

THE PREPARATION OF KANSAS ELEMENTARY
TEACHERS IN SCIENCE

by

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INTRODUCTION

This is admittedly an age of great emphasis on science. It is also a time when teacher education in general, and science teacher education in particular is being studied and evaluated to determine how to best prepare the teacher for the modern elementary school. Authorities on teacher education are not always in agreement in their recommendations. Varied standards for science education have been set forth both by authorities and teacher training institutions regarding the education needed by the elementary teacher to function adequately in the role of science teacher in the classroom.

Statement of the problem. How well the Kansas elementary teacher measured up to the standards recommended by authorities and the requirements of the state supported teacher training institutions of the state was a subject that had not been explored. The purpose of this study was to answer the following questions with reference to Kansas elementary teachers:

1. What was the extent and nature of the preparation of Kansas elementary teachers in the area of science?
2. How did the preparation of the Kansas elementary teacher compare with the requirements set forth by the state supported teacher training institutions and with the recommendations of recognized authorities and professional groups?

Procedure. An alphabetized master list of all elementary teachers in Kansas was obtained from the Kansas State Department of Public Instruction. This list contained 13,684 names and included all teachers in all grades from kindergarten through grade eight.

By division of every other page of the list in half, 176 groups of names,

still in alphabetical order, was created. Each group of names contained eighty-seven teacher's names. By a lottery process, it was decided to select every twenty-third name in each group. These names, thus selected, were marked to make up the sample list of 176 teacher's names. The sample represented 1.3 per cent of the total number of elementary teachers in Kansas.

The folder on each teacher whose name was in the sample was taken from the files in the Certification Division of the Kansas State Department of Public Instruction in Topeka, Kansas. Each teacher's transcript and certification data sheet was studied and the following information was recorded:

Sex

Kind of certificate held

Name of college or university attended

Total number of semester hours in science (astronomy, biology, botany, chemistry, geology and earth science, physics, physiology, physical science, and zoology)

Total number of semester hours in methods of teaching elementary science

The information thus obtained is presented in this report.

DEFINITION OF TERMS

Elementary teacher. A teacher currently engaged in classroom teaching in grades kindergarten through eight, inclusively, in state-supported public schools.

State-supported teacher training institutions. The following institutions comprised the list of state-supported institutions used in this study:

University of Kansas

Kansas State University

Wichita State University

Kansas State Teachers College of Emporia

Kansas State College of Pittsburg

Fort Hays Kansas State College

Curriculum requirements. The required course of study for elementary teachers as set forth in the current catalog of the above named institutions.

Science course. In this report a science course will be considered to be a course on college level taught in the science department of a college or university.

Science methods course. A college level course taught in the department of education. This course is one which deals specifically with methods of teaching science in the elementary school.

REVIEW OF LITERATURE

Much has been written about the preparation of the elementary teacher in the area of science. Research journals, books, and professional journals abound with accounts of various studies and the opinions of recognized experts on teacher education. A complete spectrum of opinions exists with the recommendations almost as widely divergent.

The considerations being given to the education of elementary teachers is best understood when it is remembered that college training for this group of teachers is a relatively recent thing. In the early decades of the twentieth century, the teacher for the lower grades went directly from the high school to the elementary classroom or was prepared in institutes or normal schools held for a few days or weeks during the summer. In the thirties and forties, the teacher's colleges took over the job of educating those men and women who were to teach in the lower grades, and there emerged a curriculum designed to prepare teachers for the elementary classroom and grant them a bachelor's degree at the end of four years of study. It was as late as 1948, however, before college attendance became compulsory for elementary teachers in Kansas. An earlier attempt to require thirty semester hours had been shelved due to the wartime shortage of teachers. The push for a college degree for all teachers was begun in 1938 by the Kansas State Teachers Association. With the entrance into the picture by TEPS (Commission on Teacher Education and Professional Standards) the matter took on a greater degree of importance and the rise in standards came rapidly. Wright has called this elevation of standards for certification phenomenal.¹ It was, however, 1959 before a bachelor's

¹C.O. Wright, 100 Years in Kansas Education, (Topeka: The Kansas State Teachers Association, 1963), p. 49.

degree became a requirement for certification in Kansas though six state supported institutions of higher learning had offered such a program for many years.¹

With the increase in the educational level of the general population which followed World War II, and especially with the launching of the first Russian orbital satellite, Americans began to critically appraise their public schools and the training of the teachers who staffed those schools. Much of the focus of the early sixties was on the science programs in the schools and on the teachers who were charged with responsibility for teaching science. Early attention was given to upgrading the education of the secondary science teacher but the movement found its way into the elementary school in a very short time with the education of elementary teachers being scrutinized with an eye to competency in science. Between the years of 1960 and 1964, the National Science Foundation and other foundations spent millions of dollars on in-service education for both secondary and elementary science teachers.²

In the mid sixties, the education of elementary teachers was being given attention as evidenced by research studies and recommendations from professional groups and authorities on teacher training. James B. Conant, in his most recent book, has recommended a plan for the education of elementary teachers which would include twelve semester hours of physical and biological science in addition to any survey course in those subjects. This is also in addition to any methods course for teaching science in the elementary school. His recommendation was formulated after a study of teacher training

¹C. O. Wright, 100 Years in Kansas Education, (Topeka: The Kansas State Teachers Association, 1963), pp. 1-178.

