TRAINING OF KANSAS HIGH SCHOOL SCIENCE
TEACHERS

by

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INTRODUCTION

The importance of training of teachers in relation to what they teach cannot be over emphasized. Several studies have been made along this line and in all cases the investigations were significant in showing a striking lack of harmony between academic training and subjects taught among a large proportion of the teachers investigated.

Koos and Woody (9) in their investigation of the Training of Teachers in the Accredited High Schools of the State of Washington, found from data secured on 110 newly appointed teachers for the year 1916-17 that three-fifths of the group were teaching from three to seven subjects and that almost half were teaching subjects in which they had little or no college training.

Hutson (4) in his study of the training in relation to what they taught of 1154 Minnesota science teachers in 1921-22 found that the number of subjects taught varied from one to seven, the teachers of the smaller schools teaching more subjects. Little or no college training was shown in the greater per cent of teachers teaching in the sciences botany, physiography and physiology.

Inman (6) in his study of "The Training of Iowa High School Teachers in Relation to the Subjects they Teach"

found that of 1048 teachers, 682 teaching for two years
taught from one to ten subjects, the most frequent being
four subjects with more than one-third teaching five or more.
Of 430 teachers who had been teaching from three to five
years the range of subjects was from one to eleven, the great-
est frequency being five with more than one-third teaching
six or more subjects. Of the 1048 high school teachers, 51
per cent were teaching in subjects in which they had no un-
dergraduate training.

Further information in regard to the number of subjects
taught and the particular combinations of subjects more
usually found has been presented in Kirby's study (7) of
teaching programs of Iowa high school teachers in 1925.
Woody (16) made a similar study of Michigan teachers in 1925.

In the present study the writer was prompted in the
face of constantly increasing standards for teachers, to in-
vestigate whether the science teachers are better prepared
than heretofore and if so, if they are teaching what they
are prepared to teach. It is commonly assumed that the
high school teacher should prepare to teach one or two sub-
jects and on leaving college for the teaching profession
teach those subjects.

The following pages of this study will show the train-
ing that Kansas Science Teachers of the Class B and C High

Schools have and what they are actually teaching.

In a national survey of the Land Grant Colleges by Whitney and Milholland (14) it was found that out of 13 of the most frequent causes for failure among graduates of those institutions who went into teaching, improper placement ranked fifth, that is, the fifth most frequent cause of failure was lack of close relationship between preparation in college and subjects taught.

As the subject combinations of the Kansas schools studied show a chaotic condition, it is hoped that this study will be of benefit in pointing out the necessity for limiting the number of subjects per teacher also the need for some form of standardization in the assignment of teaching combinations so that the teacher training institutions can adequately prepare teachers who will measure up to the standards set by the Committee of Seventeen (3), a detailed and specialized study of the subject to be taught.

THE METHOD OF INVESTIGATION

This study takes into account 554 teachers teaching science in the Class B and C high schools of Kansas for the year 1936-37. All schools furnishing adequate data were included in the study with the exception of the parochial and private schools.

These data were secured from the files of the "High
School Principal's Organization Report to the State Superin-
tendent" in the offices of the State Superintendent of Pub-
lic Instruction at Topeka, Kansas. These are the official
reports made annually to the State Office, and furnish the
most reliable source of information concerning high schools
of Kansas. These reports, in a number of cases, were not
complete due to failure of certain principals to fill in
all the information asked for.

These reports contain information pertaining to the
teacher such as degree held, subjects taught, semester hours
in the subject taught, semester hours in the teaching field,
daily class load, daily pupil load, certificate held, salary
and years of teaching experience.

Table I. Number and Per Cent of 554 Kansas Teachers in Class B and C High Schools Teaching Science Alone and Those Teaching it in a Two Subject Combination in 1936-37. (Classified According to Field)

Subject Combination	Number of Teachers	Percentage of Teachers
Science alone	5	.902
Science - Social Science	47	8.53
Mathematics	44	7.94
Industrial Arts	30	5.4
Commerce	17	3.07
Home Economics	14	2.53
Vocational Agriculture	8	1.44
English	5	.902
Physical Education	4	.722
Music	1	.18
Total	175	31.616

THE SUBJECT COMBINATIONS

Potthoff (12) states that "many of the teaching posi-
tions in the high schools have become so highly special-
ized that few, if any, well qualified teachers will ever be
available to fill them. This condition is due to the fact
that the combinations of subjects now assigned to many of
the positions are so unusual and so infrequent that no pro-
gram of teacher training can hope to supply the demand
which they represent. They can be filled only by taking
teachers with inferior qualifications. As a consequence,
then, of the high degree of specialization of many posi-
tions, efforts to raise the standards for teachers are be-
ing defeated, at least in a measure." It is undoubtedly
true in the Class B and C high schools of Kansas that sub-
ject combinations are varied and unusual in a great many in-
stances placing undue hardship both on the teacher and the
teacher training institution.

Tables I, II, III and IV show the number of subject
combinations and the number and per cent of 554 science
teachers teaching the various combinations. Figure 1 shows
graphically the per cent of teachers teaching the various
combinations. A study of the tables shows that there are
in all 83 different subject combinations taught by the 554
teachers.

Table I shows that there is a total of 175 teachers or 31.816 per cent of the 554 teachers teaching either science alone or in a two subject combination. Table I and Figure 1 show that there are five teachers or .9 per cent teaching science alone. The remaining 170 teachers or 30.72 per cent (total per cent minus the "science alone" per cent) of the 554 teachers are teaching nine different two subject combinations. The three combinations having the greatest frequency are (1) science and social sciences with 47 teachers or 8.5 per cent of the 554 teachers teaching the combination, (2) science and mathematics with 44 teachers or 7.94 per cent teaching the combination and (3) science and industrial arts with 30 teachers or 5.4 per cent teaching the combination. The remaining combinations show a considerable drop in frequency and it is interesting to note that science and music occur only once, not sufficient to warrant training for such a combination.

In the three subject combination group, Table II, there are 266 teachers or 48.01 per cent of the 554 teachers teaching 51 different combinations. In studying the table it will be seen that there are four combinations having a frequency much higher than the other combinations. About one-fifth (20.57 per cent) of the 554 teachers are teaching these four combinations. Science, mathematics and commerce with 32 teachers or 5.73 per cent teaching the

combination occur most frequently while the three combinations, science, mathematics and social science with 29 teachers or 5.23 per cent, science, social science and industrial arts with 28 teachers or 5.05 per cent and science, mathematics and industrial arts with 25 teachers or 4.51 per cent of the 554 teachers teaching the combinations follow closely.

