A STUDY OF THE EFFECT OF NEW MATHEMATICS ON TEACHER PREPARATION

A Thesis

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CHAPTER I

INTRODUCTION

1.1 Statement of the problem. In recent years, great emphasis has been placed on the revision of the mathematics curriculum. In September, 1957, a pamphlet published by the Commission on Mathematics of the College Entrance Examination Board made these comments on curriculum revision and teacher preparation:[1]

> An important consideration in any discussion of curricular revision in mathematics is the availability of teachers able and willing to offer instruction in the subject matter included in the curriculum and to give it in the spirit of contemporary mathematics.
>
> Almost from its inception, the commission has pointed out that neither its recommendations nor those of any other group can be accepted, acted upon, and implemented except by the efforts of teachers of mathematics throughout the country.
>
> Only a small percentage of teachers can possibly have had the up-to-date training required for the task. Only those who have begun their teaching careers recently have had an opportunity to take modern college courses, and even many of these teachers have had collegiate training of a more traditional character.

If teachers are going to accept this addition of new mathematics into the curriculum, they will find it

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[1] Commission on Mathematics of the College Entrance Examination Board. The Education of Secondary School Mathematics Teachers, New York, 1958, p. 1-2.

necessary to become more familiar with the new mathematics and become better prepared along those lines.

Some of the ways a teacher can become better prepared are as follows: (1) by additional course work during the summer months at their own expense, (2) by applying for and receiving scholarships to in-service and summer institutes sponsored by the National Science Foundation, (3) reading professional journals received through belonging to professional organizations, and (4) receiving literature from committees such as the School Mathematics Study Group (SMSG), or the Commission on Mathematics of the College Entrance Examination Board.

In summary, the problem may be stated briefly as a study of the effect of new mathematics on teacher preparation.

1.2 Purpose of the Study. This study will attempt to answer some of the questions which have arisen since this new emphasis has been placed on mathematics. Some of these questions are:

1. How has the mathematics curriculum already been affected?

2. What are the recommendations of the schools of Kansas who prepare her teachers?

3. How well prepared are the teachers in 1960 as compared to 1957 with respect to the total college hours held?

4. What is the training of the teachers with respect to the kinds of degrees held and their advancement toward new degrees?

5. When and what has been their most recent training and in what direction has that training been?

6. Are the teachers participating in in-service and summer institutes sponsored by the National Science Foundation?

7. How well do the teachers satisfy the levels recently set forth by the CUPM of the Mathematics Association of America?

1.3 Definition of Terms. The term "mathematics teacher" as used in this thesis will refer only to those teachers teaching full-time mathematics in Class A public high schools of Kansas with an enrollment of 200 or more students.

"New Mathematics" does not necessarily infer the mathematics has been discovered recently, but will refer to the new courses being offered at the high school level as well as the new ideas and topics that are being introduced into the traditional courses.

"Mathematics Curriculum" refers to the mathematics for the college bound students. This thesis in no way minimizes the importance of mathematics for the non-college bound student.

1.4 Limitations. This study is limited in many ways. First, it is limited to the number of responses received in answer to the letter sent to the heads of the

mathematic departments of Kansas who are assigned the task of preparing her mathematics teachers. Secondly, it is limited to the number of mathematics teachers who completed and returned the questionnaire that was sent to them.

Twelve of the twenty heads of mathematics departments replied to the letter sent to them requesting their recommendations for the necessary course work to prepare a teacher to teach the new mathematics.

Of the 285 mathematics teachers contacted, only 153 teachers returned their questionnaires. This gave a response of 52% of the teachers contacted. Three of these had to be ommitted due to inaccuracy in filling out the questionnaire. In some of the tables, there will be less than 150 teachers included due to inaccuracy in filling out that part of the questionnaire.

It is regrettable that more teachers could not find the few minutes of time necessary to fill out the questionnaire; if they had, very definite conclusions could have been made.

1.5 Method of Procedure. An issue of The Emporia State Research Studies published by Kansas State Teachers College of Emporia written by John M. Burger, was examined to find the colleges and universities of Kansas preparing

her mathematics teachers.[2]

The heads of the mathematics departments were then sent a letter asking them to give their recommendations for teacher preparation in the realm of the new mathematics.

The high school principals organization reports on file in the accreditation office of the State of Kansas Department of Public Instruction were then examined to find the names and addresses of the mathematics teachers of Kansas. A questionnaire was sent to each of the 285 mathematics teachers asking them to fill in the necessary information and return the questionnaire in the enclosed self addressed, stamped envelope. As was stated previously, only 153 teachers responded limiting the scope of this study considerably.

A copy of the letter sent to the department heads, to the mathematics teachers, and the questionnaire the teachers were asked to fill out and return appears in the appendix of this thesis.

1.6 Related Studies. Previous studies of a comparable nature made at Emporia are: Weldon N. Baker and Merle E. Brooks, "Background and Academic Preparation of the

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[2]Dr. John M. Burger. Background and Academic Preparation of the Mathematics Teachers in the Public High Schools of Kansas, 1957-1958. Emporia State Research Studies, p. 19.

Teachers of Science in the High Schools of Kansas, 1955-56"; Harold V. Sare, "Background and Academic Preparation of the Social Science Teachers in the High Schools of Kansas, 1956-57"; and John M. Burger, "Background and Academic Preparation of the Mathematics Teachers in the Public High Schools of Kansas, 1957-58."

1.7 Organization of the Thesis. Chapter II contains a table showing the kinds of courses that were taught by the mathematics teachers during the school year 1960-61. The table is used to show the number of students enrolled in the various courses, the number of teachers for the courses and number of classes being taught. It is also used to show new courses being offered at the high school level.

As has been stated, teacher preparation is very important to the success or failure of a curriculum revision. Chapter III shows the recommendations of the colleges and universities of Kansas that prepare her mathematics teachers as well as the recommendations of the Commission on Mathematics.

Chapter IV contains a table showing how well the mathematics teachers have been preparing themselves since 1957.

Questions that arise when considering teacher preparation are (1) what kinds of degrees do the teachers

hold, and (2) what kinds of degrees are they working for? Chapter V contains three tables, one showing the kinds of degrees held by the mathematics teachers and two tables showing the direction the teachers are taking when working towards a higher degree.

