A FOLLOW-UP OF PARTICIPANTS IN MATHEMATICS SUMMER INSTITUTES PROGRAMS HELD IN IOWA IN 1959

A Field Report
Presented to
The Graduate Division
Drake University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Education

by
Floyd William Lancaster
June 1962
A FOLLOW-UP OF PARTICIPANTS IN MATHEMATICS SUMMER INSTITUTES PROGRAMS HELD IN IOWA IN 1959

by

Floyd William Lancaster

Approved by Committee:

[Signatures]

Chairman

Dean of the Graduate Division
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>The Problem</td>
<td>2</td>
</tr>
<tr>
<td>Statement of the problem</td>
<td>2</td>
</tr>
<tr>
<td>Importance of study</td>
<td>3</td>
</tr>
<tr>
<td>Recent Attention to Mathematics Curriculum</td>
<td>4</td>
</tr>
<tr>
<td>Study Groups and Results</td>
<td>5</td>
</tr>
<tr>
<td>University of Illinois Committee of School Mathematics</td>
<td>5</td>
</tr>
<tr>
<td>School Mathematics Study Group</td>
<td>8</td>
</tr>
<tr>
<td>Commission on Mathematics</td>
<td>10</td>
</tr>
<tr>
<td>Other studies</td>
<td>13</td>
</tr>
<tr>
<td>Summary of Recommendations</td>
<td>13</td>
</tr>
<tr>
<td>Recommended curriculum changes</td>
<td>13</td>
</tr>
<tr>
<td>Other recommendations</td>
<td>14</td>
</tr>
<tr>
<td>National Science Foundation</td>
<td>14</td>
</tr>
<tr>
<td>Programs for Promotion of Science Education</td>
<td>15</td>
</tr>
<tr>
<td>Fellowship grants</td>
<td>15</td>
</tr>
<tr>
<td>The Foundation Institute Programs</td>
<td>15</td>
</tr>
<tr>
<td>The Special Projects in Science Education</td>
<td>16</td>
</tr>
<tr>
<td>Course Content Improvement Program</td>
<td>17</td>
</tr>
<tr>
<td>Scientific Manpower Program</td>
<td>17</td>
</tr>
<tr>
<td>Summer Institute Program</td>
<td>17</td>
</tr>
<tr>
<td>Procedures</td>
<td>19</td>
</tr>
<tr>
<td>Selection of schools</td>
<td>20</td>
</tr>
<tr>
<td>CHAPTER</td>
<td>PAGE</td>
</tr>
<tr>
<td>-----------------</td>
<td>------</td>
</tr>
<tr>
<td>Selection of schools</td>
<td>20</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>20</td>
</tr>
<tr>
<td>Population</td>
<td>21</td>
</tr>
<tr>
<td>Responses to questionnaire</td>
<td>21</td>
</tr>
<tr>
<td><strong>II. PRESENTATION OF DATA</strong></td>
<td><strong>PAGE</strong></td>
</tr>
<tr>
<td>Institute Programs Involved in This Study</td>
<td>23</td>
</tr>
<tr>
<td>Individual School Programs</td>
<td>23</td>
</tr>
<tr>
<td>Drake University</td>
<td>23</td>
</tr>
<tr>
<td>State College of Iowa</td>
<td>25</td>
</tr>
<tr>
<td>Iowa State University</td>
<td>26</td>
</tr>
<tr>
<td>State University of Iowa</td>
<td>27</td>
</tr>
<tr>
<td>The Population</td>
<td>28</td>
</tr>
<tr>
<td>Survey Form and Responses</td>
<td>29</td>
</tr>
<tr>
<td>The survey form</td>
<td>29</td>
</tr>
<tr>
<td>Responses</td>
<td>30</td>
</tr>
<tr>
<td>School enrollment</td>
<td>31</td>
</tr>
<tr>
<td>Changes of Curriculum, Material, and Career</td>
<td>31</td>
</tr>
<tr>
<td>Course content changes</td>
<td>32</td>
</tr>
<tr>
<td>Mathematics courses added to the curriculum</td>
<td>34</td>
</tr>
<tr>
<td>Changes in books and materials</td>
<td>37</td>
</tr>
<tr>
<td>Changes that affected teachers</td>
<td>39</td>
</tr>
<tr>
<td>Addition to Knowledge</td>
<td>40</td>
</tr>
<tr>
<td>Course Change Descriptions</td>
<td>44</td>
</tr>
<tr>
<td>Comments on Institute Program</td>
<td>45</td>
</tr>
<tr>
<td><strong>III. SUMMARY AND CONCLUSIONS</strong></td>
<td><strong>48</strong></td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Numbers and Percentages of Returns from the Participating Schools</td>
<td>22</td>
</tr>
<tr>
<td>II. Alteration of Course Content Reported as a Result of Participation in a Mathematics Institute in Iowa in Summer, 1959</td>
<td>33</td>
</tr>
<tr>
<td>III. Mathematics Courses Added to the Curriculum as a Result of Mathematics Institute Participation in Iowa in Summer, 1959</td>
<td>36</td>
</tr>
<tr>
<td>IV. Changes in Books and Materials Resulting from Summer Institute Participation</td>
<td>38</td>
</tr>
<tr>
<td>V. Changes in Education and Teaching Status as a Result of Mathematics Institute Participation in Iowa in Summer, 1959</td>
<td>42</td>
</tr>
<tr>
<td>VI. Addition to Knowledge of Subject Matter and Teaching Method as Reported by 139 Responses</td>
<td>43</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

In recent years, the educational system of the United States has been strongly criticized. Some criticism is natural, for the schools are publicly supported and require public participation. The more recent criticism was pointed toward a particular area in education and was the result of certain world events. The advent of Sputnik has shown that other countries could compete technologically with this country. The competition caused consternation in the public and government. One result was an increase in pressure to improve the teaching of mathematics and science.

Investigation revealed that the problem was not new to educators in these fields. Various groups had been doing research and making recommendations for many years. In mathematics, this activity was greatly increased after World War II. Several groups were organized with the specific purpose of improving mathematics education. In 1951, the government created the National Science Foundation to encourage scientific development in the United States.

The National Science Foundation has worked as a co-ordinator and sponsor for some groups prominent in mathematics and science education. The Foundation has used several tools
to promote scientific education. An important part of the Foundation program was the sponsoring of Institutes for furthering the education of mathematics and science teachers. The study here reported was particularly concerned with Summer Institutes in Mathematics.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study to investigate the effects of selected Summer Institute programs on the participants. The effects were to be shown by: changes in courses and course content, addition or change in teaching materials and tools, knowledge gain, completion of additional courses, and changes of position.

The study was limited to participants of four Summer Institutes in Mathematics presented in Iowa in 1959. The institutions that presented programs were: Drake University, Iowa State College, Iowa State Teachers College, and the State University of Iowa.¹

The study involved questions in five general areas. The questions are as follows:

1. What course or course content changes have resulted?

2. Have materials such as textbooks, library reference, or models been improved or increased?

¹Iowa State College has been re-named to Iowa State University. Iowa State Teachers College has been re-named to State College of Iowa. The latter designations have been used throughout the balance of this study.
3. Has the teacher attempted self improvement by subscribing to professional literature and taking additional courses?

4. Has the teaching load or teaching position been changed?

5. Has there been increase in knowledge of subject matter and of modern trends in mathematics?

**Importance of study.** The study was of importance because it dealt with recent efforts of the Federal Government to strengthen mathematics education in this country. The Institute program was started in 1953. There were few published studies of the effectiveness of the program available. The Analysis and Evaluation Section of the Institutes had indicated interest in studies of this type.