²Alfred de Grazia and David Sohn, Revolution in Teaching, (New York: Bantam Books, 1964), pp. 184-186.

institutions of all sizes and types in all fifty states. His research revealed that more than half of the institutions included in his survey required more semester hours in physical education or art than they required in the sciences.¹

The need for better understandings in the sciences was pointed out by the teachers themselves when they expressed their feelings of inadequacy to teach science in their classrooms. Victor surveyed the elementary teachers in one city in Illinois to study their attitudes and competency in teaching science. With a randomized sample made up of 106 teachers, he found the most common reason given by teachers for their reluctance to teach science was their feeling that their background education was inadequate. Seventy-five per cent of the teachers included in his survey had taken less than two years of science in college with biology the most common choice. He concluded that the key problem to the establishment of a definite integrated program of science in the elementary school was the lack of understanding on the part of elementary teachers of the objectives of science education. This, in turn, produced a lack of confidence in their ability to teach science in their classrooms. Victor expressed his concern that "the inadequate preparation of teachers might become a stumbling block to the process of improving the elementary science program."²

Scott echoed Victor's concern in his report of an experiment in teaching basic science in the elementary schools of Pittsburg, Pennsylvania. He found that the program which was structured around six instructional units was enthusiastically accepted in the schools but the major instructional failures

¹James B. Conant, The Education of American Teachers, (New York: McGraw-Hill Book Company, 1963), pp. 34-110.

²Edward Victor, "Why are Elementary School Teachers Reluctant to Teach Science?" The Science Teacher, 28:7, November, 1961

were associated with the lack of competence on the part of the teacher.¹

Eiss, commenting on an in-service program to train elementary teachers by the Pennsylvania Department of Public Instruction, had this to say about the goals involved: "Many elementary teachers are poorly prepared and afraid to teach science. This has resulted in a textbook-centered curriculum. At its worst, it is only a course in reading about science."² His department, the Pennsylvania Department of Public Instruction, produced a series of films for the express purpose of "giving elementary teachers a more adequate background in science."³

Pierce, whose professional capacity is that of teaching teachers, reported that his students who were teachers were "frightened and tense about teaching science because of a feeling of incompetence."⁴ The degree to which the feeling is a reflection of a lack of knowledge was reported by Washton who tested 100 teachers enrolled in his graduate class in "Science for the Elementary School." He found that these teachers possessed a knowledge of science equivalent to that of the average ninth grade student.⁵

Donald W. McCarthy, assistant science supervisor for the Cleveland, Ohio, public schools, said that the lack of a background in science among elementary teachers is appalling. He called attention to the fact that teachers admit

¹Lloyd Scott, "An Experiment in Teaching Basic Science in the Elementary School," Science Education, Vol. 46, No. 2. March, 1962.

²Albert Eiss, "New Techniques in Science Instruction in the Elementary Schools," Science Education, Vol. 46, No. 2. March, 1962.

³Ibid.

⁴William M. Pierce, "Elementary Teaching Roadblocks," The Science Teacher, Vol. 30, No. 3. April, 1963.

⁵Nathan S. Washton, "Improving Elementary Teacher Education in Science," Science Education, 45: 33-34, Feb. 1961.

they are not prepared and do not feel comfortable teaching science. He expressed his belief that children today need a teacher with more than a superficial grasp of subject matter. He pointed out that today's child will soon tire of always having the teacher say, "I don't know. Let's look up the answer together." McCarthy felt, however, that the use of a science specialist in the elementary classroom is not the answer, for the child needs a teacher who understands him as well as the subject matter at hand. He indicated that the use of team teaching holds some promise and that the use of special teachers in the intermediate grades might be feasible. He concluded that since science is increasingly becoming a major concern in the American way of life that the elementary schools must accept the challenge to lead children to a better understanding of their environment.¹

Not all persons concerned with elementary education share the opinions of those authors previously mentioned. There are those who hold that science can be effectively taught by the teacher who is trained in the understanding of children and in general methods of teaching. Among this group are those who readily recognize that the elementary teacher's training in the sciences is meager, but hold that this is not important to good teaching. Some in this group take a humorous and light-hearted posture with regard to the matter.

Blough, Schwartz, and Huggett, who have authored a textbook for use in college courses in science methods-content courses have this to say about the elementary teacher's background in science:

Don't let the idea of teaching science frighten you. It's not nearly so hard as you think. Don't judge your future experience in science by the past. Perhaps you couldn't work physics problems, and perhaps all you

¹Donald W. McCarthy, "Science Specialist vs Classroom Teacher." The Instructor, Vol. LXIII, No. 5, January, 1964.

saw through the microscope in your biology class was your eyelashes. Don't let that frighten you.

Then they list some things for the teacher to do to attain competence in science. Among those items listed are such suggestions as reading science material, studying teacher's guides which accompany textbooks, and reading curriculum materials. They also suggest that the elementary teacher seek the help of the junior high science teacher and join a science teachers association so as to learn more from the publications of the organization.¹

Along this same line is the editorial in Grade Teacher magazine which was introductory to their special issue on science. Entitled "Anybody Here Get A in Science" the editor affirmed his belief that science was "here to stay" and that the job was to teach children how to live and work in a science oriented world. And, chiding the elementary teachers for their lack of achievement in the sciences, he wrote;

And . . . like thousands of other intelligent and conscientious classroom teachers, you wonder how on earth you could have been so stupid as to let yourself slide through all those science courses by the skin of your teeth--and the grace of an understanding professor.

The editorial continues with the suggestion that teachers,

Learn as the scientist learns, by trying and failing, trying and failing, and trying and finally discovering the answer, if there is an answer. Tell the children, 'I don't know, but let's join hands, and find out together.'²

Jackson Hand follows the above editorial with a report on a way to teach science used in the New Haven, Connecticut, schools. The method he described was based on the use of lesson sheets on various units with a set of equipment

¹Glen O. Blough, Julius Schwartz, and Albert J. Huggett, Elementary School Science and How to Teach it. (New York: Holt, Rinehart and Winston, 1958). pp. 3-40.

²Toni Taylor, "Anybody Here Get A in Science," Grade Teacher, Vol. LXXXII, No. 5, January, 1965.

for each child to use in independent experimentation. He told the elementary teacher who wishes to use this method to do three things: (1) Give everybody equipment, (2) Give them problems to solve using the equipment, (3) Don't talk; don't teach; let them learn.¹ The role of the teacher in such a system would be more that of the organizer and guide, rather than a resource person. As such, it would not appear as necessary that the teacher be well versed in science but rather be a person who understood children and the nature of learning. Hand saw the teacher more as one who provides equipment and stimulus, then listened but rarely spoke.²

Helen Wardeberg, professor of elementary education at Cornell University, said that many elementary pupils know more scientific information than do their teachers, but that this should not bother the teacher. She pointed teachers to curriculum guides, courses of study, and textbooks. She expressed her belief that the teacher who reads these materials on her grade level will be well informed about science content for her particular classroom.³

The important outcome of science teaching in the elementary schools should be a way of thinking and a method of problem solving. Can a teacher, without experiencing this way of thinking and this method of problem solving guide such learning experiences for her pupils?

