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A REPORT OF AVAILABLE RESEARCH ON THE STATUS
OF SCIENCE TEACHING IN THE STATE OF KANSAS 1936-1971

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Chapter 1

INTRODUCTION

Teachers of science in the Kansas public schools meet many varying conditions and expectations. Schools in Kansas range from the very small with fewer than 50 students to very large schools with more than 2,500 students. The science teacher may be the only science teacher in the school or he may be one of many. The science teacher may have full-time status teaching four or more science classes daily or he may teach only one science class and also be required to teach such diverse subjects as social science, athletics, driver education or other courses.

Therefore, it is important that a science teacher or prospective science teacher learn the various conditions under which Kansas teachers have been expected to teach in the past. This report includes a summary of all the available research done on the status of science teaching in the state of Kansas.

PURPOSE OF STUDY

The history of science teaching and its growth is the concern of all involved with science. In order to fully understand the present problems in science teaching in Kansas one must be aware of its past failures and achievements. The teacher or prospective teacher who recognizes the advancements of his predecessors is better equipped to formulate realistic plans for his role in the future development of science.

The purpose of this paper was to present a bibliography and summaries of the available research on the subject of the status of science teaching in Kansas from 1936 to 1971. This paper was intended as a guide to further study by briefly summarizing each report available at Farrell Library, Kansas State University, and studies supplied by educators (see method of study) in the state of Kansas.

Thus, this information concerning the status of science teaching in Kansas should be a factor in the total preparation of future science teachers in Kansas. The author has attempted to catalogue this information in a meaningful way for use by those preparing for a career in the public schools of Kansas or those already in service.

METHOD OF STUDY

An investigation of literature relative to this subject was conducted from sources located at Farrell Library, Kansas State University. A letter was also sent to each of thirty-seven science educators in the state of Kansas requesting assistance securing bibliographic information or copies of studies pertaining to this subject. A list of individuals and addresses to whom the letters were sent and a copy of the letters are included in the Appendix. In addition three other letters were sent as a follow-up to the responses that were returned.

DEFINITIONS OF TERMS USED

BSCS - Biological Science Curriculum Study.

Elementary Schools - Schools in Kansas which include grades K-6.

Four Basic Sciences - Biology, chemistry, physics, and general science.

Full-time Science Teacher - Teacher who teaches four or more science courses daily.

High School - Kansas schools which include grades 9-12 unless otherwise stated.

Junior High School - Separately organized school including grades 7-9 unless otherwise stated.

Part-time Science Teacher - Teacher who teaches at least one science course per day but no more than three science courses per day.

Secondary Schools - Junior and senior high schools in Kansas; Kansas schools which include grades 7, 8, 9, 10, 11, or 12.

Senior High School - Kansas schools which include grades 10-12 unless otherwise stated.

DESIGN AND LIMITATIONS OF THE STUDY

The report was organized chronologically beginning with the earliest study. The studies were separated by the surnames of the authors and the years applicable to the period covered by the study. In those studies which did not include research over a particular span of time the publishing date was used instead. The bibliography was limited to those materials available at Farrell Library, Kansas State University and materials sent by science educators in the state (see method of study). A review of literature was also included on the status of science teaching on a national level giving a brief summary of the past development of the status of science teaching in secondary and elementary schools.

The report summaries were intended as guides to further study and include only the highlights of these reports.

Chapter 2

REVIEW OF LITERATURE

Much has been written about the status of science teaching on a national level. Research journals, books, and professional journals abound with accounts of various studies and opinions of recognized experts on teacher education. A complete spectrum of opinions exists with the recommendations almost as widely divergent.

The push for a college degree for all teachers was begun in the 1930's. This was delayed because of the shortage of personnel during World War II but was again renewed because of the increase in educational level of the general population after the war.

In 1949, Cahoon quoted the President's Scientific Research Board on Manpower for recommendations in regard to the pre-science training of secondary school science teachers:

(a) Certification should be in closely related subjects within the broad area of science and mathematics. (b) Approximately one-half the program or sixty semester hours should be allotted to the comprehensive teaching area of science and mathematics. (c) Every teacher of science should complete the basic courses (six to ten semester hours each) in biology, chemistry, mathematics and physics. (d) A minimum of eighteen semester hours of study should be required for certification in a particular subject. (e) The comprehensive area should include study beyond the basic course in at least two and preferably three of the sciences (the other sixty semester hours will allow for eighteen hours each in three subjects and the six hour basic course in the fourth). (f) Certification for general science should require broad preparation including college courses in all the subjects concerned in general science. The prospective general science teacher should meet the requirements suggested above and in addition should complete a one semester basic course in astronomy and in geology.¹

¹Science and Public Policy, Vol. 4, p. 59, cited by G. P. Cahoon, "Teaching Science for General Education in the Secondary School," School Science and Math, 49, 287 (April, 1949).

A national study by the National Education Association Research Division (1959) was done by Smith and Homman. The study showed that 49.3 percent of science teachers were full-time science teachers. Five percent had nine or less hours in science and 0.3 percent had no science training at all. Also, between 21 and 22 percent had less than twenty credit hours in the science fields. The authors further stated that the figures indicated a better situation than actually existed because the figures do not consider the appropriateness of the person's science background to his teaching position. Finally, they concluded that the four year bachelor's degree program is becoming less and less adequate as preliminary training for secondary science teaching.²

In a report by the National Association of State Directors of Teacher Evaluation and Certification, and the American Association for the Advancement of Science, it was noted from a survey including 1,230 science teachers that 99 percent of the teachers held bachelor's degrees, 29 percent had master's degrees, and many had substantial amounts of course work to their credit beyond that required for their master's degrees, but only 40 percent had credit beyond the requirements in the subjects they taught. It was concluded that science teachers need better preparation.³

²Herbert A. Smith and Guy B. Homman, "The Academic and Professional Preparation of Teachers of Science," Review of Educational Research, 31, 291-294 (June, 1961).

³National Association of State Directors of Teacher Evaluation and Certification and the American Association for the Advancement of Science, Secondary School Science and Mathematics Teachers Characteristics and Service Loads (1963).

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 also included the elementary school with the education of elementary teachers being scrutinized for competency in science. Between the years 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.⁴

In the mid-sixties the education of elementary teachers was being given much more attention as evidenced by research studies and recommendations from professional groups and authorities on teacher training. James B. Conant recommended a plan for the education of elementary teachers which would include 12 semester hours of physical and biological science in addition to any survey course in those subjects. This was also in addition to any methods courses for teaching science in the elementary school. His recommendation was formulated after a study of teacher training 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.⁵

⁴Alfred de Grazia and David Sohn, Revolution in Teaching (New York: Bantam Books, 1964), pp. 184-186.

⁵James B. Conant, The Education of American Teachers (New York: McGraw-Hill Book Company, 1963), pp. 34-110.

Not all persons concerned with education, especially elementary education, held that a teacher's training in the sciences was important to good teaching. There were those who believed that science can be effectively taught by the teacher who is trained in the understanding of children and in general methods of teaching. Grade Teacher had a special issue on science and stated that the job was to teach children how to live and work in a science oriented world. They generally felt that teachers should be taught to teach first.⁶

Many new senior high school, junior high school and elementary programs in science were developed in the sixties and are continuing in the seventies. Most of these science studies are already well established on a national scale with published materials already in use. They show promise of making unique contributions to science instruction. More and more colleges are instituting new types of training programs. Summer institutes and in-service institutes are good examples of new ideas for training teachers.

⁶Toni Taylor, "Anybody Here Get A in Science," Grade Teacher, 82,5 (January, 1965).

Chapter 3

FINDINGS

While studies on the status of science teaching were quite prolific on a national level, studies in the state of Kansas from 1936 to 1971 were scanty indeed. After much research only 25 studies could be found at Farrell Library, Kansas State University. Of the 37 letters sent to science educators five were returned with three educators making further recommendations as to possible sources of information.