In order to show that the mathematics teachers have recognized the importance of the new mathematics, Chapter VI contains tables showing the kinds of courses the teachers have taken during their entire schooling and two tables show that most of the recent schooling has been along the lines of the new mathematics.

The National Science Foundation as well as other organizations have made it possible within the past few years for a teacher to receive a stipend for attending institutes sponsored by the organizations. Chapter VII shows how well the teachers have responded to this opportunity to further their education.

In January, 1961, the Mathematics Association of America presented a new criterion about teacher preparation with emphasis on the new mathematics. Chapter VIII presents a summary of those recommendations as well as showing how well the teachers satisfy those recommendations. What the teachers lack to fulfill the recommendations are also contained in this chapter.

The final chapter, Chapter IX, presents a summary of this thesis and the conclusions based on the information presented in the previous chapters.

CHAPTER II

CURRICULUM TAUGHT BY TEACHERS

This chapter contains a table showing the mathematics curriculum offered at the schools where the mathematics teachers taught. The table is based on the replies of 145 teachers correctly completing that portion of the questionnaire. The table shows the number of students enrolled in each course, the approximate number of classes, and the number of teachers for each course.

An average of 25 per cent of the teachers neglected to put down the number of classes taught in each course. The approximate number of classes was estimated in the following manner:

1 - 30 students - 1 class
31 - 60 students - 2 classes
61 - 90 students - 3 classes
91 - 120 students - 4 classes
121 - 150 students - 5 classes

If a teacher listed a total of 56 students enrolled in Algebra, it was considered he taught two classes of Algebra.

In a pamphlet copyrighted in 1958, the Commission on Mathematics states:[3]

> The traditional secondary school program in mathematics, made up of elementary algebra, plane geometry, intermediate algebra, solid geometry, trigonometry and advanced algebra consists entirely of mathematics developed over 300 years ago, gradually introduced into the schools over the past 150 years and crystallized into essentially its present form approximately 60 years ago. The subject matter chosen and the presentation organized in accordance with an attitude toward mathematics that is now antiquated and has been discarded by present day working mathematicians. The curriculum contains obsolete material and instead of being oriented to the needs of the second half of the twentieth century, is designed to meet the needs of science and technology as these needs existed some 75 years ago.

This study does not attempt to show what should be contained in a revised curriculum. The table shows only that a revision of the mathematics curriculum is in progress, by the introduction of new courses into the mathematics curriculum of the secondary schools contacted. This introduction of new courses into the curriculum has made it necessary for the teachers of mathematics to become better prepared in their teaching field.

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[3]Commission on Mathematics of the College Entrance Examination Board. Modernizing the Mathematics Curriculum, New York, 1958, p. 21.

TABLE I

COURSES AND NUMBER OF STUDENTS TAUGHT BY THE TEACHERS

COURSES	General Mathematics	Elementary Algebra	Plane Geometry	Advanced Algebra	Trigonometry	College Algebra	Solid Geometry	Plane and Solid Geometry (Combined)	Probability and Statistical Inference	Calculus and Analytics
Number of Students	1384	4385	4013	2381	1036	551	372	1081	148	215
Number of Classes	59	174	163	106	56	26	23	41	9	13
Number of Teachers	33	86	75	72	47	17	21	19	8	10

Table I shows the effect of new mathematics on the curriculum of the secondary schools of the responding teachers. It shows new courses appearing along with the traditional courses as described by the Commission on Mathematics, such courses as a combined course in plane and solid geometry, eliminating waste material from each course. Calculus and Analytics, as a combined course, has been introduced at the high school level by some schools showing an increased preparation by the high school student. A course in Probability and Statistical Inference has also been introduced at the secondary level within the past few years.

Other courses not included in the table are Principles of Mathematics, Modern Mathematics and Beginning Analysis. One one class was offered in Modern Mathematics to 25 students, two classes of Principles of Mathematics was offered to 21 students, and two classes of Beginning Analysis was offered to 25 students.

Table I also shows a high enrollment in the college preparatory mathematics courses indicating a desire of students to become more proficient in mathematics in the place of just satisfying the state requirement of one mathematics course for graduation. This is exemplified by only 1,384 students enrolled in General Mathematics as

compared to the 4,385 students enrolled in Elementary Algebra and 5,094 students enrolled in Geometry.

The increased number of students in Geometry indicates the drop out of mathematics students between Beginning Algebra and Geometry is not as great as it has been in the past.

The following statement appears in a pamphlet published by the Commission on Mathematics in October, 1957:[4]

> It is essential that the potential scientist or engineer study mathematics throughout his full four years of high school, for only then can he enter a college, university, or engineering school properly equipped to handle the technical courses which he must master. Students planning to major in other subjects in college will find that the mathematical requirements of most fields have sharply risen in recent years.

Although the enrollment in the courses in higher mathematics is less than that in the beginning courses, it is still substantial enough to indicate some students are continuing with the advanced programs offered by the schools. These advanced programs should prepare those students for their college work.

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[4]Commission on Mathematics of the College Entrance Examination Board. Objectives of the Commission on Mathematics of the College Entrance Examination Board, New York, 1957, p. 21.

Table I does not include courses for the non-college bound student. Examples of these courses are General Mathematics II, Refresher Arithmetic, Consumers Mathematics and Business Arithmetic.

CHAPTER III

RECOMMENDATIONS FOR TEACHER PREPARATION

In a report of the Commission on Mathematics of the College Entrance Examination Board, copyrighted 1959, the following statement was made:[5]

> Future graduates of institutions engaged in teacher education must not find it necessary to fill gaps in their training. It is imperative that the under-graduate programs of such institutions be modified at once to provide a sound background of contemporary mathematical material and to produce teachers adequately equipped to deal with the new curricular patterns.

It was attempted in this chapter to show what the colleges and universities of Kansas, who prepare the mathematics teachers, are doing to satisfy the above statement made by the Commission.

In order to find what the institutions are doing towards this purpose, a letter was sent to the heads of the mathematics departments of the institutions listed in Table II. The persons contacted were asked for their recommendations as to the courses necessary to prepare a teacher to teach the new mathematics. The letters were sent during the latter part of the summer session at

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[5] Commission on Mathematics of the College Entrance Examination Board. Program for College Preparatory Mathematics, New York, 1959, p. 54.