It was not the purpose of the study to measure effectiveness of the National Science Foundation program. It was not meant to measure effectiveness of the Summer Institute program in Iowa in 1959, nor to compare merits of the Institutes of the respective schools involved. Rather, it was designed to: (1) register some changes that have occurred; (2) register the feeling of the participants about the program itself; and (3) give them a chance to express gain of knowledge in some general areas, particularly modern mathematics.
II. RECENT ATTENTION TO MATHEMATICS CURRICULUM

Although Sputnik focused the public attention, professional people in the field have realized for several years that something needed to be done about modernizing mathematics. Some of the committees mentioned in this paper were operating in this area for eight to ten years before Sputnik appeared. Some of the more enthusiastic people have stated that much change had already taken place. Dr. William Ferguson, who has worked with both the University of Illinois Committee on School Mathematics and the School Mathematics Study Group, stated:

"Today there is a revolution going on in mathematics, kindergarten through the university, with the center of attention focused on the secondary schools at the moment. Some people have not been willing to admit that changes in the mathematics curriculum are being made right now. These people have closed their eyes in the hope that when they open them, the status quo will have been restored. Sometimes this is an excellent way to avoid some of the fads and frills of our society, but none of us can escape the revolution in mathematics—it is about thirty-five to forty years overdue."

The change that Dr. Ferguson referred to has occurred in some schools. Other schools have clung to tradition.

The National Science Foundation has worked with groups that have done experimental work in the development of new mathematics curricula.

---

1Statement by Dr. William Ferguson in a lecture at Drake University Mathematics Institute, Des Moines, June 27, 1960.
Study Groups and Results

There were many examples of studies and experiments that have been performed in order to increase efficiency of the mathematics program. Some schools have individually varied parts of their curriculum to seek improvement. Many have added courses or set up special accelerated classes for the academically talented. The groups that are reported in this paper were those sponsored by a nationally known organization, or those which had received national recognition for the scope and quality of their work.

University of Illinois Committee of School Mathematics.

In 1951, the University of Illinois issued a bulletin which described the mathematical requirements for students entering the College of Engineering. It was clear to many schools that they could not meet these requirements so they asked the University for help. In December of 1952, the College of Engineering, Liberal Arts and Sciences, and the College of Education, established a committee, the University of Illinois Committee of School Mathematics, with representatives from each of the colleges to investigate problems of high school mathematics. Since that time, the Project staff, with Professor Max Beberman as director, has been working on two major tasks: that of developing new materials and that of training teachers.¹

¹Ibid.
The staff believed that often there was little connection between the view of mathematics which the student finds in conventional courses and the views of contemporary mathematicians. They found that conventional courses were often dull and inconsistent. Students felt some courses were "cut and dried." Many of the later and dynamic concepts of mathematics were left out of the earlier courses. The beginning students then became disinterested and dropped mathematics from their schedule.

The staff has developed a program around these basic contentions:

1. That it is possible to present a consistent mathematics all through high school.
2. That high school students are greatly interested in ideas and abstractions.
3. That manipulative tasks, though necessary, should be used primarily to cast light on basic concepts.¹

Through several years of presenting their program to the dozen or more schools participating in the experiment, the staff formed two major hypotheses: (1) the language and organization of mathematics needed changing; (2) the discovery method was the most effective for learning concepts.

To provide for changing the language, the staff produced several pilot textbooks. These textbooks lead the student in discovering those concepts that are consistent throughout all

branches of mathematics. This necessitated changing the whole organization of mathematics course sequence. In fact, the committee recommended that course names such as Algebra and Geometry be discarded.

The committee felt that it had made a great deal of progress. They felt that the students who participated were enthusiastic and successful enough to warrant revolutionizing the nation's high school mathematics curriculum. The following, still subject to many revisions, is a brief outline of a four-year course as advocated by the University of Illinois Committee on School Mathematics.

FIRST COURSE

Distinction between numbers and numerals.
Real numbers.
Principles of real numbers (associativity, commutativity, et cetera).
Inverse operations.
Relations of inequality.
Numerical variables (pronominals).
Generalizations about real numbers.
Notation and some concepts of the algebra of sets.
Solution of equations, linear and quadratic.
Ordered pairs of numbers.
Graphing equations and inequalities.

SECOND COURSE

Sets and relations.
Linear and quadratic functions.
Systems of linear equations.
Measures of intervals, arcs, angles and plane regions.
Elementary properties of angles, polygons, and circles.
Further study of manipulations of algebraic expressions.

THIRD COURSE

Mathematical induction (generalizations, hereditary properties, recursive definitions, progressions).
Exponents and logarithms (continuity and the limit concept, geometric progressions, the binomial series).
Complex numbers (field properties, systems of quadratic equations).
Polynomial functions (the factor theorem, synthetic division, curve tracing).

FOURTH COURSE

Deductive theories (abstraction of postulates from a model, deduction of theorems from these postulates without reference to a model, re-interpretation of the theory to yield information about other models).

School Mathematics Study Group. In the spring of 1958, the president of the American Mathematical Society, after consulting with the presidents of the National Council of Teachers of Mathematics and the Mathematical Association of America, appointed a small committee of educators and university mathematicians to organize a School Mathematics Study Group. The objective of the group was the improvement of the teaching of mathematics.

Professor E. G. Begle, Yale University, was appointed director. The Organizing Committee appointed a thirty-five member Advisory Committee consisting of college and university mathematicians, high school teachers of mathematics, experts in education and representatives of science and industry. The idea was to have experts from all fields necessary to produce a good mathematics curriculum. The Study Group was financed by the National Science Foundation.

The Group decided the problem could be broken into two parts: improving teaching, and improving curriculum. They
tried to keep five main points in mind while working on the project:

1. No one can predict what mathematical skills will be important and useful in the future.
2. No one can predict exactly what career any particular student will choose when he leaves school.
3. Teaching which emphasizes understanding, insight, and imagination, without neglecting basic skills, is the best for all students of whatever ability and makes the best preparation for any vocation which uses mathematics.
4. An understanding of the role of mathematics in our society is essential for intelligent citizenship.
5. Any normal individual can appreciate some, at least, of the beauty and power of mathematics.¹

The actual work of the Group was done in four general areas:

1. To develop a number of short experimental units. Here they started with the seventh and eighth grades, feeling these were most neglected.
2. Produce a number of sample texts for grades seven through twelve.
3. To arouse and educate the public to the role of mathematics. Some of the outstanding mathematicians of the nation were invited to write monographs in areas that might be termed as enrichment.
4. Designing of materials to help teachers directly. They have prepared a study guide and list of books so the teacher can do in-service training.

At the time of the writing of this paper, the School Mathematics Study Group had not completed some of its projects. They have written some units and texts. These have been used in many schools, some in conjunction with other experiments and school projects. Among these are the Yale, Maryland, and Michigan studies which have been publicized.

The texts produced were organized in different sequence than some of the traditional texts. The language was not changed as markedly as the Illinois Group. The introduction of modern developments and concepts are introduced at lower grade levels. Such items as set notation, probability and statistics, and the use of the axiomatic approach throughout, are samples of changes made.

Commission on Mathematics. Some years ago the Mathematics Examiners of the College Entrance Examination Board began to feel increasing concern about the curriculum they were testing. The examiners wondered if it were appropriate, in the second half of the twentieth century, for an examination in secondary school advanced mathematics to be devoted, in approximately equal parts, to trigonometry, advanced algebra, and solid geometry. Did they test accurately what the schools were teaching, and, if so, what they should be teaching?  

With these questions in mind the Board, in 1955, appointed the Commission on Mathematics. The Commission was made up of mathematicians, and college and high school teachers of mathematics. The purpose of the Commission was to study the present developments in mathematics, and make recommendations as to changes needed and methods of making the change.

The Commission felt there should be several changes made. Mathematics, being a dynamic subject, has changed a great deal in the past half century. Some new and more direct processes eliminated the need for parts of the traditional program. Scientific and technical developments have changed the areas in which modern mathematicians devote much of their time.