Most of the research studies, especially the early studies (1960 and earlier), just reported raw data and did not include conclusions nor recommendations. Any conclusions or recommendations made by authors in the subsequent studies were included in the following corresponding summaries of their studies. Following are reports on the above mentioned 25 studies:

Alm (1936-1937)⁷

The study used as a source of information was the High School Principal's Reports for the school years of 1936-1937 and 1929-1930. These reports are on file in the office of the State Department of Education at Topeka, Kansas. The reports used in the 1936-1937 school year involved 15 high schools in cities of 1st class, 70 high schools

⁷O. W. Alm, "The Report of the Committee to Study Educational Trends in Secondary Schools of the State with Respect to Basic Sciences," Transactions of the Kansas Academy of Science, 41, 275-294 (1938).

in cities of 2nd class and 148 high schools in cities of 3rd class. Another report (1929-1930) was used for comparison. This included 70 high schools in cities of 2nd class. The report included 9th through 12th grades in the 2nd and 3rd class cities.

The study gave general facts about enrollment in the Kansas high schools and the number of students graduating for each class of cities (1st, 2nd, 3rd; 1936-1937, and 2nd; 1929-1930). It gave estimated enrollments in different sciences (the basic four of biology, chemistry, physics, and general science plus agriculture, botany, physical geography, physiology and psychology) of all Kansas high schools.

The study further showed how many teachers were teaching each of the nine different science courses and the educational attainment of each teacher plus the number of semester hours of college preparation for the science courses they were teaching. It also gave a break-down on the teachers who had and who had not graduated from college and the number of semester hours for those who had not.

The study was mainly based on facts alone and no major comparisons, trends, or conclusions were drawn leaving this task "with those who are authorities in the basic sciences, those who know or set the educational policies of the community, and those who are authorities in secondary education."⁸

⁸Ibid., p. 292.

Irwin (1937-1938)⁹

The report covered aspects of teaching in the Kansas senior high schools concerning 5,200 senior high school teachers in the state. The data was taken from the High School Principals' Reports to the Office of the State Superintendent for the years 1937-1938.

It compared a study done by Ridgeway (C. W. Ridgeway's report was "A Comparative Study of the Training and Teaching Combinations of Kansas High School Teachers") in 1930 to the present study--showing that the number of science teachers teaching only one field increased from 15 percent in 1930 to 34 percent for the years 1937-1938.

Of subjects taught in combinations with science courses, those most frequently taught were mathematics and social studies.

Of 616 science teachers, 96 percent had a major or minor in a science and 34 percent were full-time science teachers. A breakdown of science with other teaching combinations was given and the percent of teachers teaching the combinations. Also, the supply of teachers found in the different academic fields was given. Salaries were reduced for science teachers from 1930 to 1938 from an average of \$1,821 to an average of \$1,259. Data showing the kinds of degrees held by the science teachers was also given.

The report covered practically all fields in addition to science. But data from the report was used occasionally in the subsequent science reports.

⁹Frank L. Irwin, "A Comparative Study of the College Preparation, Teaching Combinations and Salaries of Kansas High School Teachers (1938)," Kansas State Teachers College of Emporia Bulletin of Information, 15, 1-38 (1938).

Reed (1940-1950)¹⁰

The report showed trends in science teaching over the decade of 1940-1950. A questionnaire was sent to each of 645 high schools in Kansas of which only 237 were returned and only 100 were complete enough for the study. No mention was given of what report was used for the 1940 study. Population data was taken from the 1950 Educational Directory.

Trends in curriculum were given in general science, biology, physics, chemistry, physiology and health education with comparisons between 1940 and 1950 being done for each of four different population groups of schools.

A table showing subjects added to the curriculum was given. Eleven different subjects were included.

Eleven different categories for teaching methods were used to show percentage of schools reporting increased use of these techniques as compared to the four basic courses and physiology and health education.

Trends in teacher preparation, teacher experience and teacher salaries were also included in the report.

A comparison was shown between a Federal Survey and the 1950 Kansas Survey.

Some of the significant points of the report were: (1) increase in percentage of schools offering general biology from 70 to 90; (2) increased average enrollment per school in general biology from 56.3 to 81.7; and (3) increase in average salary from \$1,863.14 to \$3,246.31.

¹⁰Homer B. Reed, "Trends in Science Teaching in Kansas High Schools for the Years 1940-1950," Transactions of the Kansas Academy of Science, 54, 515-525 (1951).

Breukelman and Andrews (1951-1952)¹¹

The paper presented data whose main purpose was to show:

(1) offerings and enrollments in the sciences in Kansas high schools; (2) the subjects taught by Kansas high school science teachers; (3) some of the trends as revealed by comparison with previous studies; and (4) some comparisons with the national situation in science education.¹²

The data was collected from the 1951 High School Principals' Organizational Reports. Junior high schools were included in the report if 9th grade science was taught. Seventh and 8th grade science courses were not included in the study. Therefore, 654 or 99 percent of the senior high schools and 25 or 42 percent of the junior high schools were included in the report. Of the senior high schools 576 of the 659 consisted of grades 9-12.

The report broke down the data to show the size of the high school as compared with the number of science courses offered, and the type of curriculum offered, namely general science, biology, chemistry and physics.

The report tabulated other kinds of science courses offered with respect to the size of school. There were eleven different science courses included here besides the basic four.

The basic four science classes were also broken down with regard to total enrollments of students, class sizes and number of sections in each of the schools of different sizes.

¹¹John Breukelman and Ted F. Andrews, "Offerings and Enrollments in the Secondary School Sciences in Kansas in 1951-1952," Emporia State Research Studies, 1, 1-32 (1953).

¹²Ibid., p. 5.

The report showed the relationships between school size and number of full-time and part-time teachers and the average number of science pupils per science teacher. It also related size of school with number and kinds of nonscience courses taught by general science, biology, chemistry, and physics teachers.

The report showed trends in science teaching by comparing the data for the 1951-1952 study with studies done on national and local levels in 1945-1946; 1937-1938; and 1930-1931.

The report concluded that there were 752 part-time science teachers and 177 full-time science teachers leading to the recommendation that the future science teacher prepare himself in one other teaching field. All secondary school teachers should have at least 9-12 hours in one of the following areas: biological sciences, physical sciences and social sciences plus two high school units or nine semester hours of math. In addition to the above, junior high school teachers of general science should have 9-12 hours of botany, human physiology and/or zoology; 9-12 hours in chemistry and/or physics; and 9-12 hours in astronomy, geology, meteorology and/or physical geography. Prospective senior high school teachers should obtain additional hours (at least 24) in either biological sciences, chemistry or physics and broaden his perspective by choosing courses in the other two fields for an average of 18 semester hours. In other words, the prospective high school teacher should have a total of 60 semester hours of science with 24 hours in one science and 18 hours in the other two sciences recommended.

The development of a one year physical science course was recommended with the hope of improving enrollments in chemistry and physics.

It was also recommended that those high school science teachers who teach only science courses should get an advanced degree.

Breukelman and Andrews (1954-1955)¹³

The study was done after a three year interval from the previous study covering the 1951-1952 school year by Breukelman. The objectives and purpose of the study were to show:

(1) offerings and enrollments in the sciences in Kansas high schools; (2) the subjects taught by Kansas high school science teachers; (3) some of the trends as revealed by comparison with previous studies; and (4) some comparisons with the national situation in science education.¹⁴

The study was based on data found in the 1954 High School Principals' Organization Reports with the same limitations as the previous Breukelman study. One hundred percent or 650 of the accredited high schools and 37 or 65 percent of the junior high schools were included in the study.

The 9th grade was the only grade included in the junior high school data where science was taught. Of the 650 senior high schools, there were 563 high schools consisting of grades 9-12 and 87 high schools of grades 10-12.

The report showed the relationship between size of schools compared to the number of schools teaching the four main science courses (general science, biology, chemistry, and physics).

¹³John Breukelman and Ted F. Andrews, "Offerings and Enrollments in the Secondary School Sciences in Kansas in 1954-1955," Emporia State Research Studies, 4, 1-38 (1956).