David P. Butts says, "No," in his report of a research project designed to determine the relationship between the teacher's understanding and the pupil's ability to conceptualize from science experience. His report offered

¹Jackson Hand, "A Way to Teach Science for Every Teacher," Grade Teacher, January, 1965, pp. 40-41.

²Ibid., pp. 40-46.

³Helen Wardeberg, "If You Must Teach Science," Grade Teacher, January, 1965, p. 33.

evidence that teachers need understanding in depth. His conclusions after analyzing data resulting from a study of four basic science concepts were that the teacher must be able to furnish a conceptual framework for pupil's learning. The degree to which pupils in the study were able to conceptualize the principles of inertia, displacement, action-reaction, and depth pressure were directly related to the teacher's understanding of these concepts.¹

Atkins agreed with Butts in the report of his research into teaching astronomy to elementary school children. His account of this project reported that children seemed to be able to learn the astronomical concepts when taught by teachers who understood the concepts themselves.²

An attempt was made by Berryessa to identify factors which differentiated generally competent elementary teachers, who carried on an effective science program, from those whose science programs were only mediocre. Such factors as the total number of hours in college science courses and the ability to enjoy reading scientific literature were factors in favor of the better science teachers.³

In reporting the work of the Minnesota Math and Science Teaching Project, Rising pointed out the tremendous need for high quality education of elementary teachers if their pupils were to correctly conceptualize in the areas of science. He also expressed a belief that science education in some depth was needed if teachers were to adequately nurture the child's interest in science

¹David P. Butts, "The Degree to Which Children Conceptualize From Science Experience," Journal of Research in Science Teaching. 1:135-43, Issue 2, 1963.

²J. Myron Atkins, "Teaching Concepts of Modern Astronomy to Elementary School Children," Science Education, 45:54-58. February, 1961.

³Lax J. Berryessa, "Factors Contributing to the Competency of Elementary Teachers in Teaching Science," Journal of Research in Science Teaching. 1:135-43, Issue 2, 1963.

and encourage the problem solving approach to learning. He called for top level teaching in college for the prospective elementary teacher if "the elementary school science vacuum is to be filled." He emphasized the need for well educated teachers by saying that no matter what the curriculum, or what materials were available, no program could succeed in the classroom without quality instruction by qualified teachers.¹

The kinds of courses as well as the number of semester hours was a matter of concern of those interested in science education for the elementary teacher. Viall, in a study of the recommendations of several professional organizations in the United States, including the American Association for the Advancement of Science has concluded that every elementary teacher should have college courses in biological, physical, and earth sciences that emphasize in depth the fundamental concepts and principles of those disciplines. With stress on the experimental aspect of these courses, it was also recommended that such courses be taught in the subject matter department of the college or university offering teacher training.²

Bryant studied the science requirements of 284 institutions located in forty-five states all of which were members of the American Association of Colleges for Teacher Education. He found that the education in biological and physical sciences comes mainly from survey or orientation courses with a mean requirement of seventeen quarter hours. His conclusion after reviewing the results of his study was that the principal reason for a lack of emphasis in science in the elementary schools was inadequate preparation of prospective

¹Gerald R. Rising, "Recommendations for the Preparation of Elementary Teachers in Science," Science Education, Vol. 49, No. 4. October, 1965.

²William P. Viall, "NASDTEC - AAAS Studies of Teacher Education in Science," Journal of Research in Science Teaching, 1:243-45, Issue 7, 1965.

elementary teachers.¹

The kinds and types of courses needed by the elementary teacher were related to the scope of the elementary science curriculum, according to several content studies. Newport reported that a study of a series of elementary school science textbooks, which was done to determine the per cent of science facts included from the various areas of science, showed an almost even division between biological science and physical science. His findings are as follows:²

Biology	55 per cent
Physics	20 per cent
Geology	9 per cent
Astronomy	12 per cent
Chemistry	4 per cent

This division of content showing 55 per cent biological sciences and 45 per cent physical sciences was confirmed in the statement of Barnard and others with reference to a second series of science textbooks. They call attention to current trends to include more physical sciences because of recent achievements in space exploration, but they continue to subscribe to the idea of an almost equal balance between biological and physical sciences up to grade seven.³

The specific science requirements for the elementary teacher graduating from one of the six state supported institutions named in this study were more or less varied from one school to another. The variation is both a matter of kind and amount of science courses included in the curriculum.

¹Paul P. Bryant, "Science Requirements for Elementary School Teachers in Colleges for Teacher Education," Science Education, Vol. 47, No. 5. December, 1963.

²John F. Newport, "The Distribution of Science Facts in Three Editions of an Elementary Science Series," Science Education, Vol. 49, No. 5. December, 1965.

³J. Darrell Barnard, Celia Stendler, and Nelson F. Beeler, Science, A Way to Solve Problems, (New York: The MacMillan Company, 1960), pp. 35-36.

The University of Kansas required that each person majoring in elementary education take five hours of physical science, (only courses in astronomy, chemistry, geography, geology, physics, or general physical science may be chosen) and five hours in a biological science including one course that is a laboratory course. In addition, a three-semester-hour course in science and mathematics for the elementary school was included in professional course requirements as a recommended course.¹

Kansas State University required more science of its elementary education graduates than do the other state supported colleges and universities. Their curriculum requirement in science was sixteen semester hours, including at least one course in biology and one in physical science. The sixteen hours may include four hours of mathematics. A methods course in science for the elementary school was one of the required professional courses.²

The Wichita State University has established the following requirement of all teacher candidates:³

Natural Sciences - 12 semester hours

A minimum of 4 hours must be a laboratory science. Must include courses from both the biological and physical sciences after which math may be elected to reach 12 hours.

