	#	5.0759	.0434
	2	2.6			
	3	4.7			
	4				
	5				
Physics	1	3.2		7.7933	.0001
	2	2.8			
	3	3.6			
	4	4.2	*		
	5	5.0	* * *		
Earth Science	1	1.6		35.6857	.0001
	2	1.6			
	3	2.3			
	4	3.7	* * *		
	5	4.7	* * *		

TABLE 3 Continued

The Number of Preparations for Science Teachers Compared by School District Size

Subject Taught	District Size Category	Number of Preparations	Mean Separations See Note 1-2-3-4-5	*F* Ratio	*F* Probability
All	1	1.7		73.1646	.0001
	2	1.8			
	3	2.3	* *		
	4	3.4	* * *		
	5	4.2	* * * *		

Note: (*) denotes pairs of groups whose means are significantly different at the .05 level using the Scheffé procedure. (#) Although the *F* value for this comparison was significant, the Scheffé procedure produced no significant differences between means of specific groups.

Credits in Subject Taught

Differences in the average number of credits earned in the subject taught were significant for physiology, chemistry 1, and earth science teachers. Physiology teachers who taught in the largest school districts (size 1) had an average of 49.7 credits in biology. This was significantly different from the 7.3 and 7.5 credits in biology for physiology teachers in the size 2 and size 5 districts respectively.

Chemistry 1 teachers in size 2 schools had an average of 33.2 credits in chemistry. This was significantly different than the 13.3 and 20.6 credits in chemistry for teachers in size 5 and size 3 schools respectively.

Earth Science teachers in size 1 school districts had an average of 25 credits in earth science. This was significantly higher than the average for each of the other school district size categories.

Major/Minor

Another way to look at the academic preparation of science teachers is by determining whether they have the equivalent of a major or minor in the subject taught. Teachers with 30 or more credits in the subject taught were considered to have the equivalent of a major in that subject. If they had 20 to 29 credits, they were considered to have the equivalent of a minor. If they had fewer than 20 credits, they were considered to not have the equivalent of a major or a minor in the subject taught.

When the percentages of teachers with a major, minor, or neither were compared by school district size, significant differences were found for only chemistry 1 and earth science teachers. The trend in both cases was for the larger school districts to have more teachers with a major and the smaller school districts to have more teachers without the equivalent of a major or minor in the subject they teach.

Total Science Credits

The average total number of science credits for Idaho's science teachers was 49.8. The average by school district size ranged from 43.9 for size 4 to 52.3 for size 1. These differences were not significant.

Degrees Held

Approximately one third (31.6%) of the science teachers in Idaho had Master's degrees. The range was from 22.8% for size 3 school districts to 38.1% for size 4 school districts. These differences were not significant.

Endorsement

The percentage of teachers endorsed to teach the subject they were assigned was analyzed by school district size. Significant differences were found for physiology, chemistry 1, and earth science teachers. The endorsement for physiology teachers is biology. None of the physiology teachers in size 2 or 5 school districts were endorsed in biology. At least half of the physiology teachers in the other size categories were endorsed in biology.

More than half of the chemistry I teachers in the two largest size categories were endorsed to teach chemistry. While fewer than 30% of the chemistry 1 teachers were endorsed to teach chemistry in the three smallest district categories.

Half of the earth science teachers in the size 1 school districts were endorsed to teach earth science. None of those teaching in the two smallest size categories were endorsed to teach earth science. Size 2 school districts had only 6.3% of the earth science teachers endorsed to teach earth science while 26.7% of those in size 3 school districts were endorsed to teach earth science.

Preparation

Science subjects were analyzed separately in order to compare the number of preparations between school district sizes. As expected, the trend was from fewer preparations for teachers in large school districts to more for teachers in small districts. Significant differences were found within all subject areas except physiology and chemistry 2. The *F* value for the comparisons of chemistry 2 and physiology teachers was significant, but the Scheffé procedure produced no significant differences between different size school districts. Teachers in the size 5 school districts had the most preparations and those in the size 4 school districts had the next most preparations. The number of preparations for science teachers in size 5 school districts was statistically greater than at least two

of the other size categories. See Table 3 for the specific differences. The number of preparations for science teachers in size 5 school districts ranged from 5.7 for biology 2 teachers to 4.0 for physiology and general science teachers; whereas the range for science teachers in the size 1 school districts was from 1.5 to 3.2.

When the analysis of school district size versus number of preparations was conducted across all science subjects, no differences were found between size 1 and size 2 school districts. They averaged 1.7 and 1.8 preparations, respectively. The differences between each of the other size categories were all significant. The average for the size categories were 2.3 preparations for size 3, 3.4 preparations for size 4, and 4.2 preparations for size 5.

DISCUSSION

The surprising result of this study was not the significant differences were found but that the number was so small. Differences that were found tended to favor the larger school districts. In the subject areas of physiology, chemistry 1, and earth science, differences were found between teacher qualifications according to school district size when examining endorsements held and credits earned in the subject taught. In the other seven subjects there were no differences in the academic preparation of science teachers in small districts when compared to those in larger school districts.

The results may be encouraging to administrators of small schools. However, the results showed that large schools have the same problems in attracting qualified science teachers as do the smaller schools. Only 57% of Idaho science teachers were endorsed to teach the subject they taught, while 39% had less than a minor in the subject they taught.

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