Table II. Number and Per Cent of 554 Kansas Teachers in Class B and C High Schools Teaching Science in a Three Subject Combination in 1936-37*. (Classified According to Field).

Subject Combination	Number of Teachers	Per Cent of Teachers
Science - Mathematics-Commerce	32	5.78
Mathematics-Social Science	29	5.23
Social Science-Ind. Arts	28	5.05
Mathematics-Ind. Arts	25	4.51
Physical Education-Ind. Arts	18	3.25
Social Science-Home Economics	17	3.07
Social Science-Commerce	16	2.88
Social Science-English	13	2.35
Mathematics-Physical Education	13	2.35
Social Science-Physical Education	8	1.44
English-Home Economics	7	1.26
Mathematics-Home Economics	6	1.08
Mathematics-Music or Art	5	.90
Commerce-Ind. Arts	5	.90

Table II (Continued)

Subject Combination	Number of Teachers	Per Cent of Teachers
Science - Commerce-Home Economics	5	.90
Home Economics-Physical Education	5	.90
Commerce-Physical Education	4	.72
English-Music or Art	4	.72
English-Commerce	4	.72
English-Foreign Language	3	.54
Mathematics-Foreign Language	3	.54
Social Science-Voc. Agriculture	3	.54
Social Science-Music or Art	2	.36
Foreign Language-Music or Art	2	.36
Ind. Arts-Voc. Agriculture	2	.36
English-Mathematics	1	.18
Social Science-Foreign Language	1	.18
Commerce-Music	1	.18
English-Physical Education	1	.18
Industrial Arts-Music	1	.18
Music-Home Economics	2	.36
Total	556	49.01

A careful examination of Table II and Figure 1 shows 19 combinations or more than half of the combinations having frequencies of five or less teachers teaching the combinations, with five combinations occurring only once each. Such a condition shows clearly that combinations are being taught so infrequently as not to warrant training for them. Probably all combinations occurring less than five times should not be considered sufficient to warrant deliberate preparation for teaching them.

Table III and Figure 1 show 54 different combinations of four subjects being taught by 103 teachers or 18.59 per cent of the teachers of the study. Only three combinations have a frequency of ten or more teachers teaching the combinations. The three showing the greatest frequency are science, social science, industrial arts and physical education with 11 teachers or 1.98 per cent of the 554 teachers teaching the combination, science, social science, mathematics and physical education with ten teachers or 1.81 per cent teaching the combination and science, mathematics, industrial arts and physical education with ten teachers or 1.81 per cent teaching the combination.

It is interesting to note that 27 combinations of four subjects or 79.4 per cent of the 54 combinations of the group are taught by less than five teachers each, 14 of the 27 combinations are taught by only one teacher each. Again,

due to the infrequent occurrence, these 27 combinations would not warrant deliberate training for teaching them.

Table IV showing the five subject combination group is composed of nine different combinations being taught by ten teachers. It will be noted that only one combination occurs more than once which condition of infrequency makes training for all of these nine combinations entirely out of the question.

In making a study of the subject combinations it would seem that the philosophy which has prevailed in the past still prevails among the administrators or persons making the teaching assignments that any person with a liberal college training is equipped to teach any academic subject in the high school. Of course, this study takes into account the small high schools of Kansas where the teaching force is limited and that probably accounts for many of the unreasonable combinations found.

In commenting on the infrequency of subject combinations in Koos and Woody's Washington study and Hutson's Minnesota study, Koos (8) points out that the condition is especially acute for recent graduates of training institutions who, with little or no experience, fill positions in smaller schools and to whom falls the task of teaching all the loose ends of a curriculum left after the more experienced teachers have had an opportunity to select the sub-

Table III. Number and Per Cent of 554 Kansas Teachers in Class B and C
High Schools Teaching Science in a Four Subject Combination
in 1936-37. (Classified According to Field).

Subject Combinations	Number of Teachers	Per Cent of Teachers
Science -		
Soc. Science-Ind. Arts-Phy. Education	11	1.98
Soc. Science-Math.-Phy. Education	10	1.81
Math.-Ind. Arts-Phy. Education	10	1.81
Math.-Commerce-Phy. Education	7	1.26
Ind. Arts-Commerce-Phy. Education	6	1.08
Soc. Science-Math.-Commerce	6	1.08
Soc. Science-Commerce-Ind. Arts	5	.90
Soc. Science-Home Econ.-English	4	.72
Soc. Science-Commerce-Phy. Education	4	.72
Math.-Commerce-Ind. Arts	4	.72
Soc. Science-Home Econ.-Phy. Education	3	.54
Soc. Science-Home Econ.-Commerce	3	.54
Math.-English-Home Econ.	2	.36

Table III. (Continued)

Subject Combinations	Number of Teachers	Per Cent of Teachers
Science – Math.–Foreign Lang.–Phy. Education	2	.36
Math.–Soc. Science–English	2	.36
Soc. Science–Home Econ.–Foreign Language	2	.36
English–Home Econ.–Phy. Education	2	.36
Soc. Science–Music–English	2	.36
Commerce–Music–English	2	.36
Math.–Soc. Science–Ind. Arts	2	.36
Math.–Foreign Lang.–Commerce	1	.18
Math.–Soc. Science–Foreign Language	1	.18
Math.–Foreign Lang.–Ind. Arts	1	.18
Math.–Soc. Science–Music	1	.18
Math.–Voc. Agriculture–Ind. Arts	1	.18

Table III. (Continued)

Subject Combinations	Number of Teachers	Per cent of Teachers
Science -- Soc. Science-Commerce-English	1	.18
Math.-English-Ind. Arts	1	.18
Commerce-Home Econ.-Phy. Education	1	.18
English-Home Econ.-Music	1	.18
Ind. Arts-Music-Phy. Education	1	.18
Math.-English-Foreign Language	1	.18
Soc. Science-English-Education	1	.18
English-Ind. Arts-Phy. Education	1	.18
Commerce-Soc. Science-Music	1	.18
Total	103	18.69

Table IV. Number and Per Cent of 554 Kansas Teachers in Class B and C High Schools Teaching Science in a Five Subject Combination in 1936-37. (Classified According to Field).

