BENEFITS DERIVED FROM PARTICIPATION IN THE DRAKE NATIONAL SCIENCE FOUNDATION SUMMER MATHEMATICS INSTITUTES, 1962, 1965

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Master of Science in Education

by
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CHAPTER I

THE PROBLEM AND STUDY PROCEDURE

This study was undertaken to determine (1) which of selected beneficial characteristics in the teaching of secondary mathematics were included in the Drake National Science Foundation (NSF) Mathematics Summer Institutes of 1962 and 1965, (2) the opinions of participants regarding self-improvement in each characteristic through attendance and participation in the institutes, and (3) an over-all comparison of the two sessions in regard to these characteristics.

The primary sources in this study were the 103 participants of the NSF Summer Institutes for Secondary Mathematics Teachers for the years 1962 and 1965 at Drake University, Des Moines, Iowa. The institutes were designed to help re-educate the participants who were classroom teachers in mathematics, and toward this end the following objectives were determined. In 1962, the institute aimed:

1. to upgrade the mathematical experience of each participant, and in the case of the less prepared participants, to enable them to reach a level sufficient to continue in Institute Programs leading to advanced degrees,

2. to acquaint the teacher with mathematical topics beyond the level that he teaches, in order that he may teach at his level more effectively, and
3. to permit interchange of ideas concerning methods and materials between the participants.  

The 1965 Institute had as its over-all objective "to contribute in the participants' improved effectiveness of instruction in mathematics."  

Specific objectives of the 1965 Institute were to accomplish each of the following for each participant:

1. Strengthen his understandings of mathematical procedures, particularly the postulational method.

2. Better his understanding of the concepts currently being taught in "modern mathematics."

3. Broaden his understanding of the wide range of applications of mathematics.

4. Bring him an awareness of materials and techniques used by fellow high school teachers of mathematics.

The participants of the 1962 session were divided into two groupings. Those who were less prepared in collegiate mathematics were given the course "Fundamentals of College Mathematics through Calculus," and those with more advanced backgrounds had two courses, "Advanced Calculus" and "Point Set Theory." Both groups met in an afternoon session in which discussions for classroom enrichment material were given by panels made up of the Institute participants.

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1 Statement by Dr. Basil E. Gillam in a letter to the writer on October 30, 1967.

2 Ibid.  

3 Ibid.
The participants of the 1965 session were chosen for a program which required at least an undergraduate minor in mathematics and little or no graduate mathematics. Four courses were offered and each participant enrolled in two of those courses according to his need and preference. The courses were "Introduction to Mathematical Statistics," an undergraduate credit course; "Modern Geometry," which was based on Euclidean Geometry, geometry of four dimensions, and plane hyperbolic geometry and which was offered for graduate credit; "Modern Algebra," a graduate credit course in matrices, determinants, and abstract systems; and "History of Mathematics," a graduate credit course covering the development of mathematics from Greek, Babylonian, and Hindu times through the current transition to Modern Mathematics. All of the participants in the 1965 session also took part in "Institute Hour" discussions in which panels of three or four institute participants presented various topics of mathematics not usually studied in standard high school mathematics. Review sessions of mathematics through Calculus which required no preparation and which were optional to the participants were offered on a none credit basis.

The participants selected to attend these institutes consisted of both men and women secondary mathematics
teachers who had had a minimum of two years of actual teaching experience and who had been teachers during the school term immediately preceding the summer in which they attended the institute. These teachers resided in various places throughout the United States. Some of the participants attended both the 1962 and 1965 sessions, and in such cases they were considered as two participants. The writer, a participant in both sessions, was excluded from the study. A questionnaire was mailed to each participant in each of the institutes, requesting him to indicate, in his opinion, benefits in selected desirable characteristics of secondary mathematics teachers which he gained through his attendance and participation in the institute. Those participants who attended both summer institutes received a questionnaire for each session. The items on the questionnaire were formulated from the objectives of the institutes as they related to student benefits and from the past teaching and learning experience of the writer. For each item, the respondent could indicate one of three responses: (1) very much, (2) some, or (3) little or none; and he was requested to choose the response which he felt best described in his opinion the benefits he received from his attendance and participation in the institute. To insure its validity the questionnaire used was first approved by Bruce Vennard, the graduate project
advisor; Basil E. Gillam, mathematics instructor at Drake University and director for both institutes; and J. B. Hoffert, mathematics instructor at Drake University and an instructor at both institutes.