¹⁴Ibid., p. 5.

Comparisons were done between this report and the 1953 and 1951 studies regarding the percentage of schools offering the four main sciences. A comparison was made between size of school and number of schools offering other science courses besides the main four.

Enrollment data was calculated for each of the four main science courses relating them to size of school. Average enrollments in each of the four main sciences were included in the study plus a comparison of these enrollments with other studies.

The relationship between class size and number of sections compared with the size of the school was done breaking it down into each of the four main sciences.

Full-time and part-time teachers along with average number of science pupils per science teacher was compared with size of school. Also compared with size of school was the number of non-science courses taught by general science teachers, biology teachers, chemistry teachers and physics teachers.

A comparison was made between the 1951 study and the present study regarding number of non-science courses taught by general science, biology, chemistry and physics teachers plus a comparison of enrollments in the four main sciences.

Trends also were analyzed dealing with number of teachers teaching science and teaching science only; number of schools offering the four main sciences; number of classes offered in four main sciences; number of students enrolled in the four main sciences; plus other data from Alm's study of 1938, and other national and state studies.

Science teachers in the 687 high schools taught a total of

2,473 non-science courses. There were 877 part-time science teachers and 219 full-time science teachers in 1954-1955. Again, science teachers were encouraged not to specialize in one field but to be prepared in at least one other field for teaching.

"Physical education" and science teaching were looked upon as not being a good teaching combination as both are very time consuming. Also, since most teachers have to prepare for and teach many different labs a recommendation was given that the teaching load for one teacher should include no more than four laboratory classes per day.

As a result of the inadequate preparation and overloading of science teachers, the report concluded that sciences are the most inadequately taught subjects.

A minimum of 60 semester hours in science was recommended with 24 hours in one science and 18 hours in each of the other sciences. A recommendation for providing a physical science course was made; its objectives, organization and limitations. They also made the recommendation that general science be shifted to junior high school and a course in physical science be offered at the 9th grade level.

Baker and Brooks (1955-1956)¹⁵

The study investigated the academic preparation of the teachers of science in Kansas; presented data regarding background, teaching assignment and position; and presented information from the colleges from which they graduated.

¹⁵Weldon N. Baker and Merle E. Brooks, "Background and Academic Preparation of the Teachers of Science in the High Schools of Kansas 1955-1956," Emporia State Research Studies, 6, 1-40 (1957).

The report based its data on secondary school teachers who taught at least one science course during the 1955-1956 school year. The study included 650 senior high schools and 57 junior high schools with 1,177 teachers being studied. Data was obtained from the 1955-1956 High School Principals' Organization Reports on file at the State Department of Public Instruction and also from 1,144 transcripts of the 1,177 teachers. The other 33 transcripts were not on file or the microfilm copy was illegible.

The report showed the location and name of the employing school, population of city where school was located, class of school, type of organization, enrollment and size of last graduating class.

The report gave data on colleges where teachers received bachelor's degrees, age of teachers, number of teachers holding master's degrees, academic majors of science teachers by age and alma maters.

The number of science teachers teaching each of the four main sciences plus junior high science was done along with the number of science teachers teaching one or more science courses.

The academic preparation of the teachers in biology, botany, zoology, physics and chemistry was given. Also the academic preparation in ten basic courses in science was given grouped by subject taught, by age group and class of school in which employed.

Tables showing the credit hours in the science courses of graduates from Kansas State College, College of Emporia, College of Pittsburg, Fort Hays Kansas State College, Kansas University, Washburn University, and Wichita University were presented.

A brief discussion of other studies was included in the report

as was a discussion on additional research needed for science education in Kansas.

Six recommendations were given:

1. The academic preparation of the science teacher should include a balanced program in both the physical and biological sciences.
2. Preparation in the subject taught should exceed by a wide margin the six hours minimum now required in Kansas certification requirements.
3. All science teachers should meet the Class A requirements for science teachers. The student in the Class C school is as much entitled to a well-prepared teacher as is the student in the Class A school.
4. Biology teachers should have college preparation in the basic courses of botany, zoology, and field biology. Such subjects as health, hygiene, foods, nutrition, and farm crops are of secondary importance to the prospective biology teacher, and should not satisfy the requirements for science teaching.
5. The general science teacher should be the most broadly trained of any of the science teachers. He should take as many as possible of the following courses: chemistry, physics, botany, zoology, physiology, human anatomy, genetics, geology, astronomy, and microbiology.
6. The prospective science teacher should be urged to extend his training through a fifth year of college work, in order that he may enter his profession adequately prepared for the responsibilities that are his.¹⁶

Peddicord (1957-1958)¹⁷

The study investigated the number and percentage of pupils enrolled in the areas of mathematics and science for the years 1957-1958 in Kansas high schools.

¹⁶Ibid., p. 37.

¹⁷Rita Rae Peddicord, "Enrollment in High School Mathematics and Science in Kansas," (Unpublished Master's Report, Kansas State University, Manhattan, Kansas, 1959), pp. 1-25.

The data was collected from the Annual Principals' Reports for the Year 1957-1958. Four hundred ninety-eight schools were included in the study.

The study gave the percentage of students enrolled in science and compared enrollments with those for the school year 1953-1954. The sciences were broken down into the four main sciences plus physiology and botany with percentage of pupils enrolled in each subject.

It was concluded that many schools offered only general science or biology and schools could not afford adequate equipment and facilities for physics and chemistry. There was only a slight increase in enrollment from 1953-1954 to 1957-1958 in the sciences.

Novak and Brooks (1959)¹⁸

The article dealt with the college preparation needed to teach science in high school. Questionnaires were mailed to 253 science teachers selected at random from a list of Kansas high school science teachers. Subsequently, 196 or 77.4 percent were returned and analyzed.

A table was given which included a list of college courses the teachers deemed essential, helpful or of little value and an absolute minimum necessary to teach the four main science courses in high school.

Results of the survey suggested that science teachers in Kansas recommended a minimum preparation of at least one year of college work in the subject taught. No course, however, had an absolute minimum hours recommended by more than 80 percent of the teachers. The authors

¹⁸Joseph D. Novak and Merle E. Brooks, "College Preparation of Science Teachers," The Science Teacher, 26, 473-477 (1959).

inferred then that some science teachers presumed that a subject such as physics could be taught without any college preparation.

If 50 percent of the teachers recommending an "essential" for a course is used as a standard for preparation of courses then general science teachers should have Physics I, General Biology, and Chemistry I. Chemistry teachers should have Chemistry I and II, Organic Chemistry and Qualitative Analysis. Physics teachers should have General Physics I and II and Modern Physics. Biology teachers should have General Biology (with laboratory), General Zoology, General Botany, and Human Anatomy and Physiology.

Breukelman (1960)¹⁹

The paper was a "report on some of the activities, particularly those since 1956, of the Committee on Educational Trends in Science Teaching."²⁰ It also gave a detailed report on the 1959-1960 conferences of the Academy.

The first part of the paper gave resumes of two previous reports already reported upon. Alm (1938) was compared with Breukelman and Andrews (1954-1955) and Baker and Brooks (1957). The report, Reed (1951), by the Academy was summarized in this paper.

A report was made on various informal meetings held in 1957. The purpose of the meetings was to study the articulation between

¹⁹John Breukelman, "The Science Teacher Improvement Program of the Kansas Academy of Science," Transactions of the Kansas Academy of Science, 63, 1-60 (1960).

²⁰Ibid.

college and high school science programs and courses. It was decided that other aspects of science teaching should be studied.

Other meetings were held involving a study of the certification requirements for secondary teachers of science in Kansas and guide lines for future study and discussion. A summary of the meetings was given with the recommendations for certification. Support was requested for two major projects at another meeting on June 27, 1958.

The remainder of the paper dealt with the second project known hereafter as Project II called "The Science Certification Requirements Improvement and Teacher Education Improvement Program."

National Science Foundation supported Project II and two conferences of high school and college science teachers were held. The study reported on these conferences and who attended, what was discussed, and recommendations in each of the four main sciences for certification and preparation. Science supervisor training and preparation was discussed at the conferences with recommendations for preparation.