Any recommendations made were meant to be consistent with the objectives of mathematics in general education. Four of the main objectives follow:

1. An understanding of, and competence in, the processes of arithmetic and the use of formulas in elementary algebra. A basic knowledge of graphical methods and simple statistics is also important.
2. An understanding of the general properties of geometrical figures and relationships among them.
3. An understanding of the deductive method of thought. This includes the ideas of axioms, rules of inference, and methods of proof.
4. An understanding of mathematics as a continuing creative endeavor with aesthetic values similar to those found in art and music. In particular, it should be made clear that mathematics is a living subject, not one that has long since been embalmed in textbooks.1

1Ibid., p. 11.
With these objectives in mind, and also recognizing that it would be impossible to get adoption of an entirely new curriculum, the Commission made these recommendations:

1. Strong preparation, both in concepts and in skills, for college mathematics at the level of calculus and analytic geometry.
2. Understanding of the nature and role of deductive reasoning—in algebra as well as in geometry.
3. Appreciation of mathematical structure (patterns)—for example, properties of natural, rational, real, and complex numbers.
4. Judicious use of unifying ideas—sets, variables, functions, and relations.
5. Treatment of inequalities along with equations.
6. Incorporation with plane geometry of some coordinate geometry, and the essentials of solid and space geometry.
7. Introduction in grade eleven of fundamental trigonometry—centered on co-ordinates, vectors, and complex numbers.
8. Emphasis in grade twelve on elementary functions (polynomial, exponential, circular).
9. Recommendation of additional alternative units for grade twelve: either introductory probability with statistical applications, or an introduction to modern algebra.¹

The commission report lists some recommended changes in content of the courses and includes a study guide. They have also published an appendices to the original report. The appendices illustrated how a teacher might approach the teaching of some of the concepts that the Commission considers basic.

The Commission makes some general recommendations concerning the training of future teachers of mathematics. Also mentioned were some suggestions by which present teachers might seek improvement.

¹Ibid., pp. 33-34.
Other studies. There were too many other experiments and studies reported in this area to list them all. Outstanding ones were the Ball State College, Chicago Board, Evanston, Tulsa, and California State programs. Many of these were similar and were designed to select and accelerate the mathematically talented and college preparatory students.

Summary of Recommendations

In many areas the groups were in complete accord. In some the differences were a matter of degree. Of the three, the Illinois group suggested the most radical departure from tradition. Following are the Study group and the Commission reports, in that order.

Recommended curriculum changes. All three recommended changes in the present curriculum. The Illinois group suggested a change of language, a modification of content, and a change of sequence. The Study group went along the same lines with less drastic change in language, a considerable modification of content, not so much change in sequence but more accelerated. The Commission report was even more conservative about changing language, although some units recommended using modern language. They also were inclined to keep more of the traditional content and sequence.

All were consistent in de-emphasizing formality and manipulative exercises. All recommendations consistently suggested the use of patterns, unifying concepts, and the axiomatic approach to the teaching of mathematics.
Other recommendations. The teaching methods recommended were not as consistent. The Illinois group fostered the discovery method. The Study group agreed but was more flexible in their views. The Commission suggested only that it be made more dynamic.

The National Science Foundation has undertaken a program to evaluate the results of the work of some of the experimental groups.

III. NATIONAL SCIENCE FOUNDATION

The Eighty-first Congress passed Public Law 507. The act was cited as the "National Science Foundation Act of 1950." The purpose of the act was: "To promote the progress of science; to advance national health, prosperity, and welfare, to secure the national defense; and for other purposes."\(^1\)

The law further specified various areas to work in and methods to be used to accomplish its goals. The Foundation took as its main area of concern the promotion of basic research and education in the mathematical, physical, medical, biological, engineering, and other sciences.\(^2\)

In 1960 the National Science Foundation listed activities in five major classifications:

---

\(^1\)U.S. Congress, Public Law 507, 81st Cong., 2d Sess., 1959, Chapter 171.

\(^2\)National Science Foundation, National Science Foundation Programs for Education in the Sciences (Washington: Government Printing Office, 1961), p. III.
   This classification included the programs of basic research in all areas of mathematics and science.
2. Education in the Science.
   Included here were all the programs the Foundation used, such as, fellowship grants, Institute programs, Course Content Improvement programs, and other projects.
3. Dissemination of Scientific Information.
   The fundamental purpose of this section was to make the results of research more readily available to scientists and engineers throughout the country.
4. Special International Programs.
   This classification was concerned with the promotion of and cooperation in joint scientific endeavors with other countries.
5. The National Research and Development Effort.
   This area sponsored the use of surveys and other devices to determine the results of all of the Foundation's programs on the nation generally.

This study was concerned with a part of the education activities carried on by the Foundation.

Programs for Promotion of Science Education

Fellowship grants. The Foundation started its program for education in sciences in 1952 by granting 652 fellowships. Originally the fellowship grants went only to people working for advanced degrees in science, mathematics, or engineering. Over the years the number of fellowships increased to 4,010 in 1960 at a cost of $13,500,000. The recipients ranged from secondary teachers to post-doctoral in extent of education.

The Foundation Institute Programs. The Foundation

---

2Ibid., p. 82.
Institute Programs were directed toward raising the level of
the teaching of science, mathematics, and engineering in the
nation's schools. They consisted of three major types: Summer
Institute, Academic Year Institutes, and In-service
Institutes. These programs provided supplemental training in
subject matter for high school and college teachers, as well
as for staff personnel of technical institutes and elementary
schools.

A secondary objective of the institute programs was to
provide colleges and universities an opportunity to carefully
review science and mathematics courses then available to both
pre-service and in-service teachers seeking to improve their
teaching competence in these areas.

The institute program was started in 1953. During the
eight years through 1960, there had been grants for a total of
1,661 institutes, of which there were 1,057 Summer Institutes,
102 Academic Year Institutes, and 502 In-service Institutes.
Secondary school teachers comprised 85 per cent of the partici-
pants. All but the In-service participants received compensa-
tion. The cost of the institute programs went from $21,000
dollars in 1953 to more than $33 million dollars in 1960.¹

¹Ibid., p. 91.
the development and experimental testing of new ideas for the improvement of science education and of public understanding of science. These projects were quite varied and included such things as: special programs at colleges and universities for secondary students interested in the sciences or engineering; visiting scientist project; the traveling science library; and other projects concerned with science development and education.

**Course Content Improvement Program.** The purpose of the Foundation's Course Content Improvement Programs was to provide support for projects which were to modernize the content of science and mathematics curricula and courses, as well as all types of aids to learning and teaching. The first projects were started in 1954. The program has continued to support projects on all levels, although about 85 per cent are at the secondary level.

**Scientific Manpower Program.** This program maintained a register and clearinghouse of information on scientific and technical personnel. The register helped the foundation to find personnel to carry out its own programs as well as keeping on file those people possessing special skills in case of emergency mobilization.

**Summer Institute Program**

The Summer Institute Program of the National Science Foundation was created in recognition of the important role of
high school and college teachers in development of the scientific manpower potential. Financial assistance from the Foundation made possible the attendance of many teachers who would otherwise have needed to supplement their income from summer occupations not related to their profession.

The National Science Foundation has supported summer institutes for the supplemental training of high school and college teachers of science, mathematics, and engineering since the summer of 1953. The program has expanded from two institutes in 1953 to 398 in 1961, 333 of which were for secondary school teachers.¹

The Foundation provided support for summer institutes on the basis of proposals submitted by colleges and universities outlining the work that will be offered. Foundation funds were used to pay the management and instructional costs, and provide stipends and travel and dependency allowances for teacher participants. Once the proposed program was accepted by the Foundation, the institution involved was completely responsible for administration of the institute. The college or university also handled payments of all stipends and travel allowance, although the maximum rate of payment for participants was specified by the Foundation so as to be universal in all features. The policy of the Foundation in all instances was meant to encourage education, without control.

Summer institutes provided courses especially designed for science and mathematics teachers, which varied widely in scope, including institutes planned for: (1) teachers with weak or insufficient subject-matter backgrounds; (2) teachers with backgrounds adequate but out-of-date; (3) teachers desiring more advanced training; and (4) teachers desiring training in specialized areas.¹

In addition to courses, the institutes provided many opportunities for informal contacts among the teacher-participants and the instructional staff. Many institutes also provided lecture and discussion situations with recognized leaders in areas of interest to the participants.

