Name: Leo D Ridgway Date of Degree: May 28, 1961

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: IN-SERVICE TRAINING OF MATHEMATICS TEACHERS

Pages in Study: 19 Candidate for Degree of Master of Science

Major Field: Natural Science

Scope and Method of Study: Letters were written to 147 teachers and administrators in Oklahoma schools now using the School Mathematics Study Group material in their mathematics program. Responses to 52 letters were received from teachers representing 35 schools of the 55 schools in the state using SMSG material.

Findings and Conclusions: Several problems of in-service training are listed with suggestions by experienced teachers as solutions. In-service training is defined as training that will not interrupt the teacher's regular teaching schedule. Several different types of in-service training are listed. The different types vary with the individual needs of the teacher. The improvement of the preparation of the student for the mathematics of the modern world should be the final result of in-service training of teachers of mathematics.

ADVISER'S APPROVAL James H. Zant

IN-SERVICE TRAINING OF MATHEMATICS TEACHERS

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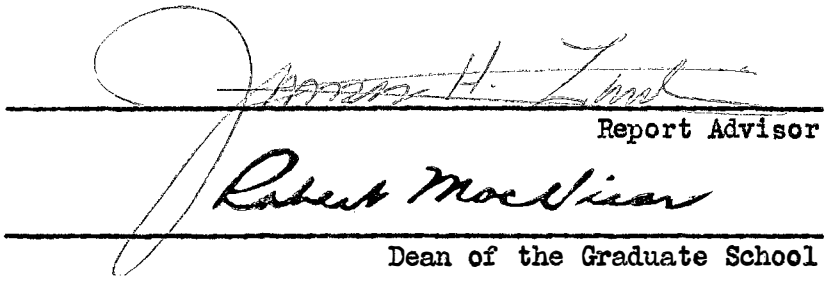
1949

Submitted to the faculty of the Graduate School of
the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
May, 1961

IN-SERVICE TRAINING OF

MATHEMATICS TEACHERS

Report Approved:



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PREFACE

It is the desire of the author to list the problems of in-service training of teachers, when a new mathematics program is proposed. The author also wishes to list suggestions of teachers and administrators that have encountered problems with the hope that schools may find solutions to the problems encountered in initiating a mathematics curriculum revision.

The author wishes to thank all who contributed their problems and suggestions for solving them. The author particularly wishes to thank Dr. James H. Zant, Director of the National Science Foundation at Oklahoma State University, for his assistance in the writing of this report. The author also thanks the National Science Foundation Academic Year Institute Committee at Oklahoma State University and the National Science Foundation for making this year of study possible.

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

There will be definite problems to be faced by teachers especially during the first year in working with new material in mathematics. Teachers, through no fault of their own, have not had the sort of training necessary to teach mathematics with the new ideas.

The purpose of this paper is to list problems that arise in in-service training of teachers of mathematics and also list suggestions that will help an individual teacher or school system solve their problems.

Many teachers and school administrators are convinced that a re-organization of the curriculum is long overdue, but it must also be undertaken as a long range problem. It is not possible to read the Commission Report,[1] and decide that soon the textbooks will be revised, then the new curriculum will be in effect. It just is not that simple. That approach was taken toward curriculum revision 50 or 60 years ago and evidence of our traditional mathematics of today shows that this approach is not successful. Teachers and school administrators should not sit and let the other teacher and school administrator encounter the problems of mathematics curriculum revision. This does not mean

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[1] The Commission on Mathematics, Program for College Preparatory Mathematics, The College Entrance Examinations Board, 1959, p. 48-58.

that our mathematics teaching in the past has been inadequate, but a track star is a little behind the times if he is shooting for a 5 minute mile. The field of mathematics is a growing field, just as any other science, but maybe not quite as evident to some people. This lack of evidence to some people presents a problem which will be discussed later in this paper.