The ten semester hours in science that was required at Kansas State Teachers College of Emporia was set forth in their catalog according to specific courses that must be taken. The requirements as listed in the

¹The University of Kansas, General Information Catalog, Vol. 66, No. 9 September 1, 1965.

²Kansas State University, Kansas State University Bulletin, General Catalog, 1964-1966. Vol. XLVIII, No. 9, September, 1964.

³Wichita State University, Catalog, 1965-1966, July, 1965.

current catalog are:¹

Science and Mathematics	
Biology 100, General Biology	3 hours
Math 100, Fundamentals of Math	2 hours
Phy. Science 214, Physical Science	5 hours
Biology 303, Field & Lab. Biol.	2 hours
Math. 200, Structure of Arithmetic	2 hours

Kansas State College of Pittsburg, like its sister institution at Emporia, prescribed the division of courses in terms of number of semester hours of each, but allowed its students to choose the specific courses in some areas. Some electives were provided as was seen from the following requirements:²

Field of Science and Math	
Biological Science	5 hours
Physical Science	5 or 6 hours
Modern Math	3 hours
Real Number System	3 hours
Elective	3 or 4 hours

Specialized Courses dealing with Content and Method	
Elementary School Science	3 hours

The curriculum for elementary education majors at the Fort Hays Kansas State College provided for some specific courses in the sciences and permitted the student to choose other courses to fill the required eleven hours.³

Curriculum in Elementary Education	
Biology I	3 hours
Approved electives in biological science	3 hours
Physical Science (excluding math)	5 hours
Content and Method Courses	
Elementary School Science	3 hours

At the present time, the requirements for a degree elementary certificate

¹Kansas State Teachers College of Emporia, Catalog Issue, Bulletin of Information, 1965-66. Vol. 44, No. 7. July, 1964.

²Kansas State College of Pittsburg, General Catalog, Vol. LXII, No. 1. April, 1965.

³Fort Hays Kansas State College, General Catalog, Vol. LV, No. 1, June, 1965.

can be fulfilled in science with ten semester hours. This must include both physical and biological science but it may also include mathematics. Effective July 1, 1966, the requirement will be raised to twelve semester hours in the natural sciences and mathematics.¹

¹Adel F. Throckmorton and the State Board of Education, (Issued by), Certificate Handbook, State of Kansas, January 1, 1966.

FINDINGS

A complete list of the names of the 13,684 teachers in Kansas elementary schools for the 1965-1966 school year was obtained from the Kansas State Department of Public Instruction. Using this list, a randomized sample was made representing 1.3 per cent of the total. The transcript of each teacher thus selected was surveyed to obtain information concerning the number and kind of college science courses that had been included in college preparation. The inclusion of a methods course in teaching science in the elementary school was also noted. If the teacher's transcript showed that a course had been taken but the grade was below passing, that course was not entered in the data. Information regarding the date and place of college graduation, sex of teacher, and kind of certificate held was also recorded.

The number of teachers represented in the 1.3 per cent sample was a total of 176. Of this number, twenty-eight, or 15.9 per cent, were men and the remaining 148, or 84.1 per cent were women. Fifteen of the 176 (all women) were not college graduates. One hundred sixty one teachers in the sample held the bachelor's degree, eighteen also had a master's degree, and one teacher had earned a Doctor of Education degree. A summary of the sample is presented in Table I.

Figure 1 shows the distribution of the sample with reference to the institution from which the bachelor's degree was obtained. Institutions outside of Kansas graduated 23.6 per cent of the sample. Of the six state supported teacher training institutions in Kansas, the Kansas State Teachers College at Emporia granted the largest number of degrees to teachers in the sample. Kansas State College of Pittsburg, and Fort Hays State College each graduated 11.1 per cent of the sample. The University of Kansas and Kansas

TABLE I
 DESCRIPTION OF 176 TEACHERS COMPRISING THE SAMPLE
 USED IN A STUDY OF KANSAS ELEMENTARY TEACHERS'
 PREPARATION FOR TEACHING SCIENCE

	Number	Per Cent
Male Teachers	28	15.9
Female Teachers	148	84.1
Teachers without a degree	15	8.5
Teachers with bachelor's degree	161	91.5
Teachers with master's degree	18	10.4
Teachers with Ed.D. degree	1	.56
Teachers receiving degree before 1940	21	13.0
Teachers receiving degree between 1940 and 1949	12	7.4
Teachers receiving degree between 1950 and 1959	48	29.8
Teachers receiving degree between 1960 and 1965	80	49.7
Teachers having taken at least one methods course (Science for Elementary Schools)	65	36.8

State University accounted for 6.2 per cent of the sample, respectively, while Wichita State University accounted for only 2.4 per cent. The remaining 19.2 per cent of the sample graduated from colleges or universities in Kansas which were either private or church-related.

When the sample was divided according to the date of college graduation, the greatest number, 49.7 per cent, fall in the period since 1960. Between 1950 and 1959, 29.8 per cent were graduated, and 7.4 per cent were granted the bachelor's degree between 1940 and 1949. Those teachers in the sample who graduated from college before 1940 made up 13.0 per cent of the sample. Figure 2 presents this information in graphic form showing the percentage in the sample graduating from college during each period.

Those Kansas elementary teachers making up the sample used in this study were found to have taken an average of 11.08 semester hours of science. The median for the group was lower than the mean with half the sample having had nine hours or less. Of the sample of 176 teachers, eight had taken no science course as a part of their college preparation while two teachers (both men) in the group exceeded fifty semester hours with totals of fifty-three and sixty-one, respectively. These two, teaching on an administrator's certificate, (code number 150) were obviously teachers in the process of transition from classroom teaching to administrative work. This was indicated by the certificate each teacher held as well as the recent college courses each had taken.