| Subject Combinations	Number of Teachers	Per Cent of Teachers
Science -		
Sou. Science-Math.-Ind. Arts-Phy. Educ.	2	.36
Sou. Science-English-Commerce-Phy. Educ.	1	.18
Sou. Science-Home Econ.-Music-Phy. Educ.	1	.18
Sou. Science-Math.-Commerce-Phy. Educ.	1	.18
Sou. Science-Math.-Commerce-Foreign Lang.	1	.18
Math.-English-Commerce-Phy. Educ.	1	.18
Sou. Science-English-Commerce-Music	1	.18
Math.-Commerce-Ind. Arts-Phy. Educ.	1	.18
Sou. Science-Commerce-English-Foreign Lang.	1	.18
Total	10	1.81
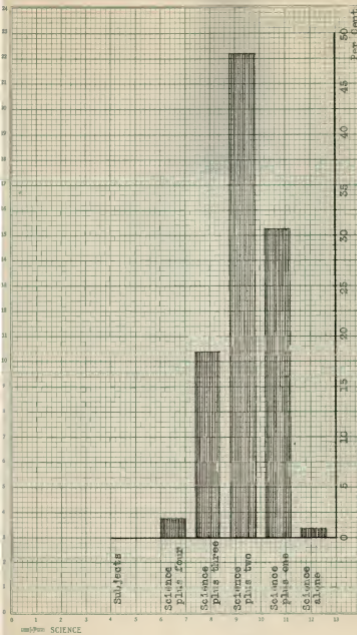
Figure 1. Proportion of 1664 teachers teaching science alone and in one, two, three, four and five subject combinations.

jects more to their liking than some of those they have been teaching.

During the past few years, school districts have been forced to curtail expenditures. This has caused a reduction in the teaching force which has necessitated an increase in the number of subjects taught by each teacher.

If teachers are to be well trained and the training agencies are to be efficient, there is no place in the schools for the unusual and infrequent subject combinations. Tables I, II, III and IV show 41 combinations or 49.4 per cent of the 83 combinations occurring two or less times. Of this number 28 or 33.7 per cent of the 83 combinations occur only once each. The writer is inclined to believe that all subject combinations occurring less than five times do not warrant specific training in these combinations. In such case 55 combinations of frequencies less than five or 65.8 per cent of the 83 combinations do not warrant deliberate preparation. If any form of standardization is to be reached a subject combination should be justified only when it has been repeated enough times to make training for it practical.

Following this paragraph is a comparison of the present Kansas study with Koos and Woody's Washington study (9) and Hutson's Minnesota study (4) with reference to the number of subjects taught and the per cent of teachers teaching each

group of subjects. The Hutson study of science teachers is
comparable to the present Kansas study more than the Koos
and Woody study which is a study of all teachers. However,
it is interesting to make the comparison with both studies
as it helps to point out more clearly the conditions as they
exist in Kansas.

Koos & Woody		Hutson		Kansas Study	
No. of Subj.	Per Cent of Teachers	No. of Subj.	Per Cent of Teachers	No. of Subj.	Per cent of Teachers
1	20	1	0	1	.9
2	21.8	2	28.5	2	30.69
3	30	3	33	3	48.01
4	23.6	4	30.2	4	18.59
5	3.6	5	4.7	5	1.81
6	----	6	2.8		
7	.9	7	.9		

The three studies seem to indicate a similarity of con-
ditions. It is noticeable, however, that Koos and Woody's
study shows a large per cent of teachers teaching only one
subject. The Kansas study shows a greater per cent teach-
ing three subjects, but a much less per cent teaching the
four and five combinations. It is notable that the greatest
subject combination found in Kansas was a five subject com-
bination where as the other studies show as high as seven

Table V. Combinations Taught by 554 Teachers of Science
Distributed According to Number of Subjects in
the Combination and Number of Teachers Assign-
ed to the Combination.

No. of Teachers assigned to the Combination	Number of Combinations					Total Combinations	Teachers
	1	2	3	4	5		
1	5	1		14	8	28	33
2-3			7	10	1	18	41
4-5		2	7	4		13	58
6-10		1	3	5		9	68
11-20		2	5	1		8	119
21-40		1	4			5	144
41-70		2				2	91
Total Combinations		9	31	34	9	85	
Teachers	5	170	266	103	10		554

Table reads: Of 554 teachers in this study, five
taught science alone, 170 were teaching two sub-
jects, that is, science and one other. To these
170 teachers has been assigned a total of nine
different combinations: One was unduplicated,
two were taught by either four or five teachers,
etc.

subjects being taught. As the Koos and Woody study was made in 1917 and the Hutson study in 1925, the present study may show a tendency toward fewer number of subjects being taught per teacher.

In Heiges' study (2) he found that science was most frequently grouped with mathematics, history or English. While in Kirby's study (7) he found that the sciences were taught more in combination than with non-science showing a tendency to group the sciences together. This study does not seem to follow any scheme whatsoever. However, the large number of groupings seems to be with mathematics, social science, commerce, industrial arts and physical education in various groupings.

Table V showing the combinations of 554 science teachers distributed according to the number of subjects in the combination is a summary of Tables I, II, III and IV presented in somewhat different manner. The table is read thus: take the three combination column (third from the left), it will be seen that 266 teachers have been assigned a total of 31 different combinations of which five were unduplicated, seven were taught by either two or three teachers, seven were taught by either four or five teachers, three were taught by six to ten teachers, five were taught by eleven to twenty teachers and four were taught by twenty-

one to forty teachers giving the totals of 31 combinations and 266 teachers.

Such a diversity of subject combinations as teachers in Kansas are called upon to teach shows emphatically the need for some standardization of subject combinations among the secondary schools. Since the training institutions can give adequate teacher training in two or three subjects, it is evident that many Kansas science teachers are teaching more subjects than they have been trained for. It would seem likewise from this great array of combinations that a teacher in the Class B and C high schools is likely to be called upon to teach most any other subject in the high school program along with science.

TRAINING OF SCIENCE TEACHERS IN SCIENCE AND IN THE OTHER FIELDS TAUGHT IN COMBINATION

It has already been noted that teachers of the smaller Kansas high schools are called upon to teach as many as five different subjects. This demand cannot result otherwise than in frequent attempts by teachers to give instruction in subjects in which they have had little or no work in higher institutions, that is, in which they are inadequately prepared. This has been clearly shown by the works of Koos and Woody (9), Hutson (4) and Inman (6).

In order to gain some knowledge of the significance of
the Tables VI, VII and VIII it must be noted that the totals
of all subjects taught are 331 for the two subject groups
(Table VI), 711 for the three subject groups (Table VII) and
260 for the four subject groups (Table VIII), or a total of
1302 subjects taught. The reason for this large number of
classes taught is obvious when it is remembered that the
teachers are teaching either two, three or four subjects.
The five subject group have not been included in this por-
tion of the study as they occur less than four times.

For all of the subjects taught, the median training is
29.19 semester hours for the teachers teaching the two sub-
ject combination group (Table VI), 20.5 semester hours for
those teachers of the three subject combination groups
(Table VII) and 13.41 semester hours for those teachers of
the four subject combination groups (Table VIII). This
seems to indicate that the smaller schools have teachers
carrying the greatest load and least prepared to do so.