It is essential that teachers move in on, not curricular revision, but modification of the existing curriculum creatively as their knowledge and skill enables them to do so, and gradually introduce the changes recommended in the Commission Report and those suggested by others, too. The teachers should not try to do everything at once. And, of course, remember that it is not likely that anything will be done in the best possible way on first trial. This is why it is so important to move gradually with a program with a goal in mind. It is not fair to the pupils or to the teacher to try everything involved in modification of the curriculum right away before it is fully understood. This method of approach will only lead to confusion. The change should be made deliberately, intelligently, gradually, and experimentally in introducing new ideas.

Only a small percentage of teachers have had up-to-date training required for the task of teaching twentieth century mathematics. Only those who have begun their teaching careers recently have had an opportunity to take modern college courses and even many of these teachers have had collegiate training of a more traditional character. Other teachers are bound to be asking: What is contemporary mathematics? Where can we learn it? How can we learn to use it? The first question can be answered in an over simplified manner by consulting a dictionary.

The purpose of this paper is to not necessarily answer the other two questions, but give an individual insight into the problems and solutions of similar questions encountered by other teachers and administrators which will enable him to solve the problem of his own situation.

The problems and solutions mentioned in this paper were obtained through correspondence with 52 individual teachers and administrators representing 35 different schools of the 55 schools in Oklahoma teaching (SMSG) School Mathematics Study Group, material during 1960-61 for the first or second year. The other 20 schools were contacted but no response was obtained. An encouraging fact of the correspondence was that there were more solutions than problems mentioned in the replies.

CHAPTER II

PROBLEMS OF IN-SERVICE TRAINING FOR A NEW MATHEMATICS PROGRAM

Definite problems will be encountered in training of teachers when a new program in mathematics is initiated into the school. The first problem is introduction of the new program in such a way that everybody involved has an understanding of the needs of a new program and will cooperate to reach the goal of initiating a new program in mathematics. If a poorly planned introduction is made, the administrator will suggest problems that he thinks are unsolvable such as financing the purchase of textbooks, finding qualified teachers or training the present teachers. These problems will not be problems at all if the administrator is convinced of the needs of a modification in the mathematics program. The administrator already has many problems like financing the purchase of some textbooks and obtaining qualified teachers but he should be shown that texts with new ideas are the textbooks he should obtain and that qualified teachers of mathematics today are ones that incorporate the concepts, and ideas of these texts in their teaching. It is really not a change or addition to his problems of financing textbooks and hiring teachers, but an understanding of the needs in these problems.

Teachers must be motivated to improve their concepts of mathematics. This can be accomplished by in-service training. In-service training is referred to here as training that will not interrupt the

teachers regular teaching schedule. When teachers enter a training program they are students, but not students in the sense of being an undergraduate. They are mature students seeking to improve their concepts in the field in which they teach, in this case mathematics. Being mature students they can not be motivated by the same methods as younger undergraduate students. An administrator may make a mistake and create problems for himself by suggesting a high school teacher teach the elementary teachers the new ideas and concepts in mathematics. The elementary teachers might tend to resent this type of in-service training. It is necessary that the subject matter be professionalized and the relevance to the work of the elementary school be stressed. The appropriate person to do this is a professor of mathematics or of mathematics education in an institution devoted to teacher education. One school in Oklahoma used the above mentioned method of in-service training of elementary teachers, only an administrator trained in the field of mathematics, was the teacher of teachers. Some of the professional aspect of the situation was lost as was indicated by letters from the administrator acting as a teacher and also a letter from the teacher acting as a student. This type of in-service training can sometimes be successful using a group discussion type of training when several of the teachers have had previous formal training in the new program of mathematics.

There are many problems that will be suggested by the people involved (administrators, teachers, and parents) when the initiation of the modification of the mathematics program does not have professionalized presentation. Parents will use the new program as a "scapegoat" for their child's poor grades. Teachers and administrators will suggest problems such as, which students should take the new program or what

will they do with transfer students who are not familiar with the new program. These problems are all similar, they are not new problems of a new program in mathematics, but they are problems of the present mathematics program that are not enlarged, but may be reduced when this new mathematics program is initiated.