In addition, conferences on physical science certification and preparation recommendations were held in Salina and Manhattan, Kansas. Four appendixes were included in the paper. Appendix A was the "AAAS Report on Preparation of High School Science Teachers." Appendix B was "Summary of Deliberation of Science Groups at Kansas TEPS Conference, 1959." Both of these dealt with recommendations for certification and preparation of science teachers on a national level. Appendix C was a "List of Participants and Committee Members" (gave name, address and school taught). Appendix D was the "Preliminary Letter Sent to Those Invited to the Salina Conference."

Breukelman and Frazier (1960-1961)²¹

The study was done after a 5-year interval from the 1954-1955 study by Breukelman and Andrews. The objectives and purpose of the study were to show:

(1) the offerings and enrollments in the sciences in Kansas junior and senior high schools; (2) the subjects taught by Kansas junior and senior high school science teachers; (3) the major trends in science teaching as revealed by comparison with previous studies; and (4) certain comparisons with the national situation in science education.²²

The study was based on data found in the 1960 High School Principals' Organization Reports with the same limitations as the previous two studies except that senior high schools and junior high schools were treated separately. Ninety-nine percent or 604 of the accredited senior high schools were used with senior high school being defined as all 2-year, 3-year, and 4-year high schools and also 6-year high schools where junior high schools were not separated from senior high schools. All senior high schools used in the study were accredited and all junior high schools were accredited except one. The number of junior high schools included in the study was 92.

The report separated into two parts: the "Offerings and Enrollments in Senior High School" and "Offerings and Enrollments in Junior High School."

The report compared the size of school with the number of schools offering from one to four or more science courses, number of

²¹John Breukelman and Ralph P. Frazier, "Offerings and Enrollments in the Secondary School Sciences in Kansas in 1960-1961," Emporia State Research Studies, 10, 1-48 (1961).

²²Ibid., p. 5.

schools offering all of the four main science courses, and number of schools offering different science courses other than the four main science courses (28 different courses were mentioned).

A comparison was made from this report and the 1954-1955 and 1951-1952 studies regarding the percentage of schools offering the four main sciences.

Enrollment data was calculated for each of the four main science courses relating them to size of school. Average enrollments in each of the four main sciences were included in the study plus a comparison of these enrollments with the two previous studies.

The relationship between class size and number of sections compared with the size of the school was done breaking it down into each of the four main sciences.

Full-time and part-time teachers along with average number of science pupils per science teacher were compared with size of school. Also compared with the size of school was the number of non-science courses taught by general science teachers, biology teachers, chemistry teachers and physics teachers.

The second part of the report dealing with the junior high school showed data comparing size of school with (1) number of schools offering science in 7th, 8th, 9th and other grades; (2) number of schools offering the sciences by grades; and (3) kinds of science courses taught and number of junior high schools offering each course.

A relationship between size of school and non-science courses taught by junior high science teachers was made as was the relationship between size of school and enrollments in junior high school science courses.

The number of sections of science offered and class size as compared to size of school was given. The number of full-time and part-time science teachers as compared with size of school was also given.

A comparison was made between the 1951-1952 studies and the present study regarding number and percent of schools in each size group.

Trends were analyzed dealing with number of science courses offered by the schools, number of schools offering four main sciences, science offerings other than four main sciences, number of teachers teaching science and number teaching science only, number of non-science courses taught by general science, biology, chemistry and physics teachers, total number of students enrolled in the four main courses, and the percentage of pupils in last four grades in public high school taking science courses from 1889 through 1959. According to the study, 1,136 different teachers taught science in the 604 accredited senior high schools. It was noted that the full-time science teacher should increase his emphasis on preparation for science teaching by taking courses relevant to science but not necessarily science in order to develop a better perspective concerning the impact of science on our society.

Also implied in the data was the recommendation that colleges should plan programs designed especially for junior high school science teachers.

Recommendations were given that separate certification of high school biology, physical science, and general science teachers be considered.

A table showing a summary of requirements for teaching the four

main sciences and physical science was included with a discussion on the table.

It was implied that colleges should immediately take responsibility to train or lend in-service assistance to teachers of science who are faced with science teaching problems. It should take into account the modern development of science for the high school student and keep the teacher abreast of new developments in science.

Breukelman and Frazier (1961)²³

The paper was a report on two National Science Foundation Academy Conferences, "III" at Lawrence, Kansas, and "IV" at Hays, Kansas. The subject for these conferences was the curriculum for teachers of science at all levels through senior high school.

The Lawrence Conference included several discussions. Some of the areas presented were as follows: pre-service science education for the elementary teachers, junior high and senior high school teachers; science responsibilities of colleges of teacher education to in-service elementary, junior and senior high school teachers; methods of improvement of science teaching competence of in-service K-12 teachers; supervisory positions needed at various grade levels; and opportunities and responsibilities of the teacher, college and administration in developing a K-12 science program.

It was decided that junior high science teachers should be broadly educated in science and colleges should offer a major in general science.

²³John Breukelman and Ralph P. Frazier, "The Science Teacher Improvement Program of the Kansas Academy of Science (Second Report)," Transactions of the Kansas Academy of Science, 64, 237-257 (1961).

The Hays conference discussed two questions:

- I. What kinds of data are needed for the formulation of college programs in science for the following?
 - A. Pre-service elementary school teachers.
 - B. Pre-service junior high school science teachers.
 - C. In-service elementary school teachers.
 - D. In-service junior high school science teachers.
- II. What kinds of studies should be made by the local school to aid the colleges in determining their science programs for the following?
 - A. Pre-service elementary school teachers.
 - B. Pre-service junior high school science teachers.
 - C. In-service elementary school teachers.
 - D. In-service junior high school science teachers.²⁴

The discussion that ensued resulted in many recommendations for kinds of surveys and data needed and were reported in the paper.

Two Appendixes were included. Appendix A gave tables from Breukelman (1961) dealing with enrollments in junior and senior high schools. Appendix B was a list of participants in the conferences with their addresses.

Cook (1961-1966)²⁵

The study covered most curriculums including science from 1961 to 1966. The data was obtained from the Junior High School Principals' Organization Reports from 1961 to 1966.

The study concluded that some Kansas schools were breaking down general science into life science, physical science and earth science; that some were extending general science to a full year course and that much new equipment had been received for the laboratories.

²⁴Ibid., p. 243.

²⁵Maureen Ann Cook, "A Study of the Changes in the Kansas Junior High School Curriculum from 1961 to 1966" (Unpublished Master's Report, Kansas State University, Manhattan, Kansas, 1966), pp. 1-34.

The study included only two pages on science and very weak data was given to support the statements made by the author.

Breukelman and Frazier (1962)²⁶

The paper was a report on two National Science Foundation Academy Conferences, "V" at Emporia, Kansas, and "VI" at Dodge City, Kansas. The conferences were held October 28, 1961, and April 7, 1962, respectively. The subject for these conferences was the curriculum for junior high school science teachers.

The Emporia Conference was opened with the purpose of discussing and exploring all aspects of the colleges' junior high school science teacher preparation. A summary of the discussions were included in the report with the following recommendations made:

- (1) Practice teaching should be done at level the prospective teacher will teach.
- (2) Earth Science preparation should include geology, physical geography, meteorology, climatology, and astronomy.
- (3) Highly flexible graduate programs should be developed for the junior high teacher.
- (4) Better science textbooks should be written.
- (5) Colleges should have better programs for the junior high school teacher.
- (6) The junior high school teacher should be better prepared concerning his role in the junior high school.

²⁶John Breukelman and Ralph P. Frazier, "The Science Teacher Improvement Program of the Kansas Academy of Science (Third Report)," Transactions of the Kansas Academy of Science, 65, 154-177 (1962).

The Dodge City conference dealt with the most desirable program for teacher preparation of senior high school teachers and the desirable college science curriculum for teachers of junior and senior level science.