Table VI shows a total of 331 teachers teaching the
two subject combinations composed of science, social science,
mathematics, industrial arts, commerce, home economics, vo-
cational agriculture, English and physical education. The
table shows that 4.53 per cent of the 331 teachers have
from none to four semester hours training, 8.46 per cent

have from five to nine semester hours and 5.74 per cent have from ten to 14 semester hours training. If the per cents 4.53, 8.46 and 5.74 are totaled, Table VI. reveals that 18.73 per cent of the teachers teaching science alone or in a two subject combination do not measure up to the Kansas standard of 15 semester hours training in the fields being taught (10).

In carrying through with the same procedure, Table VII shows a total of 711 teachers teaching the three subject combinations of which 16.17 per cent, 8.86 per cent and 10.55 per cent or a total of 35.58 per cent of the 711 teachers have less than the 15 semester hour requirement in the fields being taught. Likewise Table VIII shows a total of 262 teachers teaching the four subject combinations of which 32.44 per cent, 8.78 per cent and 10.31 per cent or a total of 51.55 per cent of the 262 teachers have less than the 15 semester hour requirement in the fields being taught.

Table VI. Number of Kansas Science Teachers in Class B and C High Schools with Semester Hours Training in Science and in the Combination Field Taught. (Combinations Occurring Less than Four Times are not Shown.)

Semester Hrs.(Field)	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50 (over)	Total
Subject Combination												
Science:												
Science: alone	3	4	6	8	5	5	4	3	3	3	3	47
Science: Gen. Science	1	3	6	5	7	7	5	2	3	2	10	41
Science: Mathematics	1	2	5	6	6	5	5	5	1	4	10	43
Science: Ind. Arts	6	4	2	2	3	5	2	2	1		6	27
Science: Commerce	2	1	1	8	3	3	1				6	16
Science: Home Econ.		1	2		2	2	1	3		1	1	15
Science: Voc. Agr.	1			2	2	2	1	2		2		13
Science: English					1	1		1			5	8
Science: Phys. Educ.	1		1	1		1	1		1		1	6
Total (All Subjects)	15	18	19	43	35	38	37	20	18	16	52	321
Per cent (All Subjects)	4.6	5.6	5.9	14.5	10.9	11.8	11.5	6.2	5.6	4.9	16.4	100.0

Table VII. Number of Kansas Science Teachers of Class B and C High Schools with Semester Hours of Preparation in Science and in the Two Combination Fields Taught. (Combinations occurring less than four times are not shown.)

Semester Hrs. (Field)	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-Over	Total
Subject Combination												
Science:												
Mathematics		1	3	8	2	3	6	1	2		6	30
Commerce	10	5	5	3	4	5	3	1	1			30
Science:												
Soc. Science	6	3	3	3	3	3	5	1		1	4	29
Science:												
Soc. Science	1	4	4	7	4	2	1	3	1			28
Fine Arts	2	4	5	2	2	9	1	1	1		4	26
Science:												
Mathematics	11	2	4	4	3	2	1	1		1	3	26
Fine Arts	4	5	5	3	2	2	1	1			1	24
Science:												
Phy. Educ.	7	1		1	1	1	3	1		1	1	17
Fine Arts	1	2	2	2		4	2	1	1		1	17
Science:												
Soc. Science	2	1	2	2	3	2	3			1	2	18
Home Econ.	1	1	1	2	4	2	1	3			2	18
Science:												
Soc. Science	1	2	2	2	1	2		1	1		2	15
Commerce	5	4	2	1			1					15

Table VII. (Continued)

Subject Combination (Field)	Semester Hrs. 0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-Over	Total
Science	1	1		1			1	1				13
Science, Nor. Science	1	1	3	2	1	4	2		2			13
Science, English	1	2	2	2	4	1						13
Science, Mathematics	12	1	3	2	1	2	2			2	2	13
Science, Phy. Educ.		1	3	2							2	13
Science, Nor. Science	8		2	2	2	1						8
Science, Phy. Educ.	1	1		2		1	1	1			1	8
Science, English		1	1	1	1							6
Science, Comm. Econ.	1	2	1	2	1	2						6
Science, Mathematics	1	1		1	2	2		1	1	1		6
Science, Home Econ.	1	1	2	1	1	1			1			6
Science, Music	1											5
Science, Mathematics	3		1	1	1		1					5
Science, Commerce	1	1				1	1					6
Science, Ind. Arts		1					1	1				6

Table VII. (Continued)

Subject Combination	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-Over	Total
Sciences:												
Commerce	1	1	2	1	1							4
Home Econ.	1	1	2	1	2			1	1			8
Science:												
Home Econ.	5			1	2							8
Phy. Educ.		1	1	1		1					1	10
Science:												
Commerce	1		1	1	1	1						5
Phy. Educ.	4		1	1	1	1						9
Science:												
English		1	2	1	2	1	1					8
Music	1	1	1	1	1				1		1	4
Science:												
Music		1	2	2	1		1					9
English	1		1	1		1	1					4
Music	1	1	2	1	2	1						4
Total Median Training (All subjects)	115	63	75	95	75	65	79	53	35	16	63	711
Per Cent Training (All subjects)	16.17	8.86	10.55	13.08	10.55	9.14	11.11	4.64	4.92	2.11	8.87	100

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Table VIII. Number of Kansas Science Teachers of Class B and C High Schools With Semester Hours Training in Science and in the three Combination Fields Taught.

Semester Hours (Field) Subject Combination	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-99	100-Over	Total
Science { Soc. Science	2	1		1		1	3					1	11
Ind. Arts	3	1	2	2		1							11
Phy. Educ.	3	3	2			1		1				1	11
Science { Soc. Science	7			1	1				1				9
Mathematics	3	2	1	2	1								9
Phy. Educ.	3	1	4										9
Science { Mathematics	10		2	3		3					2		10
Ind. Arts	2	1	1	1	2		1						10
Phy. Educ.	6		2	1	1		1						10
Science { Mathematics	2	1		1						1			6
Commerce	4			2									6
Phy. Educ.	5								1				6
Science { Ind. Arts	2	1		1			1					1	6
Commerce	1	1	2										6
Phy. Educ.	2												6
Science { Mathematics													6
Commerce													6
Soc. Science													6

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Table VIII: (Continued)

Subject Combination	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-Over	Total
Science												
Commerce	3	2	2	1			1					6
Ind. Arts	2	1		1	1							5
Soc. Science	3	2	2				1					5
Sc. Science												
Commerce	1	1	1			1						4
Home Econ.	1	1								1		4
English	1		1	1								4
1Science												
Commerce	5		1	1		1						5
Ind. Educ.	1		1				2	2	1			5
Soc. Science	1			1								4
Science												
Commerce	1		1	1			1		1			4
Mathematics	1	1		1		1						4
Commerce	2											4
Ind. Arts	1		1	1	1							4
Total	85	23	27	33	16	19	23	6	16	5	9	262
Per Cent Training (All subjects)	32.44	8.78	10.31	12.60	6.11	7.26	8.78	2.28	6.11	1.91	3.45	99.99

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Table IX. Total Semester Hours of Each Subject in Each Group.