IV. PROCEDURES

In recent years, there have been many new advances in scientific development. These advances required acceleration and change in mathematics. Some areas, such as statistics, probability, and linear programming, have become more prominent in the past few years. Thus, many mathematics teachers, whose formal education preceded this development, have gaps in their educational background.

There has been acceleration of mathematics education. Many high schools have installed courses in their curriculum that were offered only in college a few years ago.

Mathematics also has been undergoing a modernizing trend. Modernization has involved changes in terminology, changes in emphasis on various topics, reorganization of continuity, and changes in teaching methods.

The "revolution in mathematics," as it has been termed, has created tremendous re-education problems for mathematics instructors. There have been several methods used to augment the education of mathematics teachers. One of these, The National Science Foundation Mathematics Summer Institute program, has provided the topic of this study.

Selection of schools. The schools selected for this study were those Iowa colleges and universities that had held a Summer Mathematics Institute during the summer of 1959. The schools hosting these programs were: Drake University, Iowa State University, State College of Iowa, and the State University of Iowa. It was felt that a reasonable amount of time had elapsed so the effects of participation in the Institutes would be in evidence.

Questionnaire. It was decided that a questionnaire would be used to obtain the desired information. The form was drawn up to obtain information about the following major questions concerning the influence of enrollment in a Mathematics Summer Institute.

1. What course or course content changes had resulted?
2. Have materials such as textbooks, library reference, or models been improved or increased?
3. Has the teacher attempted self-improvement by subscribing to professional literature and taking additional courses?

4. Has the teaching load or teaching position been changed?

5. Has there been an increase in knowledge of subject matter and of modern trends in mathematics?

The questionnaire was designed about these questions and then submitted to several people who had experience in these or similar institutes to verify that it was understandable and might accomplish its purpose. The questionnaire is included in the Appendix.

**Population.** The population consisted of the participants in the four Mathematics Summer Institutes in Iowa in 1959. On request, each of the host institutions furnished a list containing the names and addresses of participants.

**Responses to questionnaire.** There was a total of 181 people enrolled in the mathematics section of the institutes of the four schools. The enrollment of the four institutes was as follows: Drake University - 55, Iowa State University - 29, State College of Iowa - 36, State University of Iowa - 61. A questionnaire was sent to each with a reminder postcard following about two weeks later. There were 130 responses, four others were returned marked "address unknown."

The responses of the participants of the four schools
were tabulated in Table I. A copy of the follow-up card appears in the Appendix.

**TABLE I**

**NUMBERS AND PERCENTAGES OF RETURNS FROM THE PARTICIPATING SCHOOLS**

<table>
<thead>
<tr>
<th>Schools</th>
<th>Forms Sent</th>
<th>Responses</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drake University</td>
<td>55</td>
<td>42</td>
<td>76.4</td>
</tr>
<tr>
<td>Iowa State University</td>
<td>29</td>
<td>19</td>
<td>65.5</td>
</tr>
<tr>
<td>State College of Iowa</td>
<td>36</td>
<td>31</td>
<td>86.7</td>
</tr>
<tr>
<td>State University of Iowa</td>
<td>61</td>
<td>47</td>
<td>77.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>181</strong></td>
<td><strong>139</strong></td>
<td><strong>76.8</strong></td>
</tr>
</tbody>
</table>
CHAPTER II

PRESENTATION OF DATA

I. INSTITUTE PROGRAMS INVOLVED IN THIS STUDY

The schools selected for this study were the four in Iowa that held Summer Institutes in Mathematics in 1959. These schools were: Drake University, Iowa State University, State College of Iowa, and the State University of Iowa.

Since the program of each institute was somewhat different from the others, and presented different courses, it was necessary to obtain a brief description of each.

The aims and objectives listed by the brochures of the programs generally followed those of the National Science Foundation Institute program, that is to:

1. broaden subject-matter knowledge of mathematics teachers.
2. strengthen teacher capacity and enthusiasm to motivate students to reach full potential.
3. increase teacher understanding and competency with regard to modern points of view and concepts.
4. present opportunities for teachers to hear and meet prominent men in the field of mathematics.\footnote{Drake University, 1959 Mathematics Summer Institute for Secondary School Teachers of Mathematics (Des Moines, Iowa: Drake University, 1959); State College of Iowa, Summer Institute for Teachers of Junior High School Science and Mathematics (Cedar Falls, Iowa: State College of Iowa, 1959); and National Science Foundation, Summer Institutes of Science, Mathematics, and Engineering Teachers (Washington: Government Printing Office, 1959).}

Individual School Programs

Drake University. The Summer Mathematics Institute of
1959 presented at Drake University was designed to serve two types of teachers:

1. Those who had several years of experience teaching standard curriculum in mathematics but who had no training or experience in the materials being considered for the twelfth grade courses.

2. Those teachers of eighth, ninth, and tenth grades who had been pressed into service with inadequate background in mathematics.

The courses offered were as follows:

Math 105: The Development of Mathematics--The evolution of our number system; contributions of past mathematicians; classical problems, both solved and unsolved from the past.

Math 106: Foundations of Algebra--Algebra as arithmetic; algebra from definitions and postulates; logic of rules and theorems of algebra.

Math 107: Foundations of Geometry--Rigorous treatment of undefined terms, postulates, and definitions for Euclidean geometry; introduction to other geometries.

Math 108: Introduction to Statistical Analysis and Probability--Sampling techniques; grouping of data; central tendencies: mean; standard deviation; correlation; theorems of a-priori probability and statistical probability.¹

Generally speaking, the first two listed were for teachers whose course background were deficient and the latter two were more for those who needed refresher work. Each participant was enrolled in two of the courses and upon successful completion received six semester hours of graduate credit.

¹Drake University, 1959 Mathematics Summer Institute for Secondary School Teachers of Mathematics (Des Moines, Iowa: Drake University, 1959).
In addition to attending two formal courses, each participant attended an institute hour each day. The institute hour program consisted of visiting lecturers or reports on special topics presented by a group of participants themselves.

**State College of Iowa.** The summer institute program in 1959 presented by the State College of Iowa was designed to be adaptable to meet the needs of many teaching combinations in the mathematics and science areas.

Five courses were offered, two in mathematics and three in science. Each participant was required to select two, but might attend three. The two required courses could be both in mathematics, both in science, or one in each area. The courses and other parts of the program were for teachers who did at least part of their teaching at junior high level.

The mathematics courses offered were as follows:

- **Elements of Algebra.** A modern approach to variable, relation, and function through theory of sets; conditions as set builders; application to formulas, graphs and tables as studied in the junior high school; introduction to probability theory; simple sample spaces; application to games and social problems of interest to junior high school boys and girls.

- **Elements of Geometry.** Geometric objects defined as subsets of a specified universe of discourse. Critical examinations of the definitions and methods of Euclidean geometry. Exploration of intuitive geometry, and of proofs in geometry based upon the correspondence between points and their coordinates; simple transformation groups.1

---

1 State College of Iowa, *Summer Institute for Teachers of Junior High School Science and Mathematics* (Cedar Falls, Iowa: State College of Iowa, 1959).
The program lasted eight weeks. On satisfactory completion of all parts of the program, the participant received eight semester hours of graduate credit.

In addition to the formal courses, there were lectures by visiting specialists and demonstration classes showing actual use of the modern approach to teaching mathematics. Participants also worked either individually or in small groups to develop resource units as a basis for teaching units to be used in their own classrooms.

**Iowa State University.** The mathematics summer institute program presented at Iowa State University was somewhat more limited as to participant. Eligible were teachers of mathematics through calculus in college or junior college. They were required to have at least a baccalaureate with a mathematics major and three years of full-time teaching by 1959.

The special institute courses were:

- **Algebra**—Matrices, determinants; linear systems and spaces; integers; factorization; congruences; groups; homomorphisms.

- **Analysis**—Number systems; set theory; sequences and series; continuity; differentiation; integration theory.

- **Applications**—Differential equations; Fourier theories; numerical methods; vectors; Laplace transformations; boundary value problems.1

Each participant could carry any two of the preceding special courses for three credits each, or any one special course for two credits.