Problem of Time for In-service Training

It should be noticed in the problems of initiating a new program in mathematics that the more successfully the related problems are solved the less complications you have with your present problem. This is very evident in the problem of finding time for the in-service training. If teachers are properly motivated or sold on the ideas of the new mathematics then they will find time to learn more about the new program in mathematics. This type of motivation can be accomplished in regular, state, or district teacher's meetings or by individual study made available by material purchased by the school.

Another incentive for a teacher to find time to take in-service training is by granting an extra free hour for lesson planning or individual study. It will be noted that one free hour is not adequate to do all the study necessary, but it will be sufficient for the teacher to motivate himself into studying the new concepts further.

A convenient time for the teacher and the course of in-service training to be taken often is very hard to find, but if the situation is motivated properly the problem becomes less intense.

Problem of Financing and Credit Of In-service Training

A good way of motivating people is by financing their endeavors with

money or credit of some form. Teachers, no matter how dedicated, do not overlook the reality of life that it takes money to live. Therefore monetary assistance will always help a teacher train for a new program in mathematics. This money can come from a variety of sources, and the best source is not the teacher's own pocket book. There is a shortage of teachers now because of various reasons and one is the low pay scale that exists compared with those of other professions with similar preparation requirements, therefore do not lower the teacher's income more by asking them to pay for their own in-service training.

The letters from the teachers and school administrators said several school boards in the state either give a cash award to a regular teacher that attended some kind of summer institute to learn of the new program in mathematics and other school boards gave credit to the teacher to satisfy local requirements about obtaining a minimum number of hours per year for attendance at workshops and special in-service training.

Other sources of finance and credit mentioned in the correspondence with the teachers were: The National Science Foundation; Industry; and Universities.

Credit for in-service training may be of two types. It may be credit that will satisfy local requirements or credits that will satisfy college requirements. Some teachers may have already obtained a satisfactory degree for their teaching situation therefore they are only interested in credit that will satisfy the local school board requirements, while other teachers are interested in having the credit meet the requirements they need for a higher degree. A thorough study of the local situation and contact with a near by institution of learning will

very often provide a solution to the type of credit that can be issued. In a few instances mentioned by teachers using television as an in-service training program both types of credit were given.

Problem of Adaptability of the In-service Training

The in-service training must satisfy the needs of the teacher or it is money and time wasted. If the in-service training is group study training, all the teachers should have a similar background of the subject matter and common goals, otherwise one teacher can be the worst publicity the new program can have, because that one teacher will be dissatisfied. If common goals and similar background cannot be obtained, individual study or smaller group study will be more advantageous. The advantage of this form of training is the adaptability of the subject matter to the group or the individual. It is just what the teachers need to improve their knowledge of the new concepts. There is a limit to the amount of knowledge gained, by the ability of the teachers of the group.

This limit can be extended by employing the use of a mathematics teacher from a near-by college or university. This may be financed in some situations by The National Science Foundation, school board, industries, or the University. Some teachers may have to drive to these meetings and have their expenses met by their local school board while the instructor is paid by one of the other sources previously mentioned.

The adaptability of courses for in-service training of mathematics teachers in programs for continued study such as summer school and regular study at a university has been a problem of great concern, but is being corrected to some extent. The courses offered were of two ex-

tremes, either a methods course by the department of education or an advanced course designed for a graduate student doing research. Neither of these courses meet the need of the teacher trying to learn the new program in mathematics. Some courses have been changed in name only to meet the needs of the teacher, while others have adjusted the content sufficient to meet these needs. The teacher enrolling in these courses for continued study does not have sufficient background to enroll in some graduate level courses through no fault of their own. The teacher will spend his time well by talking to the instructor of a course about its content before enrolling in the course. In-service training of teachers already teaching is a more specialized type of training and the teachers should be given this type of consideration. At schools conducting Summer Institutes and Academic Year Institutes sponsored by the National Science Foundation some specialized classes for the training of the mathematics teachers have been initiated. This type of class is very adaptable to the individual needs of the teachers enrolled, and has been very successful as indicated by the correspondence of the teachers who had participated in such programs.