Material from secondary sources which consisted of books and periodicals was used in a reviewing of the background literature of the institutes to determine how and when such institutes originated and why they were established. This study was then made to determine whether those institutes at Drake University did accomplish their purpose in the opinions of their participants.

From the questionnaires that were returned, an analysis was made to determine which of the selected beneficial characteristics in the teaching of secondary mathematics were included in each of the institutes in the opinions of the participants as based on the summary of the results. These results were given as the per cent of responses "very much" and "some" made for each item based on the total number of returned questionnaires for each institute. The responses for each characteristic of self-improvement was given individual consideration, too, and a summary made of the per cent of each response made for each item for each institute and based on the total number of returned questionnaires for each institute. Finally, an over-all comparison was made between the two sessions
based on the per cent of each response made for each characteristic of self-improvement.

It is recognized that the information from this study was based only on the opinions of the participants and might deviate somewhat from their actual benefits. However, it is felt that more constructive use in the teaching of mathematics can be made from those benefits which the participants were actually aware of having received.
CHAPTER II

REVIEW OF THE LITERATURE

Due to tremendous advances in mathematical research, automation, and automatic digital computing machines in present times, changes in mathematics have occurred that "are so extensive, so far reaching in their implications, and so profound that they can be described only as a revolution."¹ In fact, the twentieth century may be called "the golden age of mathematics, since more mathematics, and more profound mathematics has been created in this period than during all the rest of history."² This revolution has required a change in the teaching of mathematics in the schools.³

Modern mathematics, the resulting outgrowth of this change, consists of the teaching of mathematics as an integrated, dynamic, conceptual structure built on a foundation of basic concepts or assumptions from which additional conceptual notions are derived. This is opposed to the traditional method of teaching mathematics as an applied

²Ibid., p. 1. ³Ibid., p. 5.
set of rules learned by rote memory. Rather than presenting a group of isolated and unrelated topics with emphasis on operational skills, a recognized weakness in the past teaching of mathematics, the new mathematics program consists of a system of ideas integrated by fundamental concepts.\textsuperscript{1} The origin for this new approach might have begun with the creation of non-Euclidean geometry which provided for the rejection of sensual evidence in order to allow intelligent minds more freedom for the production of ideas.\textsuperscript{2} Postulates and axioms are no longer considered "self-evident truths," but are considered "acceptable assumptions" and may be contradictory between different mathematics.\textsuperscript{3} The new method demands that a definite distinction be made between defined terms and terms which must remain undefined due to the necessity of defining terms and concepts through the use of other terms and concepts.\textsuperscript{4}

If this new method of teaching mathematics was to be accomplished in the schools, it was only too evident that the focal point of its success would have to be the

\begin{enumerate}
\item \textit{Ibid.}, p. 56.
\item \textit{Ibid.}
\end{enumerate}
teacher. It became apparent that the major problem in changing the methods of high school teaching of mathematics was the reeducation of present teachers. Since the removal of good teachers from their classrooms would be unwise, it was decided that this training would preferably be received in summer programs and evening and Saturday in-service programs. These teachers already possessed knowledge of teaching methods in general, but since no teacher can teach that which he does not know, the programs needed to provide background material in modern collegiate subject matter and in the up-grading of the subject matter they were currently teaching.

To help prepare the teachers toward this end, funds were set up for a mathematics education program sponsored by the National Science Foundation (NSF), a federal agency established in 1950 by an act of Congress for the support of research and education through grants, fellowships, and other similar means, and described by the late Congressman


2Ibid., p. 172.  

3Ibid., pp. 169, 172.

Albert Thomas as "this country's first venture into government support of science for the sake of science."\(^1\) The founding fathers of the NSF believed that to realize fully the country's potential "we must make sure that those who are scientifically trained have the opportunity to work and to do whatever may be necessary to assure a sufficient supply of scientific workers who have had adequate training,"\(^2\) and the institute program was established to help further that objective.\(^3\) The program was specifically established by the Division of Scientific Personnel and Education which included an Institutes Section within its structure,\(^4\) and provided for summer institutes in mathematics through the services of universities and their mathematics departments.

The first institute in mathematics was held in the summer of 1953, at the University of Colorado and offered courses to qualified teacher participants. It was designed for college teachers of mathematics and was directed by

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\(^1\)"Albert Thomas: Late Congressman Who Supervised NSF Budget Had Witty Views on Science and Politics,"\(^5\) *Science*, CLI (March 4, 1966), 1065.