There was a noticeable difference in the preparation of men as compared to women. The twenty-eight men in the sample had taken an average of 13.8 semester hours with a median of 11.0 semester hours and a range of zero to sixty-one hours. The average for the 148 women in the sample was decidedly lower with a mean of 10.65 semester hours and a range of zero to 38. Table II

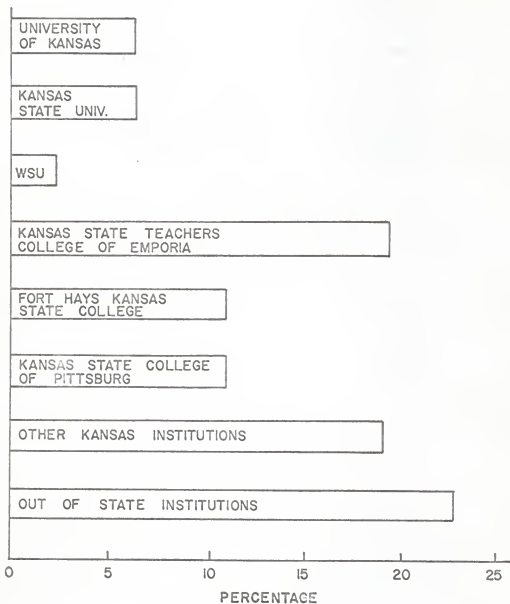


FIGURE 1

PERCENTAGE OF KANSAS ELEMENTARY TEACHERS (1965-66)
RECEIVING DEGREE FROM DESIGNATED INSTITUTION
OF HIGHER LEARNING

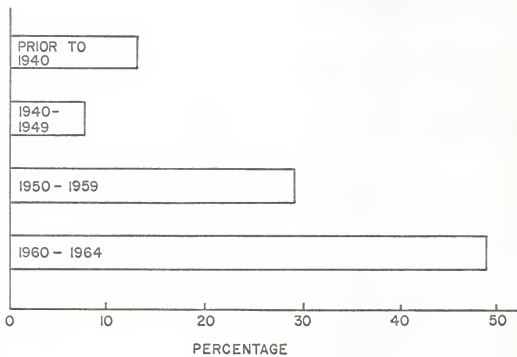


FIGURE 2
PERCENTAGE OF KANSAS ELEMENTARY TEACHERS
RECEIVING DEGREES AT VARIOUS
TIME INTERVALS

shows a division of the sample according to sex with the detailed information regarding the total number of semester hours of science courses.

TABLE II
AN ANALYSIS OF NUMBER OF SEMESTER HOURS OF
SCIENCE TAKEN BY KANSAS ELEMENTARY
TEACHERS TEACHING IN 1965-1966

Sample	Mean	Median	Mode	Range
Men	13.8	11.0	10	0-61
Women	10.65	9.5	8	0-38
Men and Women Combined	11.08	9.5	10	0-61

Dividing the sample according to date of graduation from college reveals very little difference in the average number of semester hours of science when the groups are compared. Table III shows that those who graduated before 1940 averaged 11.6 semester hours of science, those who graduated from 1940 through 1949 took an average of 12.5 semester hours of science, graduates between 1950 and 1959 averaged 11.9 semester hours, while those graduating in the sixties averaged 11.1 semester hours. When the group who has not earned at least a bachelor's degree is examined, it is found that their average number of semester hours of science is well below that of the degree group. The non-degree group had a mean of 6.4 semester hours of science with a range from zero to fifteen hours.

When the sample was divided according to the institution from which the bachelor's degree was obtained, there were some interesting differences between the graduates of the several schools. The information indicating these differences is presented in Table III. Those receiving the bachelor's degree from the University of Kansas had the lowest average number of semester hours.

This group, which made up 6.2 per cent of the sample averaged 8.9 semester hours of science. This was an average of only two semester hours above the non-degree group. Another 6.2 per cent of the sample graduated with the baccalaureate degree from Kansas State University. The average for this group was higher with the mean at eighteen semester hours and the median for the group at seventeen hours. Only two members of the sample from Kansas State University had earned fewer than sixteen semester hours in science.

TABLE III

AVERAGE NUMBER OF SEMESTER HOURS OF SCIENCE TAKEN BY KANSAS
ELEMENTARY SCHOOL TEACHERS (1965-1966) ACCORDING
TO DATE OF BACHELOR'S DEGREE

	Bachelor's Degree Before 1940	Bachelor's Degree 1940-1949	Bachelor's Degree 1950-1959	Bachelor's Degree 1960-1965	No Degree
Per Cent of Sample	13.0	7.4	29.8	49.7	8.0
Mean	11.6	12.5	11.9	11.1	6.4
Median	8.0	13.0	10.5	11.0	7.0
Mode	10.0	12.0	10.0	10.0	8.0
Range	0-33	0-38	0-61	0-24	0-15

The sample used for this study included only 4 members who had received their bachelor's degree from Wichita State University. The mean for this group was 9.1 semester hours of science with a range from five to fourteen hours.

The largest portion of the Kansas educated part of the sample, 19.8 per cent, were graduates of Kansas State College of Emporia. In this group the range in semester hours of science was zero to thirty-eight hours with

a mean of 10.0, a median of 9.5 hours and a mode of 10 semester hours. Two members of this group had taken no science courses with one of the pair holding a master's degree as well as a bachelor's degree with no science courses in either degree program.

Graduates from Kansas State College of Pittsburg, which made up 11.1 per cent of the sample, were found to be very similar to graduates from Kansas State College of Emporia in their science training. The average number of semester hours of the group from Pittsburg was 10.7 semester hours with the median and mode both at ten and a range in individual hours from zero to thirty-two.

Elementary teachers who received their teacher training at Kansas State College at Fort Hays averaged considerably higher in number of hours of science than those graduating from other former state teacher's colleges. Graduates from Fort Hays accounted for 11.1 per cent of the total sample. Their average number of semester hours of science was sixteen with a median of eleven, and a mode of ten. The range of individual credits in this part of the sample was from zero to sixty-one semester hours. The presence in this sample of two teachers, each with more than fifty semester hours of science, had an upward effect on the average of the sample as a whole. If these two individuals were removed from the sample, the group from the Kansas State College at Fort Hays would be very similar in training to the groups from Kansas State College of Emporia, and Kansas State College at Pittsburg.