It was decided that a junior high school science teacher should have a broad academic preparation in biological, earth and physical sciences with a major in one of the sciences. Plans for the future should be formulated and student teaching done in blocks of full-time teaching at the level and subject in which student plans to teach. Methods classes should include philosophy of science and scientific methods of inquiry. In-service night or weekend courses should be established. Certification requirements were discussed but further study was needed.

Also in the report a summary of "Guidelines for the Preparation of Junior High School Science Teachers," was prepared by the National Association of State Directors of Teacher Education and Certification and the American Association for the Advancement of Science.

An Appendix was included which listed participants in the conferences with their addresses.

Breukelman and Frazier (1962-1963)²⁷

The study was done after a two-year interval from the previous study covering the 1960-1961 school year by Breukelman and Frazier. The objective and purpose of the present study were "to provide up-to-date

²⁷John Breukelman and Ralph P. Frazier, "Offerings and Enrollments in Junior High School Science in Kansas in 1962-1963," Emporia State Research Studies, 12, 1-19 (1963).

information on offerings and enrollments in science courses in Kansas junior high schools."²⁸

The study was based on data found in the Junior High School Principals' Organization Reports for 1962-1963. One hundred percent or 96 separately organized junior high schools plus data from the 7th, 8th, and 9th grades of 25 six-year schools were included in the study.

The number and type of separately organized and accredited junior high schools in Kansas from the years 1951-1963 were given.

The study showed the relationship between size of school and number of schools in each size group offering junior high sciences, by grades; science enrollments in the junior high school sciences; kinds of science courses taught and number of junior high schools offering each course; number of full-time and part-time science teachers and the average number of pupils taught by each; classification of all full-time junior high school science teachers; and non-science courses taught by junior high school science teachers.

Enrollment figures were given in the 7th, 8th, and 9th grades in different kinds of junior high schools.

A report on the certification requirements for teachers was included along with a comparison between size of school and highest degrees and types of certificates held by Kansas junior high school science teachers.

The report did not go into any more detail regarding highest degree and type of certificate held. No implications were included leaving that task to the conferences of the Kansas Academy of Science.

²⁸Ibid., p. 6.

Watkins (1962-1963)²⁹

The study investigated the academic preparation in science of chemistry teachers in Kansas high schools. The data was obtained from the 1962-1963 High School Principals' Organizational Reports. Four hundred thirty-three chemistry teachers were included in the study.

Relationships between size of school and number of chemistry teachers, percent of total number of teachers, chemistry offerings, number of teachers with Master's degrees, number of credits in chemistry, number of credits in teaching area, number of part-time science teachers, number of full-time science teachers, number of full-time chemistry teachers, preparation of full-time and part-time science teachers and full-time chemistry teachers, and preparation of chemistry teachers was given.

The report concluded that size of school and teachers' academic preparation were related with teachers in larger schools better prepared. The average teacher had 20 hours in chemistry and 54 hours totally in science teaching area. The study further showed that chemistry teachers had more chemistry preparation than that required by Kansas State Department of Public Instruction.

Breukelman and Frazier (1963)³⁰

The paper was a report on two National Science Foundation Academy

²⁹Marilyn Mauck Watkins, "Academic Preparation in Science of Chemistry Teachers in the Kansas High Schools 1962-1963" (Unpublished Master's Report, Kansas State University, Manhattan, Kansas, 1963), pp. 1-27.

³⁰John Breukelman and Ralph P. Frazier, "The Science Teacher Improvement Program of the Kansas Academy of Science (Fourth Report)," Transactions of the Kansas Academy of Science, 66, 315-333 (1963).

Conferences, "VII" at Pittsburg, Kansas, and "VIII" at McPherson College. The conferences were held October 13, 1962, and April 20, 1963, respectively. The subject for these conferences was the college level science curriculum for teachers in the elementary grades.

The Pittsburg Conference was opened with an address by Kenneth D. George, Instructor in Science Education at the University of Kansas. Some of the important aspects of his speech were quoted in the report. The conference then discussed the science content desirable for an elementary teacher. Some general points of agreement in the discussion were as follows:

1. "Future elementary teachers should take at least one laboratory course each in physical science and biological science, plus a special course in science for the elementary school teacher."³¹
2. Methods courses should be taught by science educators.
3. Colleges should provide courses for prospective and in-service science teachers.
4. Teacher-aids should be made available along with science consultants.

The McPherson conference dealt with "the minimum curriculum offerings for pre-service teachers, and the course in the teaching of science at the elementary level."³²

All groups decided that both biological and physical science courses should be taken by elementary teachers and that these courses should precede the methods science course. Also, ways to help in-service

³¹Ibid., p. 320.

³²Ibid., p. 322.

teachers were discussed. Some suggestions were: in-service meetings of elementary teachers, science institutes, and workshops. Many other topics and suggestions were given at both conferences but nothing could be decided upon by all. Several Appendixes were included with Appendix A being the elementary science teacher program of Kansas State Teachers College; Appendix B -- recommendations of the Mathematical Association of America for teachers of elementary school mathematics; and Appendix C -- list of participants at the conferences along with their addresses.

Rolf's (1963-1964)³³

The study investigated the academic science, professional and general educational preparation of the beginning high school biology teachers in Kansas for the school year 1963-1964.

Data was obtained from the 1963-1964 High School Principals' Organizational Reports. The study included 167 biology teachers.

The number of credits in biology earned by part-time and full-time science teachers and full-time biology teachers as compared to the size of school was given concluding that schools over 100 had a greater percentage of qualified science teachers. Full-time biology teachers were better prepared in biological sciences but not in the supporting courses. Full-time science teachers, however, were better prepared to teach the supporting courses.

The report gave data to support the conclusion that scope and depth in the teachers' college biology training was lacking. Beginning

³³Ronald Dale Rolfs, "The Academic and Professional Preparation of the Beginning High School Biology Teachers in Kansas" (Unpublished Master's Report, Kansas State University, Manhattan, Kansas, 1964), pp. 1-32.

biology teachers tended to lack preparation in chemistry, physics, mathematics and related sciences. All of the teachers had earned the recommended professional education course credits.

Breukelman (1963-1964)³⁴

The study was based on data from the 1963 High School Principals' Organization Reports, on file at the State Department of Public Instruction, Topeka, Kansas. The data included were school enrollment and enrollment in each class taught by each teacher of biology. Fourteen (13.9%) separately organized junior high schools in which biology was taught as a separate subject in 1963-1964 and 582 (99.7%) senior high schools were included in the sample.

Breukelman cited many different trends established from his previous studies and those of others. For example, the number of students enrolled in high school biology in Kansas increased from 15,130 in 1951-1952 to 26,190 in 1960-1961, and to 33,500 in 1963-1964. Also, the number of full-time science teachers increased from 117 to more than 450. The rapid increase in BSCS Biology was noted. There were seven BSCS teachers in the Wichita-Emporia Testing Center in 1960-1961. The number was expected to reach 75 in 1964-1965.

The information obtained was summarized in six separate tables. Table I showed the status of biology as a Kansas senior high school science and included size of school; number of schools in each size category; number and percent of schools in each size category offering

³⁴John Breukelman, "Teaching Combinations of the High School Biology Teachers of Kansas, 1963-1964," Transactions of the Kansas Academy of Science, 67, 379-388 (1964).

biology; number of biology teachers in each size category; number of sections of biology in each size category; number of sections per teacher; number of students enrolled in biology in each size category; and number of biology students per teacher in each category.

Table II showed a comparison of Kansas senior high schools that had enrollments below 100 with those that had enrollments of 100 or more in 1963-1964. Breukelman came to the interesting conclusion that although slightly more than half of the senior high schools had enrollments of fewer than 99 students, only 40.6 percent of the teachers of biology, and only 12.6 percent of the biology students were in schools with less than 99 students.

Table III covered those junior high schools that taught biology as a separate subject. It included the same type of information as Table I.

Table IV showed the number of biology teachers according to size of school and numbers of biology teachers in each size category teaching science, chemistry, physics, other sciences, and courses in other fields. This table showed that about 46 percent of the biology teachers taught only biology or only science.