\(^3\)*Ibid.*.

Bernard W. Jones. Then in 1954, there were three summer institutes in mathematics sponsored by NSF; two of these were for college teachers and one was for high school teachers, the first of its kind and located at the University of Washington. By 1962, there were 118 summer institutes offered in the field of mathematics. Thus institute support tended to move downward in the educational hierarchy from college teachers to secondary teachers, and eventually it extended all the way to elementary teachers.

In these institutes NSF grants covered tuitions and fees, stipends of not more than seventy-five dollars a week, allowances for travel and allotments for dependents up to four. Sponsoring institutions selected the candidates and applications were made to them. A typical summer institute consisted of fifty students with sessions of six-to-eight weeks in length.

Programs in these first institutes in all probability were considerably influenced by earlier related

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1George G. Mallinson, Dean, "The Summer Institute Program of the National Science Foundation," School Science and Mathematics, LXIII (February, 1963), 96.

2Ibid.


4Mallinson, op. cit., p. 100. 5Ibid., p. 98.
efforts that had been undertaken by the General Electric Company, by a Division of Chemical Education of the American Chemical Society, and by other organizations,¹ but as time went on the extension of the institute programs became consistent with the needs both in size and purpose. From 1953 until 1957, support was offered for able teachers in mathematics who needed updating. Then in 1957 and 1958, it was extended to able teachers who needed additional subject matter to improve their competence; and in 1959, to less able teachers who needed basic subject matter to achieve adequacy.² Thus it seemed that support for the early institutes was based chiefly on the assumption that there were many highly-qualified teachers in both colleges and secondary schools in the United States who could profit from programs designed to update their training in mathematics,³ and it was not until 1959 that support was also given for the "vast numbers of unqualified teachers in mathematics throughout the United States who could also profit from NSF assistance." Although several such proposals were made prior to 1959, generally they were not approved.⁴

¹Ibid., p. 96.  ²Ibid.  ³"Brief Reports: NSF Summer Institutes," loc. cit.  ⁴Wallinson, op. cit., p. 96.
The major purpose of these institutes was to update the backgrounds of mathematics teachers, and courses were "designed to renew the teacher's knowledge of fundamentals, acquaint him with recent developments, and familiarize him with new ways of presenting subject matter." These courses were to be intensive, including lectures, demonstrations, discussion sessions, laboratory work, and homework. The programs were also to provide for the interchanging of ideas concerning methods and materials between the participants. College credit would be offered in many of the programs, 95 per cent did in 1962, and in many cases the participant would be able to obtain credit toward a higher degree.

Regarding the work being done in such programs, a statement by a high-level administrator in the Office of Education typifies the attitude of many persons toward the summer institute programs of the NSF. He said, "Without regard for the ultimate merit of these institute programs, no other single activity has ever had a greater impact on

1Ibid., p. 96.
2"Brief Reports: NSF Summer Institutes," loc. cit.
3Ibid.
4Hallinson, op. cit., p. 100.
5"NSF In-Service Institutes in Science and Mathematics," School Science and Mathematics, LXVI (June, 1966), 577.
American education."\(^{1}\) And after making informal visits to a number of institute programs, George G. Mallinson, Dean of the School of Graduate Studies at Western Michigan University, Kalamazoo, Michigan, who was intimately aware of these programs from the beginning and who has directed many of them since 1957, wrote that he was convinced that:

They accomplished a great deal of good, demanded a level of effort from the participants consistent with that expected of graduate students and, in general, provided kinds of opportunities to which graduate schools have frequently "turned their backs."\(^{2}\)

Indications are that the institute programs are likely to continue throughout the foreseeable future. One reason is that because of the population's growth, the college-age group stabilizing occupationally will remain smaller than the group to be served,\(^{3}\) and another factor is that projections prepared by NSF indicate that in 1968, a secondary-school student is as likely to meet with an inadequately prepared teacher as he was in 1963.\(^{4}\) With this prognosis, it would seem appropriate that studies such as this should be made of the past institute sessions to determine whether or not they are accomplishing their purpose in the opinions of the teachers for whose benefit they were established.