Nineteen and two-tenths per cent of the total sample were elementary teachers whose degree was granted by a Kansas college or university but one which is not among the state-supported group. This group of teachers showed a range of zero to twenty-two semester hours of science with a mean of 9.9, a median of 9.5 and a mode of ten. This is somewhat under the lowest mean

for the various parts of the sample who were graduates of state-supported institutions.

When the 23.6 per cent of the sample which represents those educated outside of Kansas was examined, it was found that this group of teachers showed the lowest average number of semester hours of science of any part of the sample. With a mean of 8.1, a median of 9.5, and a mode of eight, the individual teachers in this group ranged in semester hours of science from zero to twenty-two.

All six Kansas state-supported colleges and universities now require the preparatory elementary teacher to take a methods course in science teaching specifically designed for the elementary school pupil. Data accumulated in this study indicated it was primarily the recent graduate who has met this requirement. Table IV shows the percentage of teachers in the sample who have taken a methods course with the total sample divided according to the date of graduation. Of the total 176 teachers in the sample, sixty-five had taken at least one course in science methods for the elementary school. Forty of the sixty-five were teachers who have received the bachelor's degree since 1960.

Looking at the specific courses in science which were a part of the college preparation of teachers in the sample, biology was the course taken by the greatest number of teachers. Figure 3 shows that of the 176 teachers comprising the sample, 122 or 68 per cent had taken at least one course in biology. For many, this was either a three-hour introductory course or a five-hour survey course. The range in hours of biology taken is shown in Figure 4 as being from two to eighteen hours.

Next in frequency of choice of courses was the survey course in physical science with 36.2 per cent of the sample having included at least one such

course in their program of study. Here, also, most teachers who had taken any physical science had taken one five-hour course which was the survey type course. Figure 5 shows that more than half of the teachers who took any physical science had taken one five-hour course.

TABLE IV
NUMBER AND PERCENTAGE OF KANSAS ELEMENTARY TEACHERS
HAVING TAKEN SCIENCE METHODS COURSE ACCORDING
TO DATE OF COLLEGE GRADUATION

Date of Degree	Total Number Graduating	Total Number Taking Methods Course	Percentage Taking Methods
Before 1940	21	2	.09
1940 - 1949	12	1	.08
1950 - 1959	48	16	33.30
1960 - 1965	80	40	50.00
No Degree	15	6	40.00

When examining the specific courses in the physical sciences, rather than the survey course, it was seen that teachers in the sample included courses of this type less frequently than they included courses in the biological sciences. Only eighteen (10.2 per cent) had taken any physics, thirty-six (20.4 per cent) had taken geology or earth science, and forty-two (23.3 per cent) had taken at least one course in chemistry. Astronomy was the least frequently chosen of all sciences with only nine teachers in the sample of 176 having taken a course in this area.

Fifteen per cent of the teachers in the sample had included at least one course in physiology and 20.3 per cent had taken zoology. This choice of courses was found to be more prevalent among teachers who graduated from

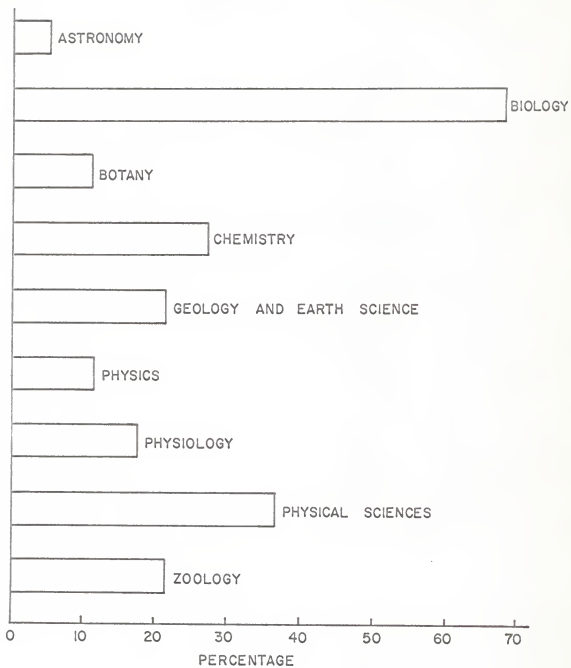


FIGURE 3

PERCENTAGE OF KANSAS ELEMENTARY TEACHERS
HAVING TAKEN ONE OR MORE COURSES
IN VARIOUS SCIENCES

college before 1950 than among those graduating since that time.

Botany was included in the college preparation of 10.2 per cent of the teachers used in this study. This choice, too, was more frequent among earlier graduates.

Table V summarizes the distribution of the sample in terms of science courses taken as a part of their college preparation.

TABLE V
NUMBER AND PERCENTAGE OF KANSAS ELEMENTARY TEACHERS
IN SAMPLE WHO HAD TAKEN ONE OR MORE COURSES
IN THE VARIOUS SCIENCES

Science Course	Number Having Taken One or More Courses	Percentage
Astronomy	9	5.1
Biology	122	68.0
Botany	18	10.2
Chemistry	42	23.3
Geology and Earth Science	36	20.4
Physics	18	10.2
Physiology	27	15.3
Physical Science	64	36.2
Zoology	35	20.3