	Semester Hrs.	1–4	5–8	9–12	13–16	17–20	21–24	25–28	29–32	33–36	Over	Total	Mean
Two Subject Combination	Soc. Science	4	11	27	14	17	17	9	3	8	35	159	28.53
	Mathematics		1	9	7	2	7	4	3	1	10	47	32
	Ind. Arts	6	6	1	6	5	5	3	1	3	3	45	21
	Commerce	2	4			2			2		5	27	21.50
	Home Econ.							2	1	1	2	16	14.5
	Voc. Agr.			2		2	2			2	7	13	45.75
	English	2						1			2	8	61.64
	Phy. Educ.				1							5	37
		3									2	4	2.84
Three Subject Combination	Science	23	14	25	33	19	19	30	15	2	34	137	35.33
	Mathematics	4	17	20	15	11	17	15	2	3	3	107	18.66
	Commerce	21	21	9	9	9	9	2	6	2	7	65	10.49
	Soc. Science	4	11	12	16	15	8	11	9	6	5	109	28
	Ind. Arts	21	11	11	10	7	7	8	4			75	15.25
	Phy. Educ.	38	1	1	1			2	1			47	2.6
	Home Econ.	1	2	2	9	5	2	2	2	2	15	59	41.28
	English	3	3	9	1	6	2	1	1			27	18.66
	Music			2		3		1	2		3	9	23.66

Table IX. (Continued)

Semester Hrs.	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-Over	Total	Median
Science	9	4	8	11	4	5	11		5		6	66	120.75
Ind. Art	10	7	4	5	1	1	4	3	1	1		56	10.75
Phy. Educ.	45	5	5	2	2				1			47	2.25
Mathematics		5	5	6	2	7	2		1			35	16.50
Commerce	14	4	4	2	2	2		1		1		32	7
Home Econ.	1			1								4	127
English	1	1			1		1					4	122
Soc. Science	2	5	6	6	5	3	5	3	5	2	2	40	21.64

Four Subject Combination

32

Figure 2. Median Number of Semester Hours Training of Teachers Teaching the Subject Combinations, Subject Combinations Two ____ Three ____ Four ____

The above data show that the smaller schools have the greater per cent of unprepared teachers. While the figures show up as against the teacher, much of the fault lies with the authorities making unwise and unusual subject combination assignments. Hutson (4) says that teacher employing authorities must standardize and simplify subject combinations in the teacher programs so that impossible tasks are not imposed upon the teacher. The training agencies must construct the curricula and guide the students so that they will be equipped to teach several subjects in some logical combination.

If all of the classes taught by teachers having less than 15 semester hours of training are totaled for Tables VI, VII and VIII it will be found that there are 450 classes or 34.56 per cent of the total number of 1302 classes taught being handled by teachers who do not measure up to the Kansas standard (10). Carrying on the same procedure of totaling all classes in Tables VI, VII and VIII being taught by teachers having less than five semester hours of training in the field taught, it is interesting to note that 215 classes or 16.51 per cent of the 1302 classes taught are being handled by teachers who have less training in the field than the five semester hour per unit subject taught, required of science teachers by the Kansas State Board of Education.

In order to ascertain the training in the field of science to compare with training in the other fields being taught in combination, Table IX totals up Tables VI, VII and VIII and gives the total semester hours in each field in each subject group together with the median training in each subject field.

In making a comparison of the training in science with that of the other fields the meaning of Tables VI, VII, VIII and IX can be more fully understood by a study of Figure 2 which shows graphically the median training of the science teachers in their own field and in the fields in which they are teaching the combinations. It will be noted that the teachers teaching the two subject combinations are better prepared in all fields than the teachers of the three and four subject combinations. The teachers of the two subject combinations are better prepared in social science with a median training of 32 semester hours, in home economics with a median training of 45.75 semester hours and in English with a median training of 37 semester hours than they are in science with a median training of 29.5 semester hours. The science teachers teaching vocational agriculture are about twice (median 51.6 semester hours) as well prepared in agriculture as they are in science. The above data either point to teachers who are deficient in science training or to specialists of other fields who are teaching science

as an added subject. In all other subject combinations the
median training in science excels.

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TRAINING OF KANSAS SCIENCE TEACHERS IN THE
SCIENCE FIELD AND IN THE SPECIFIC SUBJECT TAUGHT

</div>

While the median training of the science teachers in
the field of science is well over the requirement of 15 se-
mester hours set by the Kansas State Department of Education
as shown by Table IX and Figure 2, further study as to the
number of teachers prepared to teach science and the number
unprepared will reveal that many Kansas high school science
teachers are teaching in science subjects with deficient
preparation.

According to the standards as set up for science teach-
ers in the Handbook on Organization and Practices for the
Secondary Schools of Kansas (10), the teacher of science
must have 15 semester hours in the field of science, of
which three hours shall be in each one-half unit course
taught and five hours in each unit course taught. The re-
quirement seems rather low when compared with states such as
Pennsylvania which requires teachers to have 12 or more se-
mester hours in the subjects they are teaching (7) and In-
diana requiring a total of 40 semester hours to certify for
teaching the natural sciences (5).

The question here, however, is not whether the Kansas standards are too low, but rather to show how teachers are measuring up to the existing standards.

With reference to training in the field, Table I and Figure 3 show that 412 teachers or 74.37 per cent of the 554 teachers are prepared with 15 or more semester hours of training. Measuring by the same standard 132 teachers or 23.82 per cent have less than 15 semester hours in the field of science and are, therefore, inadequately prepared. The table shows 1.8 per cent failed to report. It is especially interesting to note that 50 teachers reporting or 9.03 per cent of the 554 teachers have less than five semester hours in the field, the standard set for subject preparation.

Table XI shows the training of the 554 teachers in the specific subjects they are teaching. It will be noted that the total number 618 is considerably greater than the number of teachers due to the fact that some teachers are teaching in more than one science subject. A study of Table XI reveals that 196 teachers or 31.71 per cent of the 618 teachers handling the subjects are well prepared with 15 or more semester hours training. Adding the total teachers having 15 or more hours, 10 to 14 hours, and five to nine hours there are 485 teachers or 78.48 per cent of the 618 teachers having five or more semester hours training.