\(^{1}\)Mallinson, op. cit., p. 95.
\(^{2}\)Ibid., pp. 102-3.  \(^{3}\)Ibid., p. 103.
\(^{4}\)Ibid.
CHAPTER III

THE QUESTIONNAIRE RESULTS

From the over-all objectives of the 1962 and 1965 NSF Summer Mathematics Institutes at Drake University, a list of characteristics which might be considered desirable in a secondary mathematics teacher was formulated into a questionnaire, and that questionnaire was mailed to the 103 participants of the institutes excluding the writer. There were fifty-three participants in the 1962 institute and fifty-two participants in the 1965 institute; the writer was a participant of both sessions. Fourteen items were included on the questionnaire, and they were as follows: (1) strengthened understanding of mathematical procedures, (2) bettered understanding of the concept of "modern mathematics," (3) broadened understanding of wide range of applications of mathematics, (4) increased background collegiate mathematical knowledge, (5) increased background knowledge in teaching assignment material, (6) developed larger vocabulary and understanding of mathematical symbolism and terminology, (7) provided new material for supplementary enrichment in classroom teaching, (8) gained new methods and materials for increasing student motivation in the classroom, (9) refreshed interest in mathematics,
(10) increased motivation toward further academic study in mathematics, (11) developed more self-confidence in teaching mathematics, (12) contributed toward a fresh and improved point of view toward the teaching of mathematics, (13) increased enthusiasm for teaching mathematics, and (14) renewed appreciation of what it is like to be a student. For each item, the respondent could indicate one of three responses: (1) very much, (2) some, or (3) little or none. He was requested to choose the response which he felt best described in his opinion the benefits he received from his attendance and participation in the institute. Those participants who attended both institutes received a questionnaire for each session.

From the 103 questionnaires mailed, ninety-eight were returned, forty-nine from the 1962 institute participants and forty-nine from the 1965 institute participants. This represented a 95.1 per cent over-all return, 94.2 per cent for 1962 and 96.1 per cent for 1965.

Of the fourteen characteristics included on the questionnaire, the majority of the participants in each institute felt that they had gained self-improvement in every characteristic with the percentage ranging from a minimum of 77.6 per cent expressing at least some improvement in an individual item up to a maximum of 100 per cent indicating self-improvement for an individual item.
The responses for each item in each of the institutes according to the per cent of returns indicating each response are given in the following paragraphs.

For the first item, "strengthened understanding of mathematical procedure," the 1962 returns showed that 46.9 per cent indicated very much improvement, 49.0 per cent indicated some improvement, and 4.1 per cent indicated little or no improvement. For 1965, 20.4 per cent indicated very much improvement, 75.5 per cent indicated some improvement, and 4.1 per cent indicated little or no improvement.

Item two was "bettered understanding of the concept of 'modern mathematics." For 1962, 38.3 per cent indicated very much, 55.1 per cent indicated some, and 6.1 per cent indicated little or none; and for 1965, 34.7 per cent indicated very much, 49.0 per cent indicated some, 14.3 per cent indicated little or none, and 2.0 per cent did not indicate any response.

For "broadened understanding of wide range of applications of mathematics," the 1962 responses were 4.1 per cent "very much," 73.5 per cent "some," and 22.4 per cent "little or none." The 1965 responses were 28.6 per cent "very much," 59.2 per cent "some," and 12.2 per cent "little or none."
"Increased background collegiate mathematical knowledge" was item four. The responses for 1962 were 51.0 per cent "very much," 42.9 per cent "some," 4.1 per cent "little or none," and 2.0 per cent no response. For 1965, 42.9 per cent responded "very much," 57.1 per cent responded "some," and none indicated little or no improvement.

The fifth item was "increased background knowledge in teaching assignment material." The responses for 1962 were 35.7 per cent "very much," 51.0 per cent "some," and 12.2 per cent "little or none." The responses for 1965 were 12.2 per cent "very much," 67.3 per cent "some," and 20.4 per cent "little or none."

The sixth item was "developed larger vocabulary and understanding of mathematical symbolism and terminology." For 1962, 40.8 per cent indicated very much improvement, 55.1 per cent indicated some improvement, and 4.1 per cent indicated little or no improvement. For 1965, 42.9 per cent indicated very much improvement, 46.9 per cent indicated some improvement, 8.2 per cent indicated little or no improvement, and 2 per cent did not indicate any response.

"Provided new material for supplement enrichment in classroom teaching" was the seventh item on the questionnaire. The responses for 1962 were 32.7 per cent "very much,"
61.2 per cent "some," and 6.1 per cent "little or none."
The responses for 1965 were 51.0 per cent "very much,"
40.8 per cent "some," and 8.2 per cent "little or none."