Table V included the non-science subjects which biology teachers taught in addition to biology.

Table VI broke down the totals into the possible combinations of teaching biology only; teaching biology plus other science; teaching biology plus other science plus non-science; and biology plus non-science. For example, of the seven biology teachers teaching in schools with fewer than 24 students in 1963-1964, none were teaching biology

only; none were teaching biology and some other science only; four were teaching biology, at least one other science and at least one non-science, and three were teaching biology and at least one non-science.

Breukelman concluded that the number of schools needing a "jack-of-all-trades" teacher who meets minimum requirements in biology were becoming fewer. He implied that graduate study is advisable for those wishing to teach in schools large enough to have a full-time biology teacher.

He established a consensus among biology educators concerning the courses which "sound preparation" for biology teachers should include. Those which he listed are as follows: laboratory college courses in botany, zoology, bacteriology, physiology, genetics, and ecology.

Walker (1963-1964)³⁵

The study investigated the academic preparation of secondary biology and general science teachers in Kansas. Data was collected from the 1963-1964 High School Principals' Organizational Reports. The study included 1,190 teachers.

Some of the results of the study were that half of the general science and 80 percent of biology teachers were full-time teachers with school enrollments over 300. Size of school and academic preparation of biology teachers were found to have a direct relationship. No relation-

³⁵Randol Rex Walker, "A Study of Academic Preparation of Biology and General Science Teachers in Relation to School Size in Kansas" (Unpublished Master's Report, Kansas State University, Manhattan, Kansas, 1964), pp. 1-32.

ship was found, however, between school size and academic preparation of general science teachers.

The average biology teacher had 33 hours in biology and a total of 57 hours in all sciences. The average general science teacher had 52 hours in science.

The percentage of teachers qualified to teach biology and percentage of biology teachers with master's degrees was included in the study.

Breukelman (1965-1966)³⁶

The study was done after a five year interval from the 1960-1961 study by Breukelman and Frazier. The objectives and purpose of this study were to show:

(1) the offerings and enrollments in the sciences in Kansas junior and senior high schools, (2) the subjects taught by Kansas junior and senior high school science teachers, and (3) some of the major trends in Kansas high school science teaching as revealed by comparison with previous studies.³⁷

The study was based on data found in the High School Principals' Organization Reports with the same limitations as the previous three studies except that senior high schools and junior high schools were treated separately as was the 1961 report. As a list of the accredited junior and senior high schools was not available at the time of the study, the report showed that 557 senior high schools were used with

³⁶John Breukelman, "Offerings and Enrollments in the Secondary School Sciences in Kansas in 1965-1966," Emporia State Research Studies, 14, 1-38 (1966).

³⁷Ibid., p. 5.

senior high schools being defined as all 2-year, 3-year, and 4-year high schools where junior high schools were not separated from senior high schools. The number of junior high schools used was 110.

The report was separated into two parts: "Offerings and Enrollments in Senior High School," and "Offerings and Enrollments in Junior High School."

The report compared the size of school with the number of schools offering from one to four or more science courses, number of schools offering all of the four main science courses, and number of schools offering different science courses other than the four main science courses. (Ten different courses were mentioned along with the category "other.")

A comparison regarding the percentage of schools offering the four main sciences was made between this study and the 1960-1961, 1954-1955, and 1951-1952 studies.

Enrollment data was calculated for each of the four main science courses relating them to size of school. Average enrollments in each of the four main sciences were included in the study plus a comparison of these enrollments with the three previous studies.

The relationship between class size and number of sections compared with the size of school was done breaking it down into each of the four main sciences.

Full-time and part-time teachers along with average number of science pupils per science teacher were compared with size of school. Also compared with the size of school was the number of non-science courses taught by general science teachers, biology teachers, chemistry teachers and physics teachers.

The second part of the report dealing with the junior high school showed data comparing size of school with (1) number of schools offering science in 7th, 8th, 9th and "grade not specified"; (2) number of schools offering science by grades; and (3) kinds of science courses taught and number of junior high schools offering each course.

The number and type of separately organized and accredited junior high schools in Kansas from 1951 to 1965 were given.

The relationship between size of school and (1) number of non-science courses taught by teachers; (2) enrollments in Kansas junior high school science courses; (3) number of sections and class size of Kansas junior high schools; and (4) number of full-time and part-time science teachers and average number of science students per science teacher was given.

A comparison was made between the 1951-1952, 1954-1955, and 1960-1961 studies and the present study regarding number and percent of schools in each size group.

Trends were analyzed dealing with number of science courses offered by the schools, number of schools offering four main sciences, science offerings other than four main sciences, number of teachers teaching science and number teaching science only, number of non-science courses taught by the four main science-course teachers, total number of students enrolled in the four main courses and the percentage of pupils in last four grades in public high schools taking science courses from 1889 through 1959. According to the study; 1,162 different teachers taught science in the 557 senior high schools. Full-time teachers included 41.8 percent of the total and 58.2 percent were part-time science teachers.

Junior high schools had relatively more full-time science teachers than the senior high schools mainly because the junior high schools were usually large enough to have one full-time science teacher.

Full-time teaching in general science was more probable than full-time teaching in chemistry, physics or physical science.

Recommendations were given that separate certification of high school biology, physical science, and general science teachers be considered.

A table showing a summary of teacher preparation requirements as recommended by American Association for the Advancement of Science was included with a discussion of the table.

It was implied the colleges should immediately take responsibility to train or lend in-service assistance to teachers of science who are faced with science teaching problems.

Odom (1965-1966)³⁸

The study investigated the nature and extent of the preparation of Kansas elementary teachers to teach science for the school year 1965-1966. One hundred seventy-six teachers were selected at random from a list of 3,684 elementary teachers obtained from the Kansas State Department of Public Instruction. Then data was collected from the teachers' transcripts and certification sheets on file in the Certification Division of the Kansas State Department of Public Instruction.

³⁸Mildred Odom, "The Preparation of Kansas Elementary Teachers in Science" (Unpublished Master's Report, Kansas State University, Manhattan, Kansas, 1966), pp. 1-40.

The study gave data on where and when the elementary teachers received their degrees, and number of semester hours of science each teacher had taken. Data was also given on percentage of teachers having one or more courses (out of nine) in science.

The study concluded that elementary teachers were better prepared in biological sciences than physical sciences and the teachers averaged twelve semester hours of science below recommended preparation levels for elementary teachers.

Rundus (1965-1966)³⁹

The study investigated the academic preparation in physics of the first year physics teachers in Kansas and the number of college credits of professional education courses they had taken plus the relationship between the academic and professional preparation of the teachers.

Data was collected from the 1965-1966 North Central Association Reports and the 1965-1966 High School Principals' Organizational Reports. Thirty-four teachers were included in the study.

Teaching combinations of the first year physics teacher according to school size were given with only one teaching physics full-time. Forty-one percent taught physics and math and twenty-three percent taught physics, chemistry and biology.

³⁹Timothy Amos Rundus, "A Study of the Academic and Professional Preparation of the First Year Secondary School Physics Teachers in Kansas" (Unpublished Master's Report, Kansas State University, Manhattan, Kansas, 1966), pp. 1-31.

Comparisons were shown between the teachers' academic preparation of related sciences, physics, chemistry, biology and mathematics, and size of school. Both full-time and part-time science teachers were included.

The report concluded that there was no significant relationship between the academic and professional preparation of teachers and size of school. Also there was a definite lack of adequate training for first year physics teachers.

Austin and Pierson (1966-1967)⁴⁰

The sample for study in this report included the Public Unified or common school districts within Cloud, Jewell, Mitchell, Osborne, and Ottawa counties for the 1966-1967 school year. Interviews were conducted with fourteen unified district superintendents and one common school district superintendent. The number of semester hours of science earned by each teacher, and years of experience and tenure of each teacher were obtained at the district offices. Visitations to the seventh and eighth grade classrooms were made to determine the adequacy of their science equipment and other facilities. Each teacher was interviewed to determine: "(1) information concerning the class schedules, (2) the attitudes of the teachers regarding science teaching, and (3) their opinion of the adequacy of their academic background in science."⁴¹

⁴⁰Arthur A. Austin and David W. Pierson, "Certain Factors Affecting Seventh and Eighth Grade Science Programs in North Central Kansas," Transactions of the Kansas Academy of Science, 71, 31-39 (1968).