---

1 Iowa State University, *Summer Institutes for Teachers of Engineering, Mathematics and Science* (Ames, Iowa: Iowa State University, 1959).
course and a regularly scheduled summer college mathematics course.

**State University of Iowa.** A brochure of the total Summer Mathematics Institute presented at the State University of Iowa in 1959 was not available. However, there was available a description of courses. A condensation of this description follows:

Introduction of Modern Algebra—The purpose of the course was to introduce some of the concepts and methods of abstract algebra. The postulational method was emphasized throughout, with special emphasis being given to the roles of definitions, postulates, and proofs.

Topics included were: sets; correspondences; equivalence relations; the ring and its subsets; domain; number properties; fields and applications with numbers.

An Analysis of Elementary College Mathematics—In this course some of the more recent changes in the elementary college curriculum were singled out for comment and discussion. Several basic topics were presented from a modern point of view with emphasis placed on organization of material and on interrelation among the ideas involved.

The course included topics from algebra, trigonometry and analytic geometry along with other branches of mathematics. Almost half the course was devoted to probability as approached with modern methods.

Topics in Secondary Mathematics from a Modern Viewpoint—This course was designed to demonstrate the manner in which selected topics from traditional school mathematics can be modernized and also to include a few basic ideas not ordinarily found in the secondary school program. Included were such topics as sets; relations and functions; scales of notation; variable and constant; inequalities; equivalence equations; converse, inverse, and contrapositive; truth table; indirect proof; vectors; and the discovery method of teaching.¹

The participants divided into groups and selected a topic for study and report. Materials developed by various

¹*State University of Iowa, Description of Courses in NSF Summer Institute for Teachers of High School Mathematics* (Iowa City, Iowa: State University of Iowa, 1959).
mathematical study groups prominent in the field of modern mathematics were available for reference.

The programs of these four summer institutes were varied in several ways. Some were combination programs for mathematics and science teachers. The requirements varied from a teacher qualified to teach a course in junior high mathematics to teachers having at least a bachelors degree with a mathematics major.

There were, however, some factors common to all of the programs. The participants were all teachers of at least one mathematics course and were all enrolled in at least one mathematics course in the institutes. The institutes were all sponsored by the National Science Foundation and therefore were designed to improve the instruction of mathematics.

The Population

The population consisted of the participants in the four summer mathematics institutes held in Iowa in 1959. Names and addresses of the participants were secured from the institutions involved. The four institutions and the number enrolled were as follows: Drake University--fifty-five attended, exclusively enrolled in mathematics courses designed for the institute; Iowa State University--twenty-nine attended who were required to take at least one special institute mathematics course, the other course was optional between a regularly scheduled mathematics course and an institute course;
State College of Iowa—thirty-six attended that were in at least one institute mathematics course; State University of Iowa—sixty-one attended, all taking two institute mathematics courses.

II. SURVEY FORM AND RESPONSES

The survey form. A survey form (Appendix) was devised and sent to all of the participants who had taken at least one mathematics course. The form was designed to be as general as possible because of the differences in the programs of the four institutions. It was divided into four sections.

Section I included concrete items. Situations that may have changed as a result of attending a summer institute were included in this section. These changes concerned addition of courses, alteration of course content, addition or change of teaching tools, professional and educational advancement. The purpose of this section was to show some of the actual results of institute participation on the teacher, in the school, in the classroom, and as a professional teacher.

Section II covered the less tangible items of new or increased knowledge of subject matter, and the application of this knowledge to the teacher's own courses. The items included in Section II were selected because they were repeated in the recommendations of various mathematics study groups. The purpose of this section was to determine if the institutes were presenting some of the materials recommended by mathematics study groups.
Section III allowed the participant to list changes in course content. These changes could have been an extension or supplement of those mentioned in Section II or they might have been initiated by the individual teachers.

Section IV was an open statement inviting the opinion of the respondent. Its purpose was to allow expression of opinion about the individual institute, or the Summer Institute program generally.

**Responses.** There was a total of 181 participants who constituted the population of this study. The survey form was mailed to the person at the address furnished by the host institution. There were 181 forms mailed, four were returned marked "address unknown." This would indicate that 177 participants received the survey form. A follow-up card was mailed to those people from whom there was not a return after a two week interval. There was a total of 139 forms returned. This number was 78.6 per cent of those actually receiving the form and 76.8 per cent of the entire population of the study.

Of the forms returned, not all were complete. Most of the forms were nearly completed in the sections requiring only a check type response. There were a very few forms that were only partially completed because the recipient had changed teaching fields, taken an administrative position, continued education, or for some other reason had not continued teaching mathematics. The tables of responses to individual questions indicate the variety in number of responses.
School enrollment. There were 137 responses in the school enrollment section. This number was high because a few people were teaching in both junior high and senior high. Of the 137 responses, eighty-five were in the secondary level and fifty-two were in junior high. The participants were primarily from large-enrollment schools; sixty-nine from schools above five hundred, twenty in the 301 to 500 class, thirty-seven in the 101 to 300 class, with only eleven from the class one hundred and under.

There were 131 responses that gave actual mathematics enrollment. Classified in the previous manner, fifty-four were above five hundred, twenty-one from 301 to 500, thirty-six from 101 to 300, and twenty in the one hundred or under class. These figures appear to indicate that the institutions that presented the programs were selective and tended to choose participants from higher enrollment schools. Possibly, many teachers from smaller schools did not apply or did not qualify.

Changes of Curriculum, Material, and Career

Section I of the survey form consisted of eleven questions. The questions could be subdivided into four categories. The categories concerned: alteration of courses previously taught, addition of new courses, changes in books and materials, and changes in the career of the teacher.

The responses to Section I were "no" or "yes." The affirmative response was graded into three classifications.
"Yes 1" classification was checked if attendance in the summer institute of 1959 was a major factor in the change that occurred. "Yes 2" was checked if institute attendance was of some influence, but was not the major factor. "Yes 3" was checked if a change had occurred, but institute attendance was of little or no influence.

Course content changes. Question one, which covered alteration of courses, was difficult to assess. Some did not complete any of the blanks while others checked more than one course. Alteration of a course covered a wide range. It included a small change in only one unit as well as a complete overhaul of the whole course.

Table II shows the results of the responses concerning the changes within some of the more common mathematics courses. Eighty-four per cent of the returns indicated they had altered algebra courses. Forty-two per cent stated institute participation was a major factor and another 37 per cent stated it was of some influence in the changes made.

Geometry courses were altered by 75 per cent of the people; 32 per cent showed the institute a major factor; 38 per cent checked it partially responsible.

Trigonometry was altered by 66 per cent; 23 per cent attributed the institute a major factor and 36 per cent checked it as being of some influence.

The response labeled "others" included all those who
### Table II

**Alteration of Course Content Reported as a Result of Participation in a Mathematics Institute in Iowa in Summer, 1959**

<table>
<thead>
<tr>
<th>Course</th>
<th>Number Responding</th>
<th>Major Influence</th>
<th>Some Influence</th>
<th>Little Influence</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Per</td>
<td>Cent</td>
<td>Number</td>
<td>Per</td>
</tr>
<tr>
<td>Algebra</td>
<td>101</td>
<td>42</td>
<td>41.6</td>
<td>37</td>
<td>36.6</td>
</tr>
<tr>
<td>Geometry</td>
<td>68</td>
<td>22</td>
<td>32.3</td>
<td>26</td>
<td>38.2</td>
</tr>
<tr>
<td>Trigonometry</td>
<td>47</td>
<td>11</td>
<td>23.4</td>
<td>17</td>
<td>36.2</td>
</tr>
<tr>
<td>Other</td>
<td>66</td>
<td>30</td>
<td>45.5</td>
<td>21</td>
<td>31.8</td>
</tr>
</tbody>
</table>
taught junior high courses, as well as the great variety of mathematics offered in high school other than those previously listed. In this group, 80 per cent had altered course content, 46 per cent attributed it directly to the institute, 32 per cent labeled it secondary.