Item eight was "gained new methods and materials for
increasing student motivation in the classroom." The 1962
responses were 16.3 per cent "very much," 63.3 per cent
"some," and 20.4 per cent "little or none." The 1965
responses were 20.4 per cent "very much," 57.1 per cent
"some," and 22.4 per cent "little or none."

The next item was "refreshed interest in mathem-
atics." The 1962 returns showed that 42.9 per cent
indicated very much improvement, 46.9 per cent indicated
some improvement, and 10.2 per cent indicated little or
no improvement. The 1965 returns showed that 40.8 per cent
indicated very much improvement, 55.1 per cent indicated
some improvement, and 4.1 per cent indicated little or no
improvement.

Item ten was "increased motivation toward further
academic study in mathematics." The 1962 responses for
this item were 44.9 per cent "very much," 36.7 per cent
"some," and 18.4 per cent "little or none." The 1965
returns for this item were 28.6 per cent "very much,
55.1 per cent "some," and 16.3 per cent "little or none."

The eleventh item was "developed more self-confi-
dence in teaching mathematics." For 1962, 30.6 per cent
indicated very much improvement, 61.2 per cent indicated some improvement, and 8.2 per cent indicated little or no improvement. For 1965, 30.6 per cent indicated very much improvement, 55.1 per cent indicated some improvement, and 14.3 per cent indicated little or no improvement.

Next was the twelfth item, "contributed toward a fresh and improved point of view toward the teaching of mathematics." The 1962 responses were 38.8 per cent "very much," 46.9 per cent "some," 12.2 per cent "little or none," and 2.0 per cent no response. The 1965 responses were 28.6 per cent "very much," 55.1 per cent "some," and 16.3 per cent "little or none."

"Increased enthusiasm for teaching mathematics" was the thirteenth item. For this item the 1962 responses were 34.7 per cent "very much," 51.0 per cent "some," and 14.3 per cent "little or none." The 1965 responses were 28.6 per cent "very much," 63.3 per cent "some," and 8.2 per cent "little or none."

The last item was "renewed appreciation of what it is like to be a student." For 1962, 61.2 per cent indicated "very much," 30.6 per cent indicated "some," and 8.2 per cent indicated "little or none." For 1965, 71.4 per cent indicated "very much," 28.6 per cent indicated "some," and none indicated "little or none."
The items which the 1962 respondents indicated they had received the most improvement in were "renewed appreciation of what it is like to be a student" for which 91.8 per cent indicated they had received at least some improvement and 61.2 per cent indicated they had received very much improvement, "increased background collegiate mathematical knowledge" for which 93.9 per cent indicated some or more improvement and 51.0 per cent indicated very much improvement, and "strengthened understanding of mathematical procedures" for which 95.9 per cent indicated at least some improvement and 46.9 per cent indicated very much improvement. Those items which received the least number of improvement responses for the 1962 institute were "broadened understanding of wide range of applications of mathematics" for which 77.6 per cent of the respondents indicated at least some improvement and 4.1 per cent indicated very much improvement, and "gained new methods and materials for increasing student motivation in the classroom" for which 79.6 per cent of the respondents indicated at least some improvement and 16.3 per cent indicated very much improvement.

In 1965, the same items were indicated as in 1962 for those in which the most improvement was felt and in addition one other which was "refreshed interest in
mathematics." The percentages for 1965 in each of these items were as follows. For "renewed appreciation of what it is like to be a student," 100 per cent indicated at least some improvement and 71.4 per cent indicated very much improvement. For "increased background collegiate mathematical knowledge," 100 per cent also indicated at least some improvement and 42.9 per cent indicated very much improvement. For "refreshed interest in mathematics," 95.9 per cent indicated at least some improvement and 40.8 per cent indicated very much improvement. And lastly, for "strengthened understanding of mathematical procedure," 95.9 per cent indicated at least some improvement and 20.4 per cent indicated very much improvement. Those items which the 1965 participants indicated as having received the least improvement in were "gained new methods and materials for increasing student motivation in the classroom" which was also indicated in 1962 and "increased background knowledge in teaching assignment material." For "gained new methods and materials for increasing student motivation in the classroom," 77.6 per cent indicated at least some improvement and 20.4 per cent indicated very much improvement. For "increased background knowledge in teaching assignment material," 79.6 per cent indicated at least some improvement and 12.2 per cent indicated very much improvement.
It is interesting to note that for all the responses made for the 1962 institute, 37.2 per cent were "very much," 51.7 per cent were "some," 10.8 per cent were "little or none," and .3 per cent were no response; and for all the responses made for the 1965 institute, 34.4 per cent were "very much," 54.7 per cent were "some," 10.6 per cent were "little or none," and .3 per cent were no response.
To summarize, this study was undertaken to determine which of selected beneficial characteristics in the teaching of secondary mathematics were included in the Drake National Science Foundation Mathematics Summer Institutes of 1962 and 1965, the opinions of participants regarding self-improvement gained in each characteristic through participation in the institutes, and an over-all comparison of the two sessions in regard to these characteristics. The population consisted of the 103 participants of these institutes, the writer excepted, each of whom was requested to complete a questionnaire listing fourteen selected beneficial characteristics in the teaching of secondary mathematics. For each item, the respondent was requested to indicate one of three responses, "very much," "some," or "little or none," which in his opinion best described the benefits he had received from the institute. An analysis was then made from the data on the questionnaires that were returned.