⁴¹Ibid., p. 14.

The writers came to interesting conclusions concerning teachers' science preparation, teachers' attitudes, classrooms, and equipment and facilities.

The study revealed a wide variation in the science preparation of teachers teaching seventh and eighth grade science in North Central Kansas. "The average number of science hours completed by teachers was 24.3; the median hours earned were 22. The median group of teachers had completed 20-29 hours of science."⁴² It was determined by the writers that the teachers who had more credit hours of science were generally teaching in larger class situations.

The teachers attitudes concerning their adequacy as science teachers and their desire for further study in science were discussed.

The study showed that the science teachers teaching in departmentalized classrooms or self-contained classrooms were divided nearly half and half. However, 1,213 students attended departmentalized classes and only 302 received instruction in the self-contained classrooms.

A table was provided concerning equipment and facilities and comparing number of students with adequacy of equipment and facilities under categories of adequate, inadequate and poor.

Pringle and Durst (1967-1968)⁴³

The report concerned the extent to which BSCS Biology had become

⁴²Ibid., p. 15.

⁴³James Pringle and Harold Durst, "Status of BSCS Biology in Kansas 1967-1968," Transactions of the Kansas Academy of Science, 72, 394-398 (1969).

accepted and incorporated into the science curriculum of the state of Kansas.

A questionnaire was sent to each of 568 public school biology teachers of which 442 or 77 percent returned the questionnaire. Thirty-four percent or 149 of the teachers responding taught BSCS Biology.

The relationship between size of school and number of BSCS teachers teaching the Blue, Yellow and Green versions of BSCS was given.

The report showed the years of teaching experience and degrees held by Kansas high school biology teachers breaking it down between BSCS and non-BSCS teachers.

Number of teachers compared with number of semester undergraduate and graduate hours was compared for the BSCS teachers and non-BSCS teachers. The report concluded that BSCS teachers have had less teaching experience, but more semester undergraduate and graduate hours in biology and were more likely to have an advanced degree than the non-BSCS teachers.

Splitter (1968-1969)⁴⁴

The study involved a questionnaire which was sent to each of 190 BSCS teachers and 93 non-BSCS teachers of which 87 percent were returned. The report covered the 1968-1969 school year.

The purpose of the study was to determine differences in attitudes between BSCS teachers and non-BSCS teachers; to become aware of criticisms, materials available, implementation and other

⁴⁴Jackie Lee Splitter, "A Study of BSCS in the State of Kansas 1968-1969" (Unpublished Master's Report, Kansas State University, Manhattan, Kansas, 1969), pp. 1-66.

factors involving BSCS in Kansas.

Some of the major conclusions of the study were the following: "Green Version" BSCS teachers favored BSCS more than others; over 50 percent were teaching Green Version BSCS; money and facilities were major hindering factors. Some criticisms of BSCS were concerned with the difficulty of the course as being too difficult, vague, or impossible to do.

The average BSCS teacher had taught in larger schools, had more college hours in biology and had more college bound students than the average non-BSCS teacher.

Other Research Studies

Some of the research studies recommended by the three educators of which copies were not available were the following: Dr. Maurice H. Witten recommended "The Effects of Selected Background Variables on Success in College Physics," by Maurice Witten (1967). A possible location source was given as the University of Michigan Dissertation Abstracts but was not obtained. Dr. Witten also recommended "Preparation of High School Physics Teachers in Kansas Public Schools," by Maurice H. Witten, which at the date of this writing was being submitted to Journal of Kansas Academy of Sciences for publication. A follow-up letter was sent to Dr. Witten asking for a copy of the report, but no response was received as of this writing.

Dr. David Pierson recommended "Analytic Geometry as a Precursor to Calculus," by Ross L. Thornbrugh; "The Ability of Selected Students to Identify Biological Principles and Facts," by V. Duane Ring;

"The Identification of Major Earth Science Principles Common to Biology, Chemistry and Physics," by William S. Dryer; and "Mobility of Western Kansas Science and Mathematics Teachers," by David Pierson. Dr. Pierson was to send a copy of his paper which was being reworked at that time for the public. Letters were sent to Ring at Pratt Community Junior College, and Dryer at Scott City Senior High asking for copies of their reports. As of this writing there were no responses to the additional follow-up letters.

Dr. William E. Claflin recommended "The Outdoor Laboratory as a Practical Facility for Teaching Field Biology in Midwestern Kansas High Schools," by Gwendolyn L. Miner (1969), Fort Hays Kansas State College Library. An interlibrary loan was requested but was not available as of this writing.

Charles Creager sent a study entitled "Status of CHEM Study in Kansas," by Guy B. Homman. The survey was unpublished and was included in the Appendix.

Richard Smith, Marysville, Kansas, was preparing a Master's Report at the date of this writing at Kansas State University dealing with the preparation of earth science teachers. Date of completion was not known.

Chapter 4

SUMMARY AND CONCLUSIONS

As previously stated twenty-five papers were reviewed. This small number of sources was somewhat surprising and leads one to believe that much more research is needed concerning the status of science teaching in Kansas.

If the sources were broken down under the headings of elementary, junior high school and senior high school, only three elementary school studies could be found. They were:

Breukelman and Frazier (1961)

Breukelman and Frazier (1963)

Odom (1965-1966)

Some of the major recommendations drawn from the three studies dealing with elementary science were that: (1) more studies need to be done concerning pre-service elementary and in-service elementary teachers for the better formulation of college programs in science; (2) studies should be started both at the elementary school level and continued at the college level; (3) one laboratory course each in physical science and biological science plus a special course in science for elementary school teachers should be taken by future elementary teachers; (4) a methods course should be taught by science educators; and (5) more in-service help is needed, especially in-service meetings, institutes and workshops. It was concluded that elementary teachers were better prepared in biological sciences than physical sciences and

that Kansas teachers averaged twelve semester hours of science below recommended preparation levels on a national level.

Eight junior high school studies were found:

Baker and Brooks (1955-1956)

Breukelman and Frazier (1960-1961)

Breukelman and Frazier (1961)

Cook (1961-1966)

Breukelman and Frazier (1962)

Breukelman and Frazier (1962-1963)

Breukelman and Frazier (1965-1966)

Austin and Pierson (1966-1967)

Some of the recommendations drawn from the eight junior high school studies were: (1) programs planned especially for junior high school science teachers should be established by the colleges; (2) the colleges should take more responsibility to train or lend in-service assistance to teachers of science; (3) the junior high science teacher should be broadly educated in science; (4) the colleges should offer a major in general science; (5) practice teaching should be done at the level the prospective teacher will teach; (6) earth science preparation should include geology, physical geography, meteorology, climatology, and astronomy; (7) highly flexible graduate programs should be developed; and (8) better science textbooks should be used. Some of the conclusions were: (a) general science was being divided into life science, physical science and earth science; (b) general science was being extended to a full year course; and (c) there were more full-time junior high science teachers than full-time high school science teachers.

Most of the eleven studies reviewed also included the senior high school as did all of the rest of the fourteen studies. As can be seen studies dealing with the elementary schools were very scanty indeed and it was recommended that much further study be devoted to this particular area. Further junior high school studies were also needed as the last one included in this report was for the 1966-1967 school year.

With regard to the senior high school studies, some of the recommendations were: (1) academic preparation of science teachers should be balanced with both biological and physical sciences; (2) preparation in subjects taught should exceed the minimum required for Kansas certification; (3) the general science teacher should be the most broadly trained of any science teacher; (4) general science teachers should have at least one course in physics, biology, and chemistry; (5) more in-service training is necessary; (6) separate certification of high school biology, physical science, and general science teachers should be considered; and (7) teacher-aids and science consultants should be readily available.