This showed the greatest alteration having been made in algebra. Eighty-four per cent had altered algebra, 79 per cent indicated that institute participation was at least partially responsible. Possibly, the reason why others were less is that algebra, being a commonly offered subject, was probably taught by the greatest percentage of teachers. Trigonometry showed the least change and probably was taught by a fewer number of participants.

**Mathematics courses added to the curriculum.** Questions two, three, and four were concerned with the addition of mathematics courses to the curriculum and the relationship, if any, of the institutes to the additional courses. Of 139 returns, 135 responded to this question. As shown in Table III, 70 per cent of the respondents were in schools that had added courses in mathematics. The courses added and the frequency they occurred were as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra in 8th grade</td>
<td>15</td>
</tr>
<tr>
<td>Senior Math</td>
<td>15</td>
</tr>
<tr>
<td>Analytic Geometry</td>
<td>12</td>
</tr>
<tr>
<td>Junior High Geometry</td>
<td>8</td>
</tr>
<tr>
<td>School Mathematics Study Group Course</td>
<td>8</td>
</tr>
<tr>
<td>Advanced Algebra</td>
<td>6</td>
</tr>
<tr>
<td>Course</td>
<td>Frequency</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Math Analysis</td>
<td>5</td>
</tr>
<tr>
<td>Trigonometry</td>
<td>4</td>
</tr>
<tr>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td>Business Arithmetic</td>
<td>4</td>
</tr>
<tr>
<td>General Math</td>
<td>3</td>
</tr>
<tr>
<td>Modern Math for 7th and 8th</td>
<td>2</td>
</tr>
<tr>
<td>Accelerated Math - 8th grade</td>
<td>2</td>
</tr>
<tr>
<td>Statistics and Probability</td>
<td>2</td>
</tr>
<tr>
<td>Math I, II, III, IV</td>
<td>1</td>
</tr>
<tr>
<td>Modern Algebra</td>
<td>1</td>
</tr>
<tr>
<td>University of Illinois Committee on School Math</td>
<td>1</td>
</tr>
</tbody>
</table>

There was undoubtedly a certain amount of duplication in the courses as appear, because of the many topics that could be listed under a given title. Senior Math, for instance, could have included trigonometry, algebra, calculus, and others and be a college preparatory course. Senior Math could, however, be a last year refresher in the basic skills and business terms for those not planning to continue their education.

Questions three and four were related to question two and were often ignored by those who did not have an affirmative answer to the second question. Question three asked if the participant had any influence on the type of course added to the curriculum. The responses showed 61 per cent had some influence on the course added. Thirty-six per cent said institute attendance was a major factor and 16 per cent stated it was of some influence on their decision.

The results on question four, which asked if the person was an instructor in the added course, were somewhat similar.
### TABLE III

**Mathematics Courses Added to the Curriculum as a Result of Mathematics Institute Participation in Iowa in Summer, 1959**

<table>
<thead>
<tr>
<th>Course Added</th>
<th>Major Influence (Per Cent)</th>
<th>Some Influence (Per Cent)</th>
<th>Little Influence (Per Cent)</th>
<th>No Change (Per Cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses added since 1959</td>
<td>94 (69.6)</td>
<td>9 (41)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did you have any influence on the type of course added?</td>
<td>34 (35.8)</td>
<td>15 (15.8)</td>
<td>9 (9.5)</td>
<td>37 (38.9)</td>
</tr>
<tr>
<td>Are you an instructor in a course that has been added since 1959?</td>
<td>32 (26)</td>
<td>7 (5.7)</td>
<td>5 (4.1)</td>
<td>79 (64.2)</td>
</tr>
</tbody>
</table>

*Indicates responses not rated.*
These showed, 26 per cent considered institute attendance a major factor, and 6 per cent that it was a secondary influence on their being an instructor in an added course.

Changes in books and materials. The third category of Section I dealt with changes in books, library materials, models, and professional journals that occurred as a result of participation in a summer institute in Iowa in 1959. The responses are presented in Table IV.

Question five asked if there had been any textbook changes in the courses taught. In the response, 46 per cent had changes; 28 per cent said the institute was a major factor; and 13 per cent considered it a secondary influence.

Question six asked if there was available more library reference material for use in mathematics classes. The responses showed 86 per cent had more material; 48 per cent believed the institute a major factor and 29 per cent considered it secondary.

Question seven asked if there were more mathematical models available. Responses showed 68 per cent had more models; 31 per cent considered the institute a major factor, 29 per cent considered it a secondary influence.

Question eight asked if there were additional journals or other professional literature that the participant had obtained as a result of the institute. Responses showed 65 per cent had more, 29 per cent checked "Yes 1," and 23 per cent checked "Yes 2."
<table>
<thead>
<tr>
<th>Changed textbooks in courses taught</th>
<th>Number Responding</th>
<th>Major Influence</th>
<th>Some Influence</th>
<th>Little Influence</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>132</td>
<td>37</td>
<td>17</td>
<td>7</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28.</td>
<td>12.9</td>
<td>5.3</td>
<td>53.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>More mathematics library reference material</th>
<th>Number Responding</th>
<th>Major Influence</th>
<th>Some Influence</th>
<th>Little Influence</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>134</td>
<td>64</td>
<td>39</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.8</td>
<td>29.1</td>
<td>9</td>
<td>14.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>More mathematical models</th>
<th>Number Responding</th>
<th>Major Influence</th>
<th>Some Influence</th>
<th>Little Influence</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>134</td>
<td>41</td>
<td>39</td>
<td>11</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30.6</td>
<td>29.1</td>
<td>8.2</td>
<td>32.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional journals or other professional literature</th>
<th>Number Responding</th>
<th>Major Influence</th>
<th>Some Influence</th>
<th>Little Influence</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>134</td>
<td>39</td>
<td>31</td>
<td>17</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29.1</td>
<td>23.1</td>
<td>12.7</td>
<td>35.1</td>
</tr>
</tbody>
</table>
This category dealt with a by-product of the institutes and yet is of great importance for it showed how many participants were made aware of other things that implement the teaching of mathematics.

Changes that affected teachers. The questions in this category were an attempt to register some changes in the career of the teacher as a result of summer institute participation in Iowa in 1959. The results of the questions are presented in Table V.

Question nine asked if the participant had enrolled in any additional courses since the institute. The participant could indicate mathematics courses or other courses. In mathematics, 49 per cent had taken additional courses, 33 per cent showed the institute a major factor, 8 per cent showed it secondary. Correspondingly, on those that had checked "other," the figures were 27 per cent and 35 per cent, respectively.

Question ten asked the participants if their teaching load in the area of mathematics had increased. Only 9 per cent checked "Yes 1" and 2 per cent "Yes 2." This appeared to be a very small increase. However, of 111 who filled in the blank used to indicate teaching load, eighty-three, or 75 per cent, were teaching 100 per cent mathematics.

Question eleven asked if the participant had changed teaching positions. Responses indicated 21 per cent had changed positions, 8 per cent said institute a major factor, and 1 per cent said it was a secondary influence.
Addition to Knowledge

Section II of the form was a check list containing some areas of knowledge or teaching methods. These areas were chosen because they covered topics recommended by prominent groups in mathematics.

The areas were quite general and did not lend themselves to a critical evaluation. For instance, if an individual had learned the definition of a "set," he could consider himself more competent in modern terminology. It would not necessarily follow that he had proficient use of all the terms involved. If this individual had explained a set to his classes, he could legitimately have checked that he had applied it to his courses. This section did present a method to show those areas touched on most often and which ones were most often applied in course work. Table VI presents the responses to Section II.

Section II contains six general areas. The participants were to check "column 1" blank if they felt more competent in the area. They were to check "column 2" if, as a result of their summer institute, they had applied some of the topics in their own courses.

The first area was that of terminology of modern mathematical concepts such as sets, field, sentences, solution set, and function. As indicated in Table V, 85 per cent felt more competent in this area and 64 per cent had used it in their courses.
Second was the area of deductive reasoning in deriving formulas and theorems in all mathematics courses. In this area, 60 per cent felt more competent, 47 per cent had applied it in courses.