Emporia. This may be the reason only 13 of the 20 persons contacted returned their recommendations.

TABLE II

PERSONS AND SCHOOLS CONTACTED

* Professor Ronald G. Smith	Pittsburg State College
* Professor John M. Burger	Kansas State Teachers College
Professor William C. Foreman	Baker University
* Professor Jean Jenkins	Bethany College
* Professor Arnold M. Wedel	Bethal College
Professor Ancil R. Thomas	Friends University
* Professor Gilbert Ulmer	University of Kansas
* Professor Robert H. Thompson	Sterling College
* Professor Leonard L. Laws	Southwestern College
* Professor Mary Nicholas Arnoldy	Marymount College
Professor Kenneth S. Carman	Kansas Wesleyan University
* Professor Joseph L. Bowman	McPherson College
* Professor P. S. Pretz	St. Benedict's College
Professor Helen Sullivan	Mount Scholastica College
* Professor W. David Bemmels	Ottawa University
Professor John R. Sherman	College of Emporia
* Professor R. G. Sanger	Kansas State College
Professor Paul Eberhart	Washburn University
Professor W. Toalson	Ft. Hays State College
* Professor C. B. Read	Wichita University

* Designates the persons answering request

The responses of the department heads were varied. All department heads agreed that courses up to and including Integral Calculus should be required. Eight of the twelve responding required combined courses in Calculus and Analytics in place of the traditional courses of Analytical Geometry, Differential Calculus and Integral Calculus. Beyond the Calculus, the recommended courses were varied as to names and types of courses.

Table III shows the recommendations of the department heads beyond Calculus. The table shows the number of hours beyond the Calculus and the courses from which the selections should be made.

Included in the table are the recommendations set forth by the Commission on Mathematics.[6]

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[6]Commission on Mathematics of the College Entrance Examination Board. Program for College Preparatory Mathematics, New York, 1959, p. 57.

TABLE III

RECOMMENDATIONS FOR TEACHER PREPARATION

SOURCE	Comm. on Mathematics	Pitt. State College	KSTC, Emporia, Ks.	Bethel College	Wichita Univ.	Univ. of Ks.	Sterling Coll.	Southwestern	Marymount	McPherson	St. Benedict's	Ottawa Univ.	Kansas State	Bethany Coll.	Total
Number of hours beyond Calculus	24	14	15	9	20	12	5	17	12		15	12	24	12	
ADDITIONAL COURSES SELECTED FROM THE FOLLOWING:															
Adv. Calculus	x			x	x		x	x			x	x	x		8
Non-Euclidean Geo.	x	x			x	x		x	x	x			x	x	9
History of Math.	x	x	x		x			x	x				x	x	8
Diff. Equations	x			x	x			x			x	x	x		7
Modern Algebra	x		x	x		x					x		x	x	7
Prob. & Stat.	x		x										x		3
College Geo.		x	x								x				3
Statistics		x													4
Theory of Numbers	x												x		2
Theory of Equations								x	x					x	3
Higher Algebra		x					x				x		x		2
Logic	x	x													4
Finite Math.								x							1
Fund. Concepts			x			x			x						3

Table III includes only the mathematics courses recommended by the responding department heads. Almost all recommended some kind of a methods course in teaching mathematics, but the names were so varied, it was hard to determine whether the course belonged in the mathematics curriculum or the education curriculum.

Taking the courses recommended the greater number of times in Table III, a strong preparatory program for the teaching of mathematics would be as follows: Twenty-one college hours beyond the calculus and analytics consisting of Advanced Calculus which received eight recommendations, Non-Euclidean Geometry which received nine recommendations, History of Mathematics which received eight recommendations, Differential Equations which received seven recommendations, Modern Algebra which received seven recommendations, Probability and Statistical Inference which received seven recommendations and Logic which received seven recommendations.

Although Probability and Statistics received only three recommendations itself, when grouped with the four recommendations for Statistics, the total recommendations would be seven. The same is true for Logic. Logic itself received only four recommendations but when considering the

course content of Finite Mathematics and Fundamental Concepts, it could be considered Logic received a total of seven recommendations.

It would be interesting to note here how well the above recommended program more than satisfies Level II of the recommendations of the Mathematics Association of America. The Mathematics Associations of America's recommendations are taken up in Chapter VIII of this study and were published in 1961, while the recommendations of the heads of the departments were made in the summer of 1959.

CHAPTER IV

TOTAL COLLEGE HOURS

This chapter contains a table showing the preparation of the mathematics teachers with respect to total number of college hours. It was felt that the table would show how well the teachers have accepted the responsibility of becoming better prepared if the total hours for 1957 and 1960 would be contained in the table.

TABLE IV

TOTAL COLLEGE HOURS

TOTAL HOURS	NUMBER OF TEACHERS 1957	NUMBER OF TEACHERS 1960
0 - 9	14	0
10 - 19	16	5
20 - 29	33	25
30 - 39	32	39
40 - 49	15	17
50 - 59	6	18
60 - 69	1	14
70 - 79	2	10
80 - 89	1	5
90 - 99	0	1
100 - above	1	1
TOTAL	131	135

Of the total 150 teachers returning their questionnaires, 15 had to be discounted for the preceding table. Eleven teachers indicated the courses they had taken by check marks and four had discrepencies as to the value in number of hours of the courses they took. The total number of hours for these 15 teachers could not be determined and were not included.

The discrepency in Table IV of 131 teachers in 1957 and 135 teachers in 1960 was accounted for by four teachers who indicated only the total number of hours and not the year the courses were taken. These four were placed in the year 1960 due to the fact that the number of hours they had in 1957 could not be determined.

Of the 14 teachers in the 0 - 9 group for 1957, the teachers indicated their first mathematics course was taken in 1959, four teachers indicated their first mathematics course was taken in 1958 and five indicated their first mathematics course was taken in 1957.

Table IV shows a definite increase in the preparation of the mathematics teachers with respect to the total number of college hours in mathematics from 1957 to 1960. This increase would be more apparent had the groups been made smaller. Eighteen of the teachers had increased their number of hours by additional course work but not enough to change to a higher group.