Sixty-four teachers or 10.36 per cent report less than five semester hours training in the subject taught, while 60 or 11.16 per cent have no training at all.

Table X. Number and Per Cent of 554 Kansas Science Teachers with Semester Hours of Preparation in Field of Science as Indicated.

Preparation in Science Field in Semester Hours	Number of Teachers	Per Cent of Teachers
15 or more	412	74.37
10-14	53	9.56
5-9	29	5.23
1-4	16	2.90
None	34	6.13
No Report	10	1.8
Total	554	99.99

Table XI. Number of 554 Science Teachers Reporting Semester Hours Training in Science Subjects Taught as Indicated.

Prep. Sem.Hrs.	Gen. Sci.	Phy. Geog.	Agr.	Phys-icl.	Bi-ology	Chem.	Phys-ics	Total	Per Cent
15 or more	67	1	36	7	57	2	26	119	31.71
10-14	24	2	13	6	27	4	44	120	19.42
5-9	24	7	35	35	30		40	169	27.35
1-4	10	3	16	21	4		10	64	10.36
0	13	3	32	13	20	1	3	69	11.16
Total	138	16	130	82	134	7	123	618	100.

Per Cent

Preparation in
Semester Hours

15 or
More

10-14

5-9

1-4

0

No
Report
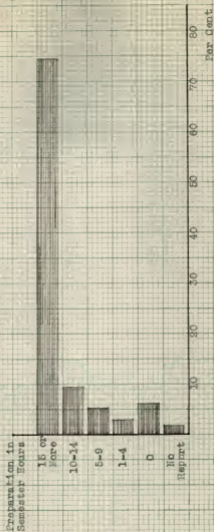
Figure 34. Percentage of 556 Kansas Science Teachers
with Semester Hours Preparation in the
Field of Science.

Assuming that all the subjects taught are unit courses regardless of the fact that physiology and physical geography are one-half unit courses, and measuring by the five semester hour per unit course taught standard, Table XI reveals that 78.48 per cent of the science teachers are prepared in their subjects while 21.52 per cent are unprepared.

With reference to training in the individual subjects, Table XI shows that out of 138 general science teachers, 67 or 48.55 per cent have 15 or more semester hours training; one or 6.25 per cent of the 16 teachers teaching physical geography has 15 or more semester hours; of the 130 teachers teaching agriculture, 36 or 27.69 per cent have 15 or more semester hours; seven or 8.54 per cent of the 82 teachers teaching physiology have 15 or more semester hours; of the 134 biology teachers, 57 or 42.54 per cent have 15 or more semester hours; two or 28.57 per cent of the seven chemistry teachers have 15 or more semester hours and of the 123 teachers teaching physics 26 or 21.14 per cent have 15 or more semester hours training.

From the data just presented it will be noted that the teachers of general science are better prepared than the teachers of the other science subjects while the teachers of physical geography are the least prepared. In listing the subjects in order of semester hours of preparation starting

with the subject in which the teachers are best prepared they are general science, biology, chemistry, agriculture, physics, physiology and physical geography.

Concerning the preparation in both the science field and the science subject it can be said that approximately three-fourths of the science teachers of this study are prepared and approximately one-fourth are unprepared. This condition,while not the best in the light of good standards, compares favorably with other studies. Inman (6) in his study of 1048 Iowa teachers found that 51 per cent were teaching subjects with no training in the subject taught while Woody (15) found that one-half of the biological science teachers in his study had no more than seven and one-half hours of college preparation in the subjects taught.

While it is evident that each science has its own specific subject matter, it is undoubtedly true that academic training in one science contributes to the preparation on another science, which would tend to ease the situation in the case of the one-fourth that were found to be insufficiently prepared.

YEARS IN THE TEACHING POSITION AND
NUMBER OF SUBJECTS TAUGHT

The number of subjects that the Kansas teachers are
teaching has already been presented. This part of the teach-
ing load is related more or less to the tenure of service in
the school. Woody (16) states that during the first and
second years of their employment in the city schools of
Michigan the teachers teach a greater number of subjects
than they will in later years of employment in the same city.
His data seem to justify the statement in that the number
of subjects taught decreased as the years of experience in-
creased until a total of twenty years of experience was
reached.

This study closely parallels the study of Woody with
the exception that no teacher was found to have occupied the
same position over 17 years. In Table XII it will be noted
that of 198 teachers new in their positions, none are teach-
ing only one subject, ten teachers or 5.05 per cent of the
198 teachers are teaching two subjects, 61 or 30.81 per cent
are teaching three subjects, 79 or 39.90 per cent are teach-
ing four subjects, 42 or 21.21 per cent are teaching five
subjects and six or 3.03 per cent are teaching six subjects.
It will be noted that the greater per cent of teachers teach-
ing for the first year in their positions, teach either three,

four or five subjects. This condition persists until the tenth year when none were found to be teaching more than four subjects.

With the exception of the one subject group, the percentages of teachers teaching two, three, four, five and six subjects seems to remain fairly constant through the seventh year. No teacher remaining in her position eight years or longer was found to be teaching six subjects. Likewise it will be noted that after nine years of service in the same school that only one teacher with 12 years of continuous service was found to be teaching more than four subjects. For the few teachers remaining in their positions for 11, 12, 13 or 17 years, there is an increase in subjects taught as none are found to be teaching only two subjects. It will be noted that only one teacher with three years continuous service taught as few as one subject.

From data presented in Table XII one may conclude that for the first seven years in a position a teacher may expect to be assigned from two to six subjects. From the eighth year to the 12th year inclusive, the teacher may expect to be assigned from two to five subjects. From the 13th year to the 17th year inclusive, the assignment may be from two to four subjects.

Looking at Table XII as a whole it will be seen that as the years of service increase there is a gradual decline in the number of subjects being taught per teacher.

Table XII. Years in Present Teaching Position and Number and Per Cent of Teachers Teaching the Number of Subjects Indicated.