From the questionnaires mailed, 95.1 per cent were returned. On these a large majority of the participants
of each session indicated that through their participation in the institutes they had gained either very much or some self-improvement in each and every one of the characteristics included in the study. Those items which received the largest number of "very much" and "some" responses were the same for both sessions with the exception of one additional item for 1965. Those items were "renewed appreciation of what it is like to be a student," "increased background collegiate mathematical knowledge," and "strengthened understanding of mathematical procedures." The item which was also included for 1965 was "refreshed interest in mathematics." For 1962, those items which received the least number of "very much" and "some" responses for self-improvement were "broadened understanding of wide range of applications of mathematics" and "gained new methods and materials for increasing student motivation in the classroom." For 1965, the items which received the least number of "very much" and "some" responses were "gained new methods and materials for increasing student motivation in the classroom" and "increased background knowledge in teaching assignment material." A comparison of the total number of "very much" responses, of the total number of "some" responses, and of the total number of "little or none" responses for one session to the corresponding totals respectively
of the other session indicated very similar over-all opinions of both sessions by their respective participants.

In conclusion it would seem that based on the limited data available, both sessions provided for improvement in each of the characteristics included in the study and which were considered beneficial to secondary mathematics teachers, that a large majority of the participants of each session felt they had received benefits in each of these characteristics, and that the two sessions were very similar in respect to these characteristics. In the opinion of the writer, this would also indicate that these institutes did provide benefits to those who participated in them, and that the participants are aware of having received those benefits.

Therefore, the writer would like to suggest that further studies of these and similar institutes be made, and if the results tend to confirm the results of this study, then it would seem that such institute programs should be continued as long as the need for them continues to exist. In addition, the college staffs who direct such programs, through a critical examination of the limited data of this study and the data of other similar studies, might be better able to determine in which areas their programs have accomplished what they had hoped they would and in which areas their programs might need further study or emphasis.
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APPENDIX

DRAKE NSF SUMMER MATHEMATICS INSTITUTE QUESTIONNAIRE

Instructions: Following is a list of characteristics which might be considered as desirable in mathematics teachers. Please circle the response below each item which best indicates the degree to which you feel each item was improved for you by your attendance and participation in the Drake NSF Summer Institute in Mathematics in 196_.

1. Strengthened understanding of mathematical procedures
   Very much Some Little or none

2. Bettered understanding of the concept of "modern mathematics"
   Very much Some Little or none

3. Broadened understanding of wide range of applications of mathematics
   Very much Some Little or none

4. Increased background collegiate mathematical knowledge
   Very much Some Little or none

5. Increased background knowledge in teaching assignment material
   Very much Some Little or none

6. Developed larger vocabulary and understanding of mathematical symbolism and terminology
   Very much Some Little or none

7. Provided new material for supplementary enrichment in classroom teaching
   Very much Some Little or none

8. Gained new methods and materials for increasing student motivation in the classroom
   Very much Some Little or none

9. Refreshed interest in mathematics
   Very much Some Little or none
10. Increased motivation toward further academic study in mathematics
   Very much        Some        Little or none

11. Developed more self-confidence in teaching mathematics
    Very much        Some        Little or none

12. Contributed toward a fresh and improved point of view toward the teaching of mathematics
    Very much        Some        Little or none

13. Increased enthusiasm for teaching mathematics
    Very much        Some        Little or none

14. Renewed appreciation of what it is like to be a student
    Very much        Some        Little or none