An example of this was one teacher in the group 30 - 39 with 30 hours of mathematics in 1957 and 36 hours of mathematics in 1960.

Three questions that arise from the table are: (1) What kinds of degrees do the teachers hold?; (2) When was their most recent training?; (3) What has been the direction of their advanced training? The answers to these three questions will be given in later chapters.

CHAPTER V

DEGREES HELD

In Chapter IV, Table IV revealed the mathematics teachers were, on the whole, well qualified with respect to total college hours in mathematics. One question arising from the table was: "What kinds of degrees do these teachers hold?" That question will be answered here by Table V showing the kinds of degrees held by the responding teachers and their major fields.

Within the past few years, many schools have placed great emphasis on the higher degrees. This emphasis can be seen by obtaining and examining the salary schedules from different schools. These salary schedules show a higher salary for those teachers with the higher degrees. In many cases, the schedules do not specify the major field the teacher must have with the higher degree. For this reason, it was felt necessary to include in Table V the major fields of the teachers as well as the degree held.

With emphasis being placed only on the higher degree, and not on the major field, there has been a tendency for some teachers to choose some field other than mathematics for their major field.

TABLE V

KINDS OF DEGREES AND MAJOR FIELDS

BACHELORS DEGREE								MASTERS DEGREE											
Mathematics	Math. - Educ.	Education	Engineering	Latin	Chemistry	Business Adm.	Home Ec.	Mathematics	Math. - Educ.	Education	Business	Phys. Educ.	Administration	History	Physics	Psychology and Guidance	Science	Economics	TOTAL TEACHERS
51	5	2	1	1	2	2	1	34	5	24	1	2	12	2	1	1	1	1	149

Of the 150 teachers replying, one teacher neglected to fill in this portion of the questionnaire and therefore could not be included in Table V.

Upon examining Table V, it is found that 84 of the 149 teachers holds a Masters Degree while 65 of the teachers hold only a Bachelors Degree.

Of the 65 teachers holding a Bachelors Degree, it was found that 51 or 78 per cent majored in Mathematics. In the case of the Masters Degree, it was found that only 39 or 46 per cent of the teachers majored in Mathematics or a combination major of Mathematics and Education. Forty-three per cent of the remaining 56 per cent with a Masters Degree majored in either Education or Administration leaving 11 per cent of the teachers majoring in some other field.

Because of the high percentage of teachers changing their major fields when working for a Masters Degree, it was felt necessary to investigate the direction those teachers with Bachelor Degrees were taking when working towards a higher degree.

Table VI-A shows the number of hours the 65 teachers had obtained toward a higher degree while Table VI-B shows the major field declared by the teachers.

TABLE VI-A

HOURS TOWARDS HIGHER DEGREE

Number of Hours	Number of Teachers
0- 4	23
5- 9	14
10-14	5
15-19	6
20-24	8
25-29	5
30-above	4
TOTAL	65

TABLE VI-B

DECLARED MAJORS

Major	Number of Teachers
None	25
Mathematics	27
Math.-Educ.	3
Administration	2
Physics	1
Education	4
Guidance	2
Library	1
TOTAL	65

In Table VI-A, eighteen teachers had not completed any work towards a higher degree. Eleven of these teachers had graduated from college within the last two years, leaving little opportunity for work towards a higher degree.

Table VI-B shows that 75 per cent of those declaring major fields are continuing their work in Mathematics or a combination major of Mathematics and Education. Only 20 per cent of the teachers have declared Education, Administration or Guidance as their major field. Considering some

teachers may choose Administration or Guidance for their life work, 20 per cent does not seem too high a percentage of change in majors.

It is believed the new emphasis being placed on mathematics is the reason more of the teachers are remaining in their major field of mathematics.

Another reason for people continuing their work in mathematics is probably due to the availability of in-service and summer institutes sponsored by the National Science Foundations and other organizations. How well the teachers have responded to this opportunity will be taken up in Chapter VII.

CHAPTER VI

COURSES TAKEN BY TEACHERS

This chapter contains tables to answer the two remaining questions posed in Chapter IV. 1. When was the most recent training of the teachers? 2. What has been the most recent training of the teachers?

In answer to question 1, it was found that 38 or 26 per cent of the teachers indicated the year 1957; 15 or 10.3 per cent indicated the year 1958; 29 or 19.9 per cent indicated the year 1960 as the last year they were enrolled in a mathematics course.

Because the training of the teachers has been recent, question 2 becomes an important consideration. In order to answer question 2, Table VII-A was constructed to show the kinds of courses enrolled in, the year a teacher was enrolled in a particular course, the total teachers enrolled in any particular course, the number of teachers enrolling in the course during the years 1957 or before and the number of teachers enrolled in that course since 1957. To further emphasize the direction the training has taken, included in Table VII-A is the per cent of teachers enrolled in the years previous to 1958 and the per cent of teachers enrolled in the same course in 1958 or after.

Because only six persons had not completed the courses up to Integral Calculus, they were not included in the table. Also not included in the table of the original 150 teachers were the four teachers who indicated only the total number of hours and not the individual courses.

To obtain the percentage of teachers enrolled in each course for the years previous to 1958, the total 146 teachers was used, and to obtain the percentage of teachers enrolled in 1958 or after, 108 teachers were used as the total since 38 teachers had not enrolled in a course since 1957.