The senior high school studies were more numerous than the other studies but still more research is needed as there seems to be a lack of studies done after 1968-1969.

If the senior high school studies were broken down by subject matter, namely biology, chemistry and physics, only one physics study was found (Watkins 1962-1963). Two chemistry studies were found (Watkins 1962-1963, and Homman 1968 (see Appendix)). Five biology studies were found (Breukelman 1963-1964, Pringle and Durst 1967-1968, Rolfs 1963-1964, Splitter 1968-1969, and Walker 1963-1964). All the rest of the senior high school studies included all the sciences.

The physics study (Rundus 1965-1966) concluded that only one beginning physics teacher was teaching physics full-time in Kansas with 41 percent teaching physics and math and 23 percent teaching physics, chemistry, and biology. No significant relationship between academic preparation and size of school was found. The author concluded that there was a lack of adequately trained first-year physics teachers.

The chemistry study (Watkins 1962-1963) concluded that academic preparation and school size were directly related with the better prepared chemistry teachers teaching in the larger schools. The average chemistry teacher had 20 hours in chemistry and 54 hours in science.

Some of the conclusions drawn from the biology studies were:

- (1) schools over 100 in size had a greater percentage of qualified biology teachers with full-time biology teachers better prepared in biological sciences but not in the supporting courses than full-time science teachers;
- (2) although more than 50 percent of senior high schools had enrollments of fewer than 99 students only 40.6 percent of biology teachers and only 12.6 percent of biology students were in schools with fewer than 99 students;
- (3) 46 percent of biology teachers taught only biology or only science;
- (4) the number of schools needing only a part-time biology teacher were becoming fewer;
- (5) 80 percent of biology teachers were full-time in schools with enrollments over 300;
- (6) the average biology teacher had 33 hours in biology and 57 hours in science totally;
- (7) BSCS Biology was taught by 34 percent of biology teachers;
- (8) BSCS teachers generally had less experience but had more semester hours in biology and were more likely to have an advanced degree;
- (9) "Green Version" BSCS was used by more than 50 percent of teachers;

(10) money and facilities were major hindrances to incorporating BSCS; (11) the average BSCS teacher taught in larger schools, had more college hours in biology and taught more college bound students than non-BSCS teachers. It was recommended that (a) the scope and depth of biology teacher training be improved; (b) more physics, chemistry and mathematics courses be included in biology teacher preparation; (c) laboratory college courses in botany, zoology, bacteriology, physiology, genetics, and ecology should be included in preparation of biology teachers; and (d) full-time biology teachers strongly consider graduate study.

Again much more study is needed not only for science in general but also in each of the individual curriculums in the state of Kansas.

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APPENDIX

Science Educators in the State of Kansas
February 1, 1972
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While I am writing to you, let me take this opportunity to inform you of two more items of mutual interest. (1) I am happy to announce that NSF has just informed us that we will have funding for a Summer Institute in Level I of the Intermediate Science Curriculum Study materials. I am including a copy of the brochure. I would appreciate your making it available to interested candidates. (2) We are planning to offer a three-hour course in Harvard Project Physics as a part of our regular summer offerings, provided we can get fifteen enrollees. (Our Harvard Project Summer Institute was not funded for this summer.) If you know people who might be interested, will you have them contact me for further information?

Name _____

Position _____

Address _____

____ Please check if you wish a copy of the bibliography.

1. Paper Title _____

Author's Name _____ Date of Publication _____

Advisor's Name _____ Instructor _____

Please Indicate a Possible Source for the Paper(s) _____

2. Paper Title _____

Author's Name _____ Date of Publication _____

Advisor's Name _____ Instructor _____

Please Indicate a Possible Source for the Paper(s) _____

3. Paper Title _____

Author's Name _____ Date of Publication _____

Advisor's Name _____ Instructor _____

Please Indicate a Possible Source for the Paper(s) _____

4. Paper Title _____

Author's Name _____ Date of Publication _____

Advisor's Name _____ Instructor _____

Please Indicate a Possible Source for the Paper(s) _____

Status of CHEM Study in Kansas

May 9, 1968

439 Chemistry Teachers323 Responded to QuestionnaireCHEM Study Usage:

41	Teachers in 84 schools use CHEM Study.
50	More use CHEM Study Laboratory only.
65	Of 91 had formal training in CHEM Study.
8	Schools or teachers had used CHEM Study but various circumstances are not now using it.

148 of 323 were aware of CHEM Study revisions.

Reasons for Not Using CHEM Study:

47	No qualified teacher.
21	Too difficult.
23	Lack of administrative support.
27	Not in agreement with philosophy.

Masters Degrees

146 of 323 have a Master's Degree in various areas.

Texts Used:Other than CHEM Study, 95% of 323 reporting used Modern Chemistry by Metcalfe, Williams, and Castka.Curricular Study - Chemistry

<u>M.S. People</u>	<u>Interest In</u>	<u>Non-M.S. People</u>
49	Refresher Course	105
61	Descriptive P. Chem.	81
42	Math for P.S. Majors	51
37	Safety in the Lab.	52
55	Practicum in Junior College	34
47	Industrial Tours	57
70	Instrumental Methods	85
3	Student Projects	20
	Tech. in Teaching Chemistry	247 altogether

Areas Needing More Stress in Basic Chemistry

Atomic and Molecular Structure	107
Bonding	155
Chemical Equilibrium	129
Math. of Chemistry	93
Chemistry Kinetics	130

Semester Hours Credit in Chemistry

<u>Hours</u>	<u>No.</u>	<u>Hours</u>	<u>No.</u>	<u>Hours</u>	<u>No.</u>
1-11	16	26-32	47	Over 50	34
12-18	85	33-40	38	Not reported	6
19-25	63	41-50	34		

N = 323 of 439

CHEM Study Teachers have a mean number of semester hours preparation of 36.4 while non CHEM Study Teachers have a mean number of semester hours of preparation of 26.8.

The mean semester hours of preparation of 317 teachers reporting was 29.4. Six did not report this item.

Interest Areas Categorized by Semester Hours Preparation

Total Semester Hours in Chemistry	Refresher Course	Descriptive Physical Chem.	Safety in the Lab.	Practicum in Junior College Teaching	Industrial Chemistry Tours	Instrumental Methods for Teachers
1-11	10	8	4	1	4	5
12-18	56	34	22	9	14	35
19-25	31	31	16	10	17	29
26-32	20	30	17	17	17	29
33-40	18	17	5	15	17	20
41-50	8	12	9	15	10	20
Over 50	12	12	16	19	19	22

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A REPORT OF AVAILABLE RESEARCH ON THE STATUS
OF SCIENCE TEACHING IN THE STATE OF KANSAS 1936-1971

by

HOWARD PAUL HAEKER

B. A., Hastings College, Hastings, Nebraska, 1968

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Physical Science Teaching

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1972

The study included the available research done on the status of science teaching in the state of Kansas from 1936 to 1971. Summaries on 25 different sources were given. The summaries on the studies included the purpose, type of data, and major summaries and conclusions. They are arranged according to the years that the studies covered. The bibliography was limited to those materials available at Farrell Library, Kansas State University, and materials sent by science educators in the state.

Much more study is warranted for all fields of science in the state with elementary school science being the most deficient. Only three studies were found concerning the elementary school. Some of the major recommendations for elementary school science were that more studies need to be done concerning pre-service elementary and in-service elementary teacher preparation; one laboratory course each in physical science and biological science plus a special course in science for elementary teachers should be taken by future elementary teachers; and a methods course should be taught by science educators.

Eight studies were found concerning the junior high school. Some of the major recommendations for the junior high school were the establishment of a specific program for science teaching for the junior high level; more in-service and pre-service training including a general science major; and more flexible graduate programs should be developed.

It was recommended that teachers' academic preparation for senior high be generally improved; that general science teachers be given a broader background in science; that there should be more in-service training; and that more teacher aids and science consultants be utilized.