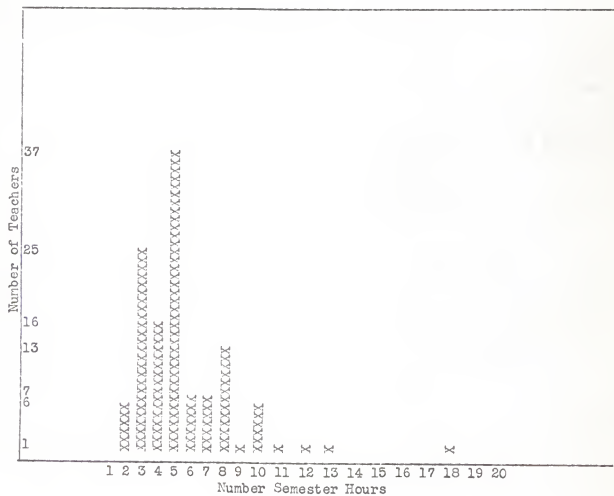


FIGURE 4

FREQUENCY DISTRIBUTION OF SEMESTER HOURS OF BIOLOGY

X - ONE TEACHER IN SAMPLE

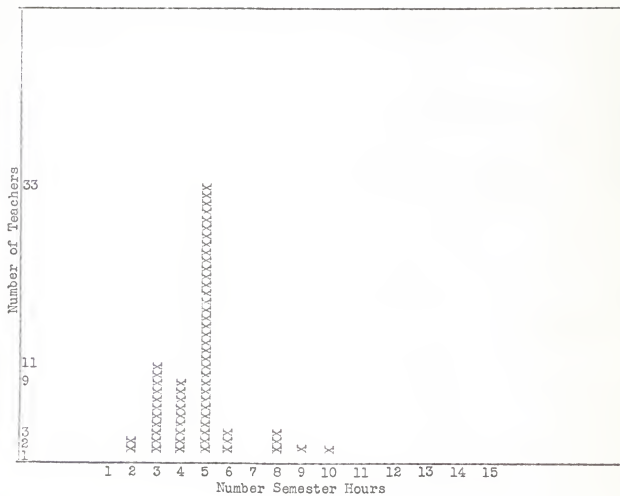


FIGURE 5

FREQUENCY DISTRIBUTION OF SEMESTER HOURS IN
PHYSICAL SCIENCE SURVEY COURSE

X - ONE TEACHER IN SAMPLE

SUMMARY

This study was undertaken to survey the preparation of the Kansas elementary teacher, currently in the classroom, with respect to the nature and number of courses in science included in the college program of studies. Information was collected with the idea of trying to answer the following questions:

1. What was the extent and nature of the preparation of the Kansas elementary school teacher in the area of science?
2. How did the preparation of the Kansas elementary school teacher compare with the requirements currently set forth by the state-supported teacher-training institutions and with the recommendations of recognized authorities and professional groups?

Any study of the preparation of elementary teachers in Kansas must, in order to place the study in the proper context, give consideration to the rapidity of change in teacher certification requirements in the state. When it is remembered that only seventeen years ago the elementary teacher could go directly from high school graduation into the elementary classroom, it is then not surprising to find such a high percentage of the teachers graduated from college in the past five years. Almost half of the teachers in the sample received the bachelor's degree between 1960 and 1965. From the records examined, it was evident that a majority of these graduates were teachers who began college several years ago but finished the bachelor's degree after it became a requirement for certification in 1959. With the sixty-hour Continuing Certificate still valid in the state, the segment of the sample made up of teachers without a bachelor's degree (8.5 per cent) is also not phenomenal.

Looking at the specific preparation in the area of science which has prefaced the teacher's performance as a science teacher in the classroom,

several considerations are outstanding.

The average elementary school teacher, now teaching in Kansas, has taken 11.08 semester hours of science in college. Most of these hours are accounted for in introductory or general courses in biology and in the survey-type course in physical science. About one-third of the teachers in the sample had taken courses in chemistry and physics and less than one-fourth had taken astronomy or earth science. It would appear that study, in depth, in the physical sciences has been included by too few of the teachers training for the average classroom. Since the science curriculum in the elementary school is about evenly divided between the biological and physical sciences, additional education in the latter is probably desirable.¹ In the biological sciences, the picture is somewhat improved. Almost one-half of the teachers in the sample included courses in the biological sciences in addition to the general biology course. These courses in physiology, zoology, and botany should broaden the teacher's field of knowledge and elevate the level of confidence in the ability to teach these sciences.

The difference in the amount of preparation between men and women was of importance. The average number of semester hours of science taken by men exceeded that taken by women by four semester hours. The average for women was 9.5 semester hours, while that for men was 13.5 semester hours. This is a matter of greater concern when it is noted that women teachers outnumber men teachers by a ratio of seven to one.² This indicated that the job being

¹John F. Newport, "The Distribution of Science Facts in Three Editions of an Elementary Science Series," Science Education, Vol. 49, No. 5, December, 1965.

²James B. Burr, William Coffield, Theodore J. Jenson, and Ross L. Neagley, Elementary School Administration, (Boston: Allyn and Bacon, Inc. 1963), p. 50

done in the classroom was being done by a teacher who was less prepared than the average presented in this study.

Those teachers without a degree, whose level of college preparation was somewhere between sixty and 120 semester hours, made up 8.5 per cent of the sample. These teachers, all women, were noticeably less prepared in science than the rest of the group. Their average number of semester hours in science was 6.4 semester hours with four teachers in the group having taken no science at all. Professional groups have long called for an end to the validity of the certificate based on less than a bachelor's degree.¹ It has been difficult to get legislative action to back up these recommendations, and at present the Sixty-hour Continuing Certificate is still renewable with January 1, 1967, now slated as the date to cease renewing such certificates.² When this procedure becomes effective, it should serve to up-grade the general education of teachers as a whole, including their preparation to teach science.

When the preparation of Kansas elementary teachers was compared with that recommended by authorities and professional groups, it was found that with a median of 9.5 semester hours, the group was well below the recommendations of Conant³ and the plan formulated by the Kansas State Teachers Association and approved by the Commission on Teacher Education and Professional Standards.⁴ Conant has recommended a minimum of twelve semester hours in science in addition

¹C. O. Wright, 100 Years in Kansas Education, (Topeka: The Kansas State Teachers Association, 1963), p. 49.

²Adel F. Throckmorton and the State Board of Education, (Issued by), Certificate Handbook, State of Kansas, January 1, 1966. p. 30.