TABLE VII-A

COURSES TAKEN BY TEACHERS

	1957	% of 146	1958	1959	1960	Total to 1960	Since 1957	% of 108
Abstract Algebra (Mod.)	15-1*	11.0	12	20-1*	24-1*	71-3*	56-2*	53.7
Higher Algebra	29	19.9	5	6	0	40	11	10.2
Theory of Equations	66	45.1	8	5	2	81	15	13.9
Finite Mathematics	4-4*	5.5	8	7	8	27-4*	23	21.3
Group Theory	4	2.7	4	2	1	11	7	6.5
Functions and Limits	3-4*	4.8	0	1-1*	3-3*	7-8*	4-4*	7.4
Theory of Sets	3	2.3	2	3	6	14	11	10.2
Theory of Numbers	6	4.1	2-1*	2	4	14-1*	8-1*	8.3
College Geometry	38	26.0	5	5	4	52	14	13.0
Modern Geometry	11	7.5	5	5	8	29	18	16.7
Solid Anal. Geometry	34	23.2	2	1	0	37	3	2.8
Higher Geometry	5-1*	4.1	2	1-1*	1	9-2*	4-1*	4.6
Projective Geometry	31	21.2	2	2	2	37	6	5.6
Non-Euclidian Geometry	4	2.7	4	6	2	16	12	11.1
History of Mathematics	59	40.0	2	9	6	76	17	15.7
Methods of Teaching Mathematics	86-30*	**	9-8*	11-8*	5-2*	111-48*	25-18*	**
Fundamental Concepts	11	7.5	5	10-2*	9-1*	34-3*	24-3*	25.0
Modern Develop. I & II	8	5.5	13	17	25	63	55	51.0
Prob. and Statistics	15	10.3	11	13	12	50	36	36.0
Elem. Statistics	44	30.0	4	7	6	61	17	15.7
Probability	7	4.8	0	0	1	8	1	0.9
Business and Educ. Statistics 1	17	11.6	1	1	1	20	3	2.8
Adv. Calculus	35	24.0	6	4	4-1*	40-1*	14-1*	13.9
Diff. Equations	58	39.8	5	7	1	71	13	12.0
Theory of Functions	12	8.2	1	1	3	17	5	4.6
Astronomy	39	26.7	3	3	2	47	8	7.4
Descriptive Geometry	19	13.0	1	0	0	20	1	9.2
Math. of Finance	38	26.0	5	4	2	49	11	10.1
Slide Rule	17	11.6	4	0	0	21	4	3.7
Field Work	17	11.6	2	0	0	19	2	1.9
Adv. Math. Statistics	3	2.3	3	2	1	9	6	5.5
Vector Analysis	6	4.1	2	0	1	9	3	2.8
Programming Computers	0	0.0	0	2	1	3	3	2.8
Applied Mathematics	8	5.5	4	1	2	15	7	6.5
Ill. Program or SMSG Materials	0	0.0	1	1	1	3	3	2.8

* Similiar Courses but different titles
** Many teachers enrolling in more than one course

From Table VII-A, it can be seen that enrollment in courses which are considered as preparation for teaching new mathematics has greatly increased while those along traditional lines are decreasing in enrollment. Two examples of this are Abstract Algebra as compared to Higher Algebra, and Modern Geometry or Non-Euclidian Geometry as compared to College Geometry and Solid Analytical Geometry. Abstract Algebra increased progressively from 11 per cent in 1957 to 53.7 per cent in 1960 while Higher Algebra decreased progressively from 19.9 per cent in 1957 to 10.2 per cent in 1960. Other courses in the field of Algebra such as Finite Mathematics, Theory of Sets, and Group Theory also show increases in enrollment.

While Modern Geometry showed an increase in enrollment from 7.5 per cent in 1957 to 16.7 per cent in 1960, Non-Euclidian Geometry, also considered a Modern Geometry course, was showing a greater increase in enrollment from 2.7 per cent in 1957 to 11.1 per cent in 1960.

To better exemplify the change in enrollment from the traditional courses of study to the more modern courses, Tables VII-B and VII-C were constructed to show respectively those courses showing an increase in enrollment since 1957 and those courses showing a decrease in enrollment since 1957.

TABLE VII-B

COURSES SHOWING INCREASED ENROLLMENT

COURSE	% in 1957 Or Before	% After 1957
ABSTRACT ALGEBRA (MODERN)	11.0	53.7
FINITE MATHEMATICS	5.5	21.3
GROUP THEORY	2.7	6.5
FUNCTIONS AND LIMITS	4.8	7.4
THEORY OF SETS	2.3	10.2
THEORY OF NUMBERS	4.1	8.3
MODERN GEOMETRY	7.5	16.7
HIGHER GEOMETRY	4.1	4.6
NON-EUCLIDIAN GEOMETRY	2.7	11.1
FUNDAMENTAL CONCEPTS	7.5	25.0
MODERN DEVELOPMENTS	5.5	51.0
PROBABILITY AND STATISTICS	10.3	36.0
APPLIED MATHEMATICS	5.5	6.5
ILL. PROGRAM OR SMSG MATERIALS	0.0	2.8

TABLE VII-C

COURSES SHOWING DECREASED ENROLLMENT

COURSE	% in 1957 Or Before	% After 1957
HIGHER ALGEBRA	19.9	10.2
THEORY OF EQUATIONS	45.1	13.9
COLLEGE GEOMETRY	26.0	13.0
SOLID ANALYTICAL GEOMETRY	23.3	2.8
PROJECTIVE GEOMETRY	21.1	5.6
HISTORY OF MATHEMATICS	40.0	15.7
ELEMENTARY STATISTICS	30.0	15.7
PROBABILITY	4.8	0.9
BUSINESS OR EDUC. STATISTICS	11.6	2.8
ADVANCED CALCULUS	24.0	13.9
DIFFERENTIAL EQUATIONS	39.8	12.0
THEORY OF FUNCTIONS	8.2	4.6
ASTRONOMY	26.7	7.4
DESCRIPTIVE GEOMETRY	13.0	9.2
MATHEMATICS OF FINANCE	26.0	10.1
SLIDE RULE	11.6	3.7
FIELD WORK	11.6	1.9
VECTOR ANALYSIS	4.1	2.8

Table VII-B shows the effect of new mathematics on teacher preparation. Those courses showing an increase in enrollment since 1957 are all background courses for the new mathematics with the exception of Applied Mathematics. The courses showing the greatest enrollment since 1957, Abstract Algebra (Modern), Finite Mathematics, Theory of Sets, Modern and Non-Euclidian Geometry, Fundamental Concepts, Modern Developments and Probability and Statistics, are all courses receiving recommendations in Chapter III.

It is more difficult to conclude from Table VII-C that all courses showing decreased enrollment are traditional courses. However, the courses in Higher Algebra, Theory of Equations, College or Solid Analytical Geometry, and Elementary Statistics are courses which were once strongly recommended for teacher preparation.

Many courses showing a decrease in enrollment--Projective Geometry, History of Mathematics, Probability, Advanced Calculus, Differential Equations and Theory of Functions, are still considered favorable preparatory courses. Their decrease could be partly due to the larger number of teachers already having these courses in their under-graduate programs.