Number and Percentage of Teachers of Indicated Number of Subjects

Years in Present Position	Subject 1 No.	Subject 1 Per Cent	Subject 2 No.	Subject 2 Per Cent	Subject 3 No.	Subject 3 Per Cent	Subject 4 No.	Subject 4 Per Cent	Subject 5 No.	Subject 5 Per Cent	Subject 6 No.	Subject 6 Per Cent	Total No.	Total Per Cent
1			10	5.05	61	30.81	79	39.90	42	21.21	6	3.05	198	100.
2			5	4.06	39	31.80	58	47.15	17	13.82	4	3.25	123	100.8
3	1	1.47	3	4.41	20	29.41	22	32.35	16	23.53	6	8.82	68	99.99
4			2	6.25	10	31.25	15	46.87	4	12.50	1	3.13	32	100.
5			4	11.76	7	20.6	15	44.12	8	23.52			34	100.
6			2	6.90	11	37.93	10	34.48	5	17.24	1	3.45	29	100.
7			2	10.	8	40.	5	25.	4	20.	1	5.	20	100.
8					6	46.16	5	38.46	2	15.38			13	99.99
9			2	18.18	4	36.36	4	36.36	1	9.09			11	99.99
10			2	22.22	4	44.44	3	33.33					9	99.99
11			1	25.			3	75.					4	100.
12					1	50.	1	50.					2	100.

Table XII. (Continued)

Number and Percentage of Teachers of Indicated Number of Subjects

Years in Present Position:	Subject 1		Subject 2		Subject 3		Subject 4		Subject 5		Subject 6		Total	
	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.	No.	Per Cent.
13					2	50.	2	50.					4	100.
14			2	100.									2	100.
15			2	66.66			1	33.33					3	99.99
16														
17	2	100.											2	100.
Total	36:		176:		222:		100:				19:		554:	

DAILY CLASSES AND DAILY PREPARATIONS

A very important method of describing the instructional load of the teacher is to refer to the number of classes conducted daily or weekly. Closely allied to this portion of the load is the number of daily preparations that the teacher has to make.

Owing to the fact that the science teacher has considerable laboratory time to contend with, the number of periods taught would necessarily tend to be higher than for non-laboratory subjects. On the other hand it would be expected that fewer daily preparations would be necessary.

Table XIII shows that the number of daily classes for all periods taught vary from one to eight with the greater per cent teaching four and five classes. It will be noted that seven teachers or 1.26 per cent of the 554 teachers teach two classes, 52 teachers or 9.38 per cent teach three classes, 196 teachers or 35.38 per cent teach four classes, 206 teachers or 37.18 per cent teach five classes, 70 teachers or 12.63 per cent teach six classes, 21 or 3.79 per cent teach seven classes and two teachers or .36 per cent teach eight daily classes.

The typical number of classes daily is five with four classes being a close second, almost three-fourths of the teachers teaching these amounts. It will likewise be noted

that the teachers teaching six, seven and eight classes totals to 93 teachers, or 16.78 per cent of the 554 teachers who are teaching more than the five daily classes, the number recommended by the North Central Association (11).

In an investigation conducted for the North Central Association by Davis (1) he found that of the schools represented in the study, about a fourth required for all subjects four recitations daily; almost a half, five daily; almost a fourth, six daily and only two per cent as many as seven. In comparing his data with Table XIII it will be seen that fewer science teachers teach five and six classes in Kansas at present than was taught by schools in the Davis survey of 1923. The larger per cents teaching seven and eight classes at this time in the Kansas schools are likely due to reduced teaching school facilities and to the size of the schools.

Davis shows that in the high schools the typical number of different daily preparations is three, although 15 per cent of the teachers are obliged to make four preparations and eight per cent are compelled to make more than four, while eight per cent only have one preparation daily and three per cent make only two.

Table XIII. Number and Per Cent of Daily Classes
and Daily Preparations of 554 Kansas
High School Science Teachers.

Number of Daily Classes	Teachers		Number of Daily Preparations	Teachers	
	Number	Per Cent		Number	Per Cent
1			1		
2	7	1.26	2	12	2.17
3	52	9.39	3	91	16.43
4	196	35.38	4	238	42.96
5	206	37.18	5	167	30.14
6	70	12.63	6	34	6.13
7	21	3.79	7	12	2.17
8	2	.36	8		
Total	554	99.98		554	100.
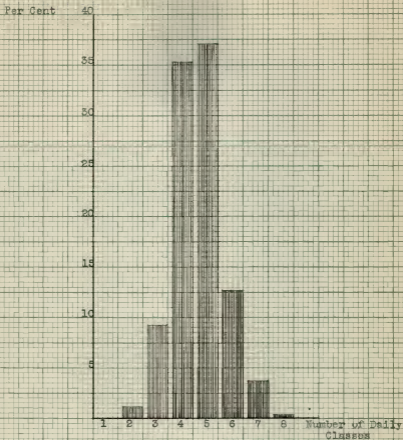
Figure 4. Percentage of the 564 Science Teachers
Teaching One, Two, Three, Four, Five,
Six, Seven or Eight Daily Classes.
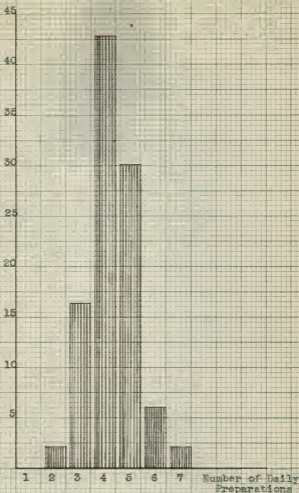
Figure 5. Percentage of the 554 Science Teachers
Making One, Two, Three, Four, Five, Six,
and Seven Daily Preparations.

Table XIII shows that the typical number of daily pre-
parations for the Kansas teachers is four with almost one-
third having five daily preparations. It has generally been
thought that the greater the preparation for a class the
easier and more effective would be the recitation. If this
is true, then the teaching load should be regulated so as to
allow a longer time for preparations. This would necessitate
fewer preparations which would be of great benefit to the
Kansas high schools.

Figure 4 shows graphically the per cent of the 554
teachers who are teaching either two, three, four, five, six,
seven or eight daily classes. An examination of Figure 4
reveals that no teachers were found teaching only one class
and that a very few, .56 per cent of the 554 teachers were
found to be teaching as many as eight classes. It will also
be noted that only 1.26 per cent of the teachers teach two
classes while twice as many teachers, 3.79 per cent teach
seven classes. Likewise a greater per cent teach six clas-
ses than teach three classes. The greater per cent of the
554 teachers teach four or five classes. There are 37.18
per cent of the teachers teaching five classes and 35.38 per
cent teaching four classes or a total of 72.56 per cent or
about three-fourths of the 554 teachers teaching either
four or five classes. Figure 4 shows plainly that the major-

ity of Kansas teachers teach either four or five daily classes, while 12.63 per cent or about one-eighth of the 554 teachers teach six classes daily, the third most frequent number of classes taught.