Third was the area of the number system, distinguishing between properties of the natural numbers, integers, rational, reals, and complex numbers. Responses showed 78 per cent felt more competent with 58 per cent having applied in their own classes.

Fourth was the related area of real numbers to bases different than ten. Responses were very similar to the third, 75 per cent felt more competent, 60 per cent said this had been used in their classes.

Next was the area of motivation devices; that is, famous problems of past and present, mathematical models, magic squares, et cetera. Returns showed 47 per cent felt more competent and 46 per cent applied some of these devices in classes.

Last was the area of statistics and probability, and the related area of computing machines. In this area, 46 per cent felt more competent, but only 26 per cent applied it in courses. Responses in these areas showed the greatest percentages along the lines of modern mathematics and more rigorous treatment. Although there have been many recommendations by various study groups, these were common to all.
<table>
<thead>
<tr>
<th></th>
<th>Number Responding</th>
<th>Influence of Mathematics Institute Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Num-</td>
<td>Per</td>
</tr>
<tr>
<td></td>
<td>ber</td>
<td>Cent</td>
</tr>
<tr>
<td>Additional courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>since institute:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>120</td>
<td>40</td>
</tr>
<tr>
<td>Other</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>Has mathematics teaching load increased?</td>
<td>128</td>
<td>11</td>
</tr>
<tr>
<td>Have you changed teaching position?</td>
<td>136</td>
<td>11</td>
</tr>
<tr>
<td>Description</td>
<td>More Competent</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>----------------</td>
<td>---</td>
</tr>
<tr>
<td>The area of terminology of modern mathematical concepts such as, sets, field, sentences, solution set, junction</td>
<td>118 85</td>
<td></td>
</tr>
<tr>
<td>The area of deductive reasoning in deriving formulas and theorems in all math courses</td>
<td>84 60</td>
<td></td>
</tr>
<tr>
<td>The area of the number system, distinguishing between properties of the natural numbers, integers, rational, reals, and complex numbers</td>
<td>108 78</td>
<td></td>
</tr>
<tr>
<td>The area of real numbers to bases different than ten</td>
<td>104 75</td>
<td></td>
</tr>
<tr>
<td>The area of motivation devices; that is, famous problems of the past and present, mathematical models, magic squares, etc cetera</td>
<td>68 49</td>
<td></td>
</tr>
<tr>
<td>The area of statistics and probability, and the related area of computing machines</td>
<td>64 46</td>
<td></td>
</tr>
</tbody>
</table>
Course Change Descriptions

Section III of the form was simply an open statement. It was to allow the participants to tell some of the things they were doing differently in course work as a result of summer institute attendance. The statement was as follows: "If you have altered course content and could list some or all such changes, you may do so here." Many of the respondents left this section blank. Some made a short descriptive statement such as "use more modern terminology." Others had more lengthy statements and described several things that they had done to revise their courses. For the sake of brevity, these responses have been classified as follows:

<table>
<thead>
<tr>
<th>Type of Response</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study number properties and numbers to other bases</td>
<td>23</td>
</tr>
<tr>
<td>Modernized approach or terminology</td>
<td>21</td>
</tr>
<tr>
<td>Have added or stress more inequalities</td>
<td>19</td>
</tr>
<tr>
<td>More concise use of definitions and axioms</td>
<td>18</td>
</tr>
<tr>
<td>Have used some set approach</td>
<td>16</td>
</tr>
<tr>
<td>Increased use of functions</td>
<td>11</td>
</tr>
<tr>
<td>Use associative, commutative, et cetera, laws</td>
<td>9</td>
</tr>
<tr>
<td>Have added School Mathematics Study Group materials</td>
<td>9</td>
</tr>
<tr>
<td>Changed plane geometry to plane and solid geometry</td>
<td>8</td>
</tr>
<tr>
<td>Added unit on logic</td>
<td>5</td>
</tr>
<tr>
<td>Do more graphing</td>
<td>5</td>
</tr>
<tr>
<td>Added more advanced topics or accelerated courses</td>
<td>5</td>
</tr>
<tr>
<td>Modernized algebra courses</td>
<td>4</td>
</tr>
<tr>
<td>Added statistics</td>
<td>4</td>
</tr>
<tr>
<td>Used units from University of Illinois Committee on School Mathematics</td>
<td>2</td>
</tr>
</tbody>
</table>

There were other responses that were difficult to classify, such as the reorganization or fusion of different courses. Several people also mentioned that they could not
get administrative approval to change textbooks and make other changes they felt desirable. One stated, "My superintendent feels our program is successful now and can see no reason to change it." Another stated, "Ours is a large system. Our program and materials are controlled and will change very slowly, if at all." A third said, "The head of the math department retires in a few years. He doesn't want to take the trouble to re-educate himself."

**Comments on Institute Program**

Section IV was another open question that invited the participants to give their opinion of the effectiveness of the institute program. On some of the returns this section was blank. Many had only one or two word comments such as "good" or "very effective." On some forms the space was filled and continued on the back. It was necessary to make some judgment and classification of the comments.

None of the comments stated the summer institute program was ineffective. One could say the critical comments were "qualified good." First, each comment was placed into one of two categories: "good or excellent," and "qualified good." The rating was as follows: Good or excellent--110, and qualified good--13. The comments were then classified so as to obtain some kind of tabulation. The type of comment and the frequency it appears is as follows:
<table>
<thead>
<tr>
<th>Type of Comment</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good for introduction or refresher in modern mathematics</td>
<td>32</td>
</tr>
<tr>
<td>Questioned selection of participants and selection of courses</td>
<td>9</td>
</tr>
<tr>
<td>Liked contacts, observations and demonstrations</td>
<td>4</td>
</tr>
<tr>
<td>Good--felt it would be more effective if extended to three or four summers</td>
<td>4</td>
</tr>
<tr>
<td>Good--would like to see more done on junior high level</td>
<td>4</td>
</tr>
<tr>
<td>Have used the materials developed and distributed in institute</td>
<td>4</td>
</tr>
<tr>
<td>Questioned modern mathematics</td>
<td>2</td>
</tr>
<tr>
<td>Felt bewildered in modern mathematics</td>
<td>2</td>
</tr>
<tr>
<td>Would like to see more actual demonstration of modern mathematics</td>
<td>2</td>
</tr>
<tr>
<td>Too difficult for inadequate backgrounds</td>
<td>2</td>
</tr>
<tr>
<td>Did not comment</td>
<td>15</td>
</tr>
</tbody>
</table>

Comments were favorable by great majority. Many were highly enthusiastic about being introduced to new concepts in mathematics. Others felt they received great benefit from the formal and informal discussions and demonstrations about methods of teaching. The most frequent comment indicated that the participant appreciated the opportunity to study modern mathematics. Nine people felt host schools should have been careful to provide a more homogeneous grouping of participants. Fifteen people did not respond to Section IV. Other comments were too varied to classify.

Several people with weak backgrounds in mathematics said they felt much more competent in the field. A few had gone to other institutes or received Academic Year grants and felt the summer institute had prepared them for greater achievement in their studies.

None of the returns stated the institute was of no value. Those that were critical usually used wording such as
"Effective, but . . ." or "would have been more effective if . . ." or "was good for most participants . . .," and then would give reasons why they did not benefit fully from the institute.

The criticism was not of the institute program or of quality of instruction. The most common complaint was that the courses in the institute did not apply to the needs of this individual. Some junior high people were assigned to advanced courses that had no bearing on the level they were teaching. Several commented that they, with weak backgrounds, were asked to compete with people having strong backgrounds.

Courses in modern mathematics bewildered a few people and a few more did not feel the modern courses would be as effective as traditional. Some responses went into local situations that blocked the adoption of modern courses in the curriculum.
CHAPTER III

SUMMARY AND CONCLUSIONS

In the summer of 1959, four schools in Iowa were hosts to Summer Mathematics Institutes. The four schools were: Drake University, Iowa State University, State College of Iowa, and State University of Iowa.