Although the results of Tables VII-A, VII-B and VII-C may leave a favorable impression, it can still be recognized that many teachers must still fill in gaps in their preparation towards the new mathematics.

CHAPTER VII

INSTITUTES ATTENDED BY TEACHERS

This chapter contains a table designed to answer the question stated in the introduction: "How well are the teachers participating in institutes sponsored by the National Science Foundation?"

In the Report of the Commission on Mathematics, "Program for College Preparatory Mathematics", the following statement about teacher preparation was made:[7]

> New courses must be designed for the needs of secondary school teachers. Departments of education and departments of mathematics must cooperate in setting up and administering such programs. Cooperation often will bring about more effective recruitment of participants, improved communication between departments concerned, and increased understanding of their mutual responsibility for the improvement of secondary instruction.

The report goes on to make the following statement about in-service and summer institutes:

> There have been some efforts in this direction in recent years. Some universities have recognized the necessity of providing subject matter courses for teachers returning after a considerable absence from formal mathematical studies. Certain industries and foundations have supported conferences, summer institutes and academic year institutes for secondary school mathematics teachers. Funds have been provided to relieve the teacher participants of financial concern and enable the institute directors to engage the best scholars and teachers of mathematics from all parts of the country.

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[7]Commission on Mathematics of the College Entrance Examination Board. Program for College Preparatory Mathematics, New York, 1959, p. 5.

Table VIII is designed to show the number of teachers who have participated in the above-mentioned institutes as well as the kinds of institutes they had attended.

TABLE VIII

INSTITUTES ATTENDED

In-service Institute	SUMMER INSTITUTES 1	2	3	4	1 In-service 1 Summer	1 In-service 2 Summer	1 In-service 3 Summer	1 Summer 1 Academic Year	Academic Year	Attended None	Total Teachers
6	32	26	7	1	7	0	1	4	1	65	150

As can be noted from the table, all 150 respondents were considered for the above table. If a respondent did not fill in this portion of the questionnaire, it was considered he had not attended any type of institute.

As can be noted from Table VIII, all but 65 of the 150 teachers had attended at least one institute with most having attended more.

Another important question to be considered, resulting from the table, was what had the 65 teachers who had not attended an institute done since 1957?

Upon investigation, it was found that 32 of the 65 teachers had been enrolled in at least one course of mathematics since 1957.

Although the institutes have been a contributing factor towards the additional education of the teachers, some teachers have found it necessary to continue their education at their own expense.

Table IX shows the places and number of participating teachers at each of the schools listed in the replies on the questionnaire.

TABLE IX

PLACES SUMMER INSTITUTES WERE ATTENDED

SCHOOL	NO.	SCHOOL	NO.
Univ. of California	2	Louisiana State Univ.	2
Carleton College	2	Univ. of Massachusetts	2
California University at Davis, Calif.	1	Univ. of Michigan	1
Univ. of Colorado	3	Univ. of Minnesota	1
Drake University	1	Univ. of Missouri	2
Duke University	1	Montana State Univ.	2
Florida State Univ.	1	Univ. of New Mexico	1
Univ. of Illinois	2	Univ. of Nebraska	2
Univ. of Indiana	1	Oklahoma Univ.	6
Iowa State Tchr. College	3	Oklahoma State Univ.	4
KSTC, Emporia, Kansas	18	Southwestern, Durant, Oklahoma	1
Kansas University	32	Oregon State Univ.	1
Kansas State University	5	Univ. of South Dakota	1
Washburn Univ., Topeka	2	South Dakota School of Mines	1
Ft. Hays State, Hays	6	Stanford Univ.	1
Kansas State College, Pittsburg, Kansas	5	Texas Christian Univ.	1
Wichita University	1	Univ. of Vermont	1
Leoti	2	Univ. of Wisconsin	1

As Table IX shows, the places where the institutes were attended were widely scattered with the schools of Kansas having over half the attendance.

In the case of the in-service institutes, ten teachers indicated they had attended one at Kansas State Teachers of Emporia and four teachers indicated they had attended one at Kansas State College of Pittsburg.

In the case of the academic year institutes, three persons indicated they had attended one at Kansas University, one person indicated they had attended one at Oklahoma State University and one person indicated he had attended an academic year institute at Stanford University.

According to the tables, the teachers of Kansas have been making good use of the opportunity to further their education, with the help of sponsored institutes and doing it in many sections of the country.

CHAPTER VIII

RECOMMENDATIONS OF THE MATHEMATICS ASSOCIATION OF AMERICA

In this chapter, the recommendations of the Committee on Teacher Training of the Mathematics Association of America and how well the mathematics teachers satisfy the recommendations of the Committee are considered.

In January, 1961, the Mathematics Association of America published a summary of their recommendations for the training of mathematics teachers. Because this study is primarily concerned with the preparation of secondary school teachers only, that portion of the summary pertaining to the secondary schools was considered.

The Association divides the teaching of all mathematics into five levels. The three levels pertaining to the secondary schools are:[8]

LEVEL II. Teachers of the Elements of Algebra and Geometry.

Included here are teachers who are assigned the task of giving introductory year courses in either Algebra or Geometry or the less formal preliminary material in these fields. The introductory courses are now commonly taught in grades 7-10.

Mathematics Association of America. Recommendations for the Training of Teachers of Mathematics. Michigan State University, Oakland, January, 1961, p. 11-13.

LEVEL III. Teachers of high school mathematics.

These teachers are qualified to teach modern high school mathematics in grades 9 - 12. Such sequences have been recommended by the Commission on Mathematics, the School Mathematics Study Group, the University of Illinois Committee on School Mathematics and others.

LEVEL IV: Teachers of the elements of Calculus, Linear Algebra, Probability, etc.

This is a mixed level, consisting of teachers of advanced programs in the high school, junior college teachers and staff members employed by universities to teach in the first one or two years. These teachers should be qualified to present a modern two year college mathematics program.

In April, 1961, Professor John G. Kemeny of Dartmouth College and Chairman of the Committee on Teacher Training presented the following summary for teacher training at a joint meeting of the Kansas Association of Mathematics Teachers and the Kansas Section of the Mathematics Association of America. This meeting was held at Ottawa University, Ottawa, Kansas.[9]

(1) Preparation for teaching at Level II.