A study of Figure 5 shows that 42.96 per cent of the 554 teachers make four daily preparations while 30.14 per cent make five preparations, 16.43 per cent make three preparations and 6.13 make six daily preparations. It is interesting to note that the same per cent of teachers, 2.17 per cent, are required to make both two and seven daily preparations. Figure 5 shows emphatically that the greater per cent of Kansas teachers are required to make either four, five or three daily preparations in the order given.

RECOMMENDATIONS

In an effort to overcome some of the defects that have been brought to light in the present study the following remedial measures are offered:

1. The State Department of Education should make, or cause to be made, an intensive survey of the state to find out what subjects are most commonly taught in combination. A Standardization Committee consisting of representatives of the State Department of Education, Teacher Training Schools and Schools Administrators from various sections of the

state could take these data, from them develop a list of standard subject combinations to be used in the high schools of Kansas.

2. The teacher training institutions should build their curricula to train the prospective teacher in certain established subject combinations that the schools of Kansas demand.

3. Only standardized subject combinations should be taught in the Kansas high schools.

4. The high school administrators should be required to make assignments to teachers in compliance with the standardized subject combinations.

5. Teachers should be trained to teach in two or three subject fields and specialization in any one field should not be narrow but should prepare the teacher in the whole field in which they are being trained.

6. Appointment of teachers should be made only after careful inquiry has been made as to their preparation of the subjects that they will be called upon to teach.

7. Teachers should be certified by specific subjects or fields to be taught rather than by the "Blanket Certificate". In order to teach a subject the teacher should have at least 12 semester hours training in that subject.

8. Duplication of training facilities in the state should be eliminated in as far as possible. Oregon (13) for example in 1931 limited elementary teacher training to three specific state teachers' colleges, while the high school administrators and teachers of literature, languages and art, music, business administration, physical education and social science are prepared at the state university. The state college offers curricula for the preparation of teachers in biology, physical sciences, mathematics, vocational subjects, education and vocational guidance. Such a scheme would offer a more specialized training and would be more efficient.

9. The six year plan would allow teachers of science in the smaller high schools to complete the days schedule in their own fields as it would do likewise in the other fields.

10. Insofar as possible discouragement in the multiplication of the very small high school should be carried on as small staffs mean impossible subject combinations.

CONCLUSIONS

1. The subject combinations are varied and unusual.

2. The 554 Kansas science teachers are required to teach 83 different subject combinations.

3. Only five teachers or .9 per cent of the 654 teachers are privileged to teach science alone.

4. Of the 83 combinations, 63.8 per cent occur so infrequently that they do not justify deliberate preparation for teaching them.

5. No teacher was found to be teaching in over five subject fields.

6. Many Kansas science teachers are teaching more subjects than they could possibly be prepared for.

7. Teachers in the smaller schools carry the heaviest loads and are least prepared to do so.

8. The smaller schools have the greater per cent of unprepared teachers.

9. The better prepared teachers teach fewer subjects than do the poorly prepared teachers.

10. Measured by the Kansas standards for the teaching of science, approximately one-fourth of the teachers are unprepared.

11. Compared to Indiana and Pennsylvania, teaching requirements for the certification of Kansas science teachers are too low.

12. For all classes taught in the B and C high schools, 16.5 per cent or approximately one-sixth of the teachers have less than 15 semester hours in the field in which they teach.

13. For the first seven years in a position a teacher may expect to teach from two to six different subjects.

14. The typical number of daily classes is five.

15. Approximately three-fourths of the teachers of the study teach either four or five daily classes.

16. The typical number of daily preparations is four with 42.96 per cent of the teachers making this amount.

17. The teachers of the Kansas high schools should be prepared to teach at least four subjects.

18. About 17 per cent of the science teachers teach more than five daily classes, the number recommended by the North Central Association.

19. Kansas science teachers teach from two to eight classes daily.

20. Nineteen of the 554 teachers (Table XII) teach six specific subjects.

ACKNOWLEDGMENT

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LITERATURE CITED

1. Davis, Calvin C.
   The size of class and the teaching load. In Proce-
   edings of the Twenty-eighth Annual Meeting of the
   North Central Association of Colleges and Secondary
   Schools. 1923 (1):30-56. 1923 .

2. Baiges, J. S.
   How many and what subjects should a teacher be
   prepared to teach. School Review. 38:286-299.
   April, 1930.

3. Halleck, Reuben P.
   Joint recommendations of the committee of seventeen
   on professional preparation of high school teachers.
   Proceedings and Addresses of the N. E. A. 45:536-538.
   1907.

4. Hutson, Percival W.
   A study of teacher training in relation to the sub-
   jects they are teaching. Educ. Admin. and Super.
   9:425-436. 1923.

5. Hutson, Percival W.
   The scholarship of teachers in secondary schools.
   New York. MacMillan. 190 p. 1927.

6. Inman, James Henry.
   The training of Iowa high school teachers in relation
   to the subjects they teach. Uni. of Iowa Studies in
   Education. 4(9):3-56. 1929.

7. Kirby, Thomas J.
   Subject combinations in high school teachers' pro-
   grams. Sch. Rev. 34:494-505. Sept., 1926.

8. Koos, Leonard V.
   The American secondary school. Boston. Ginn and
   Company. 755 p. 1927.

9. Koos, Leonard V. and Woody, Clifford.
   The training of teachers in the accredited high
   schools of the state of Washington. In the Eighteenth
   Yearbook of the Nat. Soc. for the Study of Education.
   Part I. 213-257. 1919.

10. Markham, W. T.
    Handbook on organization and practices for the second-
    ary schools of Kansas. Topeka. Kansas State Print-
    ing Plant. 86 p. 1934.

11. Proceedings of the Commission on Secondary Schools.
    North Central Assn. 4:3-148. June, 1929.

12. Potthoff, Edward F.
    Teaching combinations: reductio ad absurdum. Sch.
    Rev. 43:417-427. June, 1935.

13. Seidel, Theodore A.
    Trends in teacher preparation and certification.
    Educ. Admin. and Super. 20:193-206. March, 1934.

14. Whitney, F. L. and Hilholland, John.
    The relation of teachers college preparation to sub-
    jects taught after graduation. Sch. and Soc. 37:
    533-536. April, 1933.

15. Woody, Clifford.
    Number of subjects taught by graduates of the
    university of Michigan who began teaching in 1922-1923
    school year and the amount of academic preparation in
    subjects taught. Educ. Admin. and Super. 10:368-384.
    Sept. 1924.

16. Woody, Clifford.
    Number and combination of subjects taught in the 1924-
    1925 school year in the north central high schools of
    Michigan. Educ. Admin. and Super. 12:529-548. Nov.,
    1926.