It was the purpose of this study to investigate the effects of these Summer Institute programs on the participants. The effects were to be shown by change in courses and course content, addition or change in teaching materials and tools, knowledge gain, completion of additional courses, and change of teaching load or position.

Each of the four institutions were contacted and each supplied a list of participants with addresses and a description of the institute program presented. A questionnaire was designed and sent to each of the participants of the four institutes. The number of participants and forms returned were as follows: Drake University--55 participants, 42 responses; Iowa State University--29 participants, 19 responses; State College of Iowa--36 participants, 31 responses; State University of Iowa--61 participants, 47 responses; total of 181 participants, 139 responses.

The Institute programs of the four schools were quite varied. The range of teaching levels selected was from junior high to college level. The courses offered were designed to
meet a variety of needs.

I. SUMMARY

Recommendations of Study Groups in Mathematics

Groups had been evaluating the mathematics education process for several years. The University of Illinois Committee of School Mathematics, the School Mathematics Study Group, and the Commission of Mathematics were prominent groups that published recommended changes to be made in mathematics education.

These recommendations were varied but contained some common items. They generally agreed there should be modernization, acceleration, more emphasis on structure and less on drill.

Aim of Summer Institute. The National Science Foundation did not specify that universities and colleges that received grants present courses in modern mathematics. The Foundation did approve many programs with modern courses.

The basic aim of the summer institutes was to improve instruction of mathematics in the nation's schools. To do this, the institutes needed to remedy several types of deficiencies:

1. The experienced teacher who needed refresher courses.
2. The teacher who was "filling a gap" with an inadequate background in mathematics.
3. The teacher who was to teach advanced courses that were beyond his previously adequate background.
4. The teacher who was unaware of developments in modern

Results of Questionnaire

Responses indicated that the summer institute had been successful in these areas. The results that follow were condensed from tables in the previous chapter and illustrate the effect of institute participation in several areas.

Changes that occurred in course content: Algebra--78 per cent, Geometry--70 per cent, Trigonometry--60 per cent, other--77 per cent.

Material changes were as follows: Textbook change--41 per cent, more mathematics library material--77 per cent, more mathematical models--60 per cent, additional journals or other professional literature--52 per cent.

Forty-two per cent had enrolled in additional mathematics courses, 11 per cent had an increased mathematics teaching load, and 10 per cent had changed teaching position.

One section was a check list so teachers could indicate areas in which knowledge was increased. As many as 86 per cent felt more competent in the field of modern terminology, and the fewest, 46 per cent, knew more about statistics.

The most common course alterations were: addition of units on number properties and number systems to other bases, change to modern mathematics approach, more rigorous treatment of axioms and definitions, inequalities, set theory, and more work in functions. There were others listed but the frequency of occurrence was less.
An open section invited institute attendees to comment on their institute, and institute programs generally. The returns showed 123 comments. Of the comments, 110 could be classified as favorable with little or no reservations. Thirteen people had reservations, but felt the programs were good. The critical responses were as follows: applicants were not put in courses closely related to the level they were teaching; courses were too difficult; mistakes in grouping participants caused unfair competition; too much emphasis on modern mathematics, and vice versa.

II. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The purpose of the study was to investigate effects of summer institute participation on a selected group. Effects were to be indicated by changes in content of courses taught, changes and addition of books and materials, self-improvement by additional education or professional literature, changes of teaching load or position, or increase in knowledge of mathematics.

Responses indicated that institute participation had:
1. influenced many to alter courses or add new courses,
2. been a factor in change of textbooks and procurement of additional models and materials,
3. influenced more than one-third of the participants to take additional college courses,
4. given participants a broader knowledge about topics, concepts, and terms of modern mathematics,
5. aroused enthusiasm for the institute programs and the
courses offered by host institutions.

Recommendations

To accomplish the aim of the National Science Foundation
to facilitate the teaching of mathematics in the public schools,
it is recommended:

1. The Summer Institute program should be continued.

2. Teachers and institutions should be very selective to
   match the type of program to the need of the teacher.

3. School administration and public need to be advised of
   changes in mathematics.

4. Modern mathematics should be extended into the educa-
   tion curriculum for elementary teachers.

5. Institute programs should have more demonstration classes
   showing application of teaching of modern mathematics.

Some topics touched upon by this study could be developed
into further studies. The area of modern mathematics and the
changes occurring in mathematics education are attractive topics
for investigation and evaluation.
BIBLIOGRAPHY


State University of Iowa. Description of Courses in NSF Summer Institute for Teachers of High School Mathematics. Iowa City, Iowa: State University of Iowa, Summer, 1959.

A FOLLOW-UP OF PARTICIPANTS IN MATHEMATICS SUMMER INSTITUTE PROGRAMS HELD IN IOWA IN 1959

In recent years the Federal Government, through the National Science Foundation, has sponsored a number of programs to further the teaching of mathematics. This questionnaire has been sent to the participants in the four summer Mathematics Institute programs presented in Iowa in 1959. The purpose of the study is to tabulate some of the changes that have resulted from the program.

NAME: ___________________________ SCHOOL: ______________

SCHOOL ENROLLMENT (Complete one)
Secondary 9-12 _____ or 10-12 _____
Jr. High 7-9 _____ or 7-8 _____

TOTAL ENROLLMENT IN MATHEMATICS COURSES ______

Section I

Instructions: In this section, the questions are to be answered "Yes" or "No." Some "Yes" answers are followed by blanks with ratings of 1, 2, or 3; 1 being designated if participation in the Institute was of prime importance, 2 if it was not a major factor but did have some influence, and 3 if it had little or no significance. The following questions refer to your teaching and changes that have taken place since your participation in the Mathematics Institute.

1. Have you altered course content in the mathematics courses you teach?

   Algebra
   Geometry
   Trigonometry
   Others

   Yes 1 2 3
   No 1 2 3
   No 1 2 3
   No 1 2 3
   No 1 2 3
2. Has your school added any mathematics courses since 1959? If yes what course or courses? No _ Yes _

3. If new mathematics courses were added, did you have any influence on the type of course selected? No _ Yes 1 2 3 _

4. Are you an instructor in a course that has been added to the curriculum since 1959? No _ Yes 1 2 3 _

5. Have you changed textbooks in any of the mathematics courses you teach? No _ Yes 1 2 3 _

6. Do you have available more library reference material for use in mathematics classes? No _ Yes 1 2 3 _

7. Do you have available more mathematical models? No _ Yes 1 2 3 _

8. Do you have available additional journals or other professional literature? No _ Yes 1 2 3 _

9. Have you enrolled in any additional courses since the institute? If Yes: Math ____ Other ____ No _ Yes 1 2 3 _

10. Has the percentage of your teaching load in the area of mathematics increased? No _ Yes 1 2 3 _

11. Have you changed teaching positions? No _ Yes 1 2 3 _

Section II

Instructions: In the first column, check the areas of mathematics in which you feel more competent, and in the second column check the areas that you have adapted to your own courses; both as a
result of your summer institute.

The area of terminology of modern mathematical concepts such as, sets, field, sentences, solution set, function.

The area of deductive reasoning in deriving formulas and theorems in all math courses.

The area of the number system, distinguishing between properties of the natural numbers, integers, rational, reals, and complex numbers.

The area of real numbers to bases different than ten.

The area of motivation devices; that is, famous problems of the past and present, mathematical models, magic squares, et cetera.

The area of statistics and probability, and the related area of computing machines.

Section III
If you have altered course content and could list some or all such changes, you may do so here.

Section IV
You are invited to give your opinion of the effectiveness of the institute programs.
Dear Fellow-teacher:

I have not received the questionnaire I sent you concerning your participation in a Summer Institute in 1959. I realize your time is limited, but the more returns I receive, the more complete and accurate my study will be.

This is a request for your special consideration. Please check the questionnaire and return it promptly. At this point a Master of Science in Education depends upon your help. Believe me, such help is appreciated.

Sincerely yours,

/s/ Floyd Lancaster