To teach courses at level II, a teacher must have had three years of high school mathematics, a Bachelors Degree with a mathematics minor and seven courses at the college level. These courses should be as follows:

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[9]Address by John G. Kemeny at a joint meeting of the K.A.T.M. and Kansas Section of M.A.A.

3 courses of Calculus and Analytics.
1 course of Modern or Abstract Algebra.
1 course of Modern Geometry.
1 course of Probability and Statistics.
1 elective. This elective should be either introduction to real variables, number theory, topology, history of mathematics, or numerical analysis, including the use of high speed computing machines.

(2) Preparation for teaching Level III.

The preparation for teaching Level III is the same as for Level II with these added criteria. A Bachelors Degree with a mathematics major, eleven courses in place of 7 and 2 courses from each of the four groups after calculus.

(3) Preparation for teaching Level IV.

In order to teach Level IV, a teacher must have a Masters Degree in mathematics, fulfilled all requirements for Level III and at least two courses of theoretical analysis in the spirit of the theory of functions of real and complex variables.

In order to see how well the mathematics teachers of Kansas fulfill the above recommendations, it was necessary to group the courses on the questionnaire. The courses were grouped in the following manner:

(1) ANALYSIS:

Calculus and Analytics
Functions and Limits
Advanced Calculus
Differential Equations
Theory of Functions

(2) ALGEBRA:

Abstract Algebra (Modern)
Finite Mathematics
Theory of Sets
Group Theory

(3) GEOMETRY:

College Geometry (after 1957*)
Modern Geometry
Projective Geometry
Non-Euclidian Geometry

(4) PROBABILITY AND STATISTICS:

Probability and Statistics
Elementary Statistics
Advanced Statistics
Probability

(5) ELECTIVES:

Higher Algebra
Theory of Equations
Theory of Numbers
Solid Anal. Geometry
History of Mathematics
Fundamental Concepts
Modern Developments

* Since 1957, many college geometry courses have been presented in the modern trend.

After checking each questionnaire, it was found that 34 of the 150 teachers satisfied the recommendations for Level II, 8 teachers satisfied the recommendations for Level III, and 2 teachers satisfied the recommendations for Level IV.

When considering those teachers who could not qualify for at least Level II, it was found that 17 teachers lacked a course in the field of Algebra, 9 teachers lacked a course in the field of Geometry, 12 teachers lacked a course in the field of Algebra and Geometry, 13 teachers lacked courses in the fields of Algebra and Probability, 10 teachers lacked courses in the fields of Geometry and Probability, and the remainder lacked more than the amount already mentioned.

It should be pointed out here that the recommendations of the Association have not been adopted as requirements. In his speech to the teachers at Ottawa, Professor Kemeny pointed out that, "These recommendations have received wide spread approval wherever they had been presented."[10]

From the results of this chapter so far, it appears that if the recommendations of the association are adopted, the mathematics teachers of Kansas will again have the task of bolstering their inadequate preparation.

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[10]Opinion expressed by Professor John G. Kemeny at a joint meeting of the Kansas Association of Mathematics Teachers and the Kansas Section of the Mathematics Association of America. Ottawa University, April 15, 1961.

CHAPTER IX

SUMMARY AND CONCLUSIONS

9.1 Summary. It was the purpose of this study to gather information showing the effect of the new mathematics on the preparation of the mathematics teachers teaching in the Class A public high schools of Kansas with enrollment of 200 or more students.

The importance of a study of this kind can be seen when examining the recommendations of the many organizations recommending a new mathematics curriculum for the high schools and thereby new preparatory courses for the high school teachers. Some of these organizations are the Commission on Mathematics of the College Entrance Examination Board, the School Mathematics Study Group sponsored by the National Science Foundation, the University of Illinois Committee on School Mathematics, and the Mathematics Association of America.

When investigating the kinds of courses being taught in the high schools, it was found that the schools where the responding teachers taught had begun to introduce new and advanced courses into their curriculums. Courses like a combined course in plane and solid geometry in place

of the one year of Plane Geometry and one half year of Solid Geometry, College Algebra, Probability and Statistical Inference, and a combined course in Calculus and Analytics. Other courses being introduced, but not to as great an extent, were Principles of Mathematics, Modern Mathematics, and Beginning Analysis.

Table II also shows a large number of students taking the full four years of high school mathematics.

A recommended program of preparation for teaching the new mathematics was found to be 21 hours of college mathematics beyond the Calculus and Analytics consisting of Advanced Calculus, Non-Euclidean Geometry, History of Mathematics, Differential Equations, Modern Algebra, Probability and Statistical Inference and Logic.

The data in Table IV, of Chapter IV, revealed that the teachers had done considerable work in bettering their mathematical background. In 1957, 48 per cent of the teachers had less than 30 hours of college mathematics while in 1960, the percentage had decreased to 22 per cent. It was also found that 49 per cent of the teachers had more than 40 hours of college mathematics by the end of 1960. One teacher, Mrs. Lottchen L. Hunter, had as much as 120 hours of mathematics.

It was found that by 1960, 56.5 per cent of the responding teachers held a masters degree and one person, Mrs. Hunter, held a doctorate. Of the 84 persons with masters degrees, 46 per cent majored in mathematics or a combination of mathematics and education, and 43 per cent majored in either education or administration.

When investigating the direction the 65 teachers with bachelors degrees were taking when working towards an advanced degree, the investigation revealed that 35 per cent had 15 hours or more towards their degree and of those declaring majors, 75 per cent had declared mathematics or a combined course in mathematics and education as their major field.

The courses showing the highest enrollment since 1957 were found to be the courses considered as preparation for the new mathematics. Such courses as Modern Algebra, Finite Mathematics, Group Theory, Functions and Limits, Theory of Sets, Theory of Numbers, Modern Geometry, Non-Euclidean Geometry, Fundamental Concepts, Modern Developments, Probability and Statistics, Programming High Speed Computers, and courses in the study of the Illinois material and the School Mathematics Study Group materials.