³James B. Conant, The Education of American Teachers, (New York; McGraw-Hill Book Company, 1963), pp. 34-72.

⁴"A Proposal on Teacher Preparation," Spectrum, Martha Crane, Editor. Vol. 12, No. 1. pp. 5-8.

to any mathematics. He sees this equally divided between the biological and physical sciences. Kansas State Teachers Association, with the approval of TEFS, is pushing for a five year program of teacher training which would include sixteen semester hours in the biological and physical sciences.

When compared with the current requirements for certification in Kansas, the average Kansas elementary teacher, with 11.5 semester hours of science is slightly above the required hours for the degree elementary certificate. Effective July 1, 1966, the requirements in science will be raised to twelve semester hours, however part of the requirement can be met with courses in mathematics.¹

When the teachers in the sample were divided according to the institution from which the baccalaureate degree was earned, all groups with the exception of those graduating from Kansas State University and Fort Hays State College fell below the science requirements of their parent institution. This was probably due to the fact that so many had either graduated or begun their college education at a time when the required courses in science were less stringent than those now established. This was also the probable explanation for only sixty-five of the 176 teachers in the sample having taken a methods course dealing specifically with science for the elementary school. Since the methods course is a relatively recent requirement of the state-supported colleges and universities, it is likely that this was the reason so few of the earlier graduates included it in their program of study.

Though the average Kansas elementary school teacher was somewhat below the recommendations of both authorities and professional organizations, there

¹Adel F. Throckmorton and the State Board of Education, Certificate Handbook, State of Kansas, (Topeka, Robert R. Sanders, State Printer, January 1, 1966), p. 17.

was reason to believe that the average will move upward with time because of changes in the requirements for certification and the curriculum changes in teacher-training institutions. The standards for certification are constantly being revised upward in Kansas. This is indicative of the fact that teachers, themselves, are asking that science training as well as other training be upgraded to meet the challenge in the classroom for a dynamic science program on the child's level of interest and ability.

CONCLUSIONS

From the information obtained on the sample used in this study, the following conclusions have been made:

1. The average Kansas elementary school teacher, with a mean of 11.5 semester hours of science, was slightly below the recommended level of preparation suggested by both authorities and professional organizations.
2. Kansas elementary teachers who received the bachelor's degree from Kansas State College of Emporia, Kansas State College at Pittsburg, the University of Kansas, and Wichita State University, averaged below the science requirements set up by their parent institution. Those graduating from Kansas State University and Kansas State College at Fort Hays averaged above their school's requirement.
3. Kansas elementary teachers were better prepared in the biological sciences than they were in the physical sciences. Many of the teachers in the sample met the required science standard by taking introductory or survey-type courses.
4. Men teachers were considerably better prepared in science than were women teachers.
5. Those teachers without a bachelor's degree were less well prepared in college courses than any other group used in the study.
6. Some elementary teachers have had no college level science courses. Five per cent of the sample studied had taken no science course as a part of their college preparation for teaching.
7. Less than half of the Kansas elementary teachers have taken a methods course dealing specifically with science for the elementary school.
8. Kansas elementary teachers who are graduates of out-of-state

institutions, as well as those graduates of private and church-related Kansas institutions have had less science education than those graduates from Kansas state-supported schools.

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THE PREPARATION OF KANSAS ELEMENTARY
TEACHERS IN SCIENCE

by

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AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

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ABSTRACT

The objective of this study was to survey the nature and extent of the preparation of the 1965-1966 Kansas elementary teachers to teach science.

A machine-made alphabetical list of all 13,684 teachers currently teaching in grades one through eight was obtained from the Kansas State Department of Public Instruction and used as the population for the study. A randomized 1.3 per cent sample, made up of 176 teachers, was selected. The records on file in the Division of Certification of the Kansas State Department of Public Instruction in Topeka were studied to record the following information on each member of the sample: semester hours of science, semester hours of elementary school science methods, kind of degree or degrees held, date and institution granting bachelor's degree, sex, and kind of certificate.

The data accumulated in the survey showed the average Kansas elementary school teacher to have taken 11.08 semester hours of science in college with the median for the group at nine semester hours. Men, making up 15.9 per cent of the sample, were more extensively prepared than were women. The mean for men was 13.8 semester hours while that for women was 10.65 semester hours.

When teachers in the sample were grouped according to date of graduation, there was no notable difference in the number of semester hours of science. There was, however, a higher percentage of the teachers who graduated since 1960 who had taken a course in methods of teaching science in the elementary school.

Fifteen teachers in the sample (8.0 per cent) were not college graduates. With an average of 6.4 semester hours of science, this group was less well prepared than were those who were college graduates. Among those graduating

from Kansas state-supported institutions, the group from the University of Kansas had the lowest average number of semester hours of science (8.8 hours), while the group graduated from Kansas State University was highest with an average of eighteen semester hours. Graduates from Kansas State College of Emporia and Kansas State College at Pittsburg were very similar in science preparation with a mean of 10.01 and 10.7 hours, respectively. The group who graduated from Fort Hays Kansas State College had a higher mean than those from other former state teacher's colleges, but the median was the same.

Elementary teachers in the sample were considerably better prepared in the biological sciences than in the physical sciences. Of the 176 teachers in the sample, 122 had taken at least one course in biology, sixty-two had taken either physiology or zoology, and eighteen had a course in botany. Sixty-four teachers in the sample had credit in a survey course in physical science, forty-two had taken chemistry, but only eighteen had taken physics and nine had included astronomy.

From the study of Kansas elementary teacher's preparation to teach science, it can be concluded that the group averaged slightly below the twelve semester hours of science which has been recommended by both authorities and professional groups. Distribution between biological and physical sciences was weighted in favor of the former which is contrary to that recommended. Women, who out-number men seven to one in the classroom, were less well prepared to teach science. The difference in preparation of graduates of the various state-supported colleges and universities in Kansas corresponded to the differences in the requirements at the various institutions.

To the extent that the sample was representative of Kansas elementary school teachers, the conclusions are applicable to the entire population.