It was found that the teachers have been making good use of the opportunity to participate in institutes

sponsored by the National Science Foundation. Over half, 57 per cent, of the teachers had attended an institute of some kind. Of the 65 persons who had not participated in some sort of institute, 32 teachers indicated they had done advanced work at their own expense.

The most discouraging portion of the study was found to be the fulfillment of the recommendations of the Mathematics Association of America. Over 71 per cent of the 150 teachers could not qualify for Level II, which is the level for teaching elementary Algebra and Geometry.

There were 34 teachers qualifying for Level II, 8 teachers for Level III, and 2 teachers qualifying for Level IV. For those teachers not qualifying for Level II, it was found that the teachers lacked courses in the fields of Algebra and Probability and Statistics more than any other field.

Perhaps the standings of the teachers would have been better if the names of the courses and the recommendations could be made more specific.

9.2 Conclusions. It is regrettable that more definite conclusions cannot be made. Because of the small percentage of return from the questionnaires, 52 per cent, any conclusion must be made only for the responding teachers

and not for the entire group of full-time mathematics teachers.

Of the teachers responding, it was found that taken as a group, the teachers have recognized and accepted the fact that new mathematics has entered the high school curriculum within the past few years and have attempted to better prepare themselves to teach this new mathematics.

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APPENDIX

Enclosed in this appendix is a copy of the letter sent to the heads of the departments of the schools contacted, the questionnaire and the letter of explanations that were sent to the mathematics teachers.

Date

Department Chairman

Dear Sir:

I am seeking some information for a masters thesis. The thesis concerns the new mathematics and teacher preparation.

Will you please send me a list of the courses you require your students to take for preparing to teach mathematics at the high school level. If you feel that this is not enough preparation for teaching the new mathematics, will you list the additional courses you think should be required.

I realize this will require some of your time and hope it will not inconvenience you too much. Your suggestions will be very important for my thesis. Please feel free to offer any other suggestions you feel should be considered along this line.

Thank you for your help and cooperation.

Sincerely,

Charles L. Crane

Date

Dear Mathematics Teacher:

In the summer of 1957, a study was made to show the preparation of the mathematics teachers of Kansas. This is a follow-up of that study. We hope to have a more complete picture by using the questionnaire method for obtaining the complete course work of the various teachers chosen to contact.

We hope to show that since the advent of the modernization of mathematics, the mathematics teachers of Kansas have attempted to prepare themselves by additional course work in school, in-service institutes and summer institutes.

Please fill out the attached sheet as soon as possible and return it to me in the self-addressed envelope. Do not feel it is necessary for you to go to a transcript for any of the information. The type of courses taken is of greater importance than the number of hours or the year taken.

I realize the names of the courses listed may differ somewhat from different schools, so please try to associate the courses you have taken with the ones listed. If this cannot be done, there is space provided for the courses that have not been listed.

Thank you for your help and cooperation.

Sincerely,

Charles L. Crane

1. NAME _____

2. BACHELORS DEGREE FROM _____ YEARS SINCE _____

3. MAJOR _____ MINORS _____

4. NUMBERS OF HOURS COMPLETED TOWARD MASTERS ____ MAJOR ____

5. MASTERS DEGREE FROM _____ MAJOR ____

6. PLEASE LIST HERE THE COURSES YOU ARE TEACHING THIS YEAR AND THE NUMBER OF STUDENTS:

_____ _____

_____ _____

_____ _____

_____ _____

7. HAVE YOU EVER ATTENDED THE FOLLOWING:

	(PLACE)	(YEAR)
a. IN-SERVICE INSTITUTE	_____	_____
b. SUMMER INSTITUTE	_____	_____
(If more than one please list all)	_____	_____
	_____	_____

8. PLACE IN THE BLANK THE NUMBER OF HOURS YOU RECEIVED IN EACH OF THE FOLLOWING COURSES YOU HAVE TAKEN

(COURSE)	BEFORE 1957	1958	1959	1960	G or U
I. PREPARATORY:					
INTER. ALGEBRA	___	___	___	___	_____
COLLEGE ALGEBRA	___	___	___	___	_____
TRIGONOMETRY	___	___	___	___	_____
ANALYTICAL GEOMETRY	___	___	___	___	_____
**CALCULUS I AND II	___	___	___	___	_____
**CALCULUS AND ANALYTICS, I, II, III	___	___	___	___	_____

**PLEASE LIST THE TOTAL NUMBER OF HOURS IN THESE COURSES.

		1957	1958	1959	1960	G or U
II.	ALGEBRAS:					
	ABSTRACT ALGEBRA (MODERN)					
	HIGHER ALGEBRA					
	THEORY OF EQUATIONS					
	FINITE MATHEMATICS					
	GROUP THEORY					
	FUNCTIONS AND LIMITS					
	THEORY OF SETS					
	THEORY OF NUMBERS					
III.	GEOMETRIES:					
	COLLEGE GEOMETRY					
	MODERN GEOMETRY					
	SOLID ANALYTICAL GEOMETRY					
	HIGHER GEOMETRY					
	PROJECTIVE GEOMETRY					
	NON-EUCLIDIAN GEOMETRY					
IV.	TEACHING OF MATHEMATICS:					
	HISTORY OF MATHEMATICS					
	METHODS OFH. S. MATH FOR TEACHERS					
	FUNDAMENTAL CONCEPTS					
	**MODERN DEVELOPMENTS I & II					
V.	PROBABILITY AND STATISTICS:					
	PROBABILITY AND STATISTICS					
	ELEMENTARY STATISTICS					
	PROBABILITY					
	BUSINESS STATISTICS OF EDUC. STAT.					
VI.	ANALYSIS:					
	ADVANCED CALCULUS					
	DIFFERENTIAL EQUATIONS					
	THEORY OF FUNCTIONS					
VII.	APPLICATIONS:					
	ATRONOMY					
	DESCRIPTIVE GEOMETRY					
	MATHEMATICS OF FINANCE					
	SLIDE RULE					
	FIELD WORK					

VIII. LIST HERE ANY COURSES YOU HAVE TAKEN BUT WEREN'T LISTED ABOVE:

	1957	1958	1959	1960	G or U
_____	___	___	___	___	___
_____	___	___	___	___	___
_____	___	___	___	___	___
_____	___	___	___	___	___