All of the problems and suggestions of this chapter were suggested in letters from administrators and teachers who are now teaching a new program in mathematics. This is only a small percentage of the teachers requiring up-to-date training for the task of teaching a new program in mathematics. Only those who have begun their teaching careers recently have had an opportunity to take modern college courses, and even many of these teachers have had collegiate training of a more traditional character. All activities concerned with in-service training of teachers must be encouraged. Yet the fact remains that the future will require

a much greater and better coordinated effort than that of the past, if teachers in sufficient number are to have adequate opportunities for the training they need.

CHAPTER III

SUGGESTIONS FOR IN-SERVICE TRAINING

Conferences and Similar Activities

Those teachers who cannot arrange a formal program of study that will meet their needs can still formulate and carry out a plan for independent study. Experienced teachers said such study is most effective if pursued by a small group of teachers from the same school or from a few nearby schools meeting together for discussion, and affording each other mutual support and assistance.

There are lots of books on the subject matter of mathematics that are designed to meet the needs of the teacher, but the new ideas in mathematics for the most part have been embodied in advanced research journals that teachers cannot read for the same reason they cannot take most present-day graduate courses, they do not have the prerequisites. Nevertheless, some books of special interest to teachers have been written and more are on the way for example, Irving Adler's, The New Mathematics. Clear explanations of the basic subject matter of modern mathematics can be found in some of the newer textbooks for college freshmen and sophomores. These texts have the added advantage of providing secondary school teachers with information about the kind of new material their students will encounter in college and how it will be presented there. The last three Yearbooks published by the National

Council of Teachers of Mathematics (NCTM) have several articles that provide an excellent insight into the ideas of new mathematics.

Periodicals such as The American Mathematical Monthly, and The Mathematics Teacher, and School Science and Mathematics have served and will no doubt serve increasingly as sources of articles on the subject matter and teaching of a new program in mathematics. Indeed, reporting as they do on experimental programs and curricular proposals, they are the chief sources of answers to questions concerning the introduction of a new mathematics program in the classroom. Teachers have a right to expect that their school libraries or public libraries in their communities, or both, will place on their shelves the books and periodicals mentioned above, as well as those recommended in the selected bibliography of this paper. Teachers can avail themselves to some of the material by membership in mathematics professional organizations.

The small group meetings may be professional society meeting sessions. Abundant opportunities are provided at the national and sectional meetings of the National Council of Teachers of Mathematics, the Mathematical Association of America, and similar organizations. While most of the addresses at such meetings are brief and sporadic, they often are informative and can serve to stimulate a serious interest that is worth pursuing. Expertly conducted classroom discussions also can play an important part of in-service training at meetings of this kind.

College and university mathematics faculties have a responsibility for cooperating fully with school teachers in their endeavors to bring themselves up-to-date in mathematics. Moreover, shorter programs of this kind can be used effectively to acquaint not only teachers but also influential school administrators on local, county and state levels with

the needs and trends in present-day mathematics.

Several university faculties are offering programs for secondary school teachers during the academic year at a time so chosen that teachers may attend while still teaching full-time at their school; for example, a series of meetings on Saturdays, evenings, or late afternoons. Lectures on topics that are manageable in the time allowed are followed by discussions. This type of conference is best suited to localities in or near large centers of population. The National Science Foundation supported institutes of this type are designed especially for teachers of science and mathematics who wish to broaden their scientific knowledge and to increase their capacity to motivate students toward careers in science, mathematics and engineering. The institutes are conducted by colleges and universities and are staffed by mathematicians and scientists of recognized competence in their fields. During 1960-61, the Foundation is supporting 191 such In-service Institutes for secondary school teachers; in 1961-62, the Foundation will support about the same number, this information was published by the National Science Foundation, Washington 25, D. C., in September, 1960. Foundation grants for these institutes provide allowances for travel and books for the participating teachers, as well as instructional costs, so that the teacher may participate without payment of tuition or fees. Any teacher, irrespective of his school system, is eligible for selection as a participant in an In-service Institute for Secondary School Teachers if he is teaching at least one course in science or mathematics in grades 7 through 12 in a public, private, or parochial school. In addition, those directly engaged in supervision of instruction in science and mathematics at the secondary level may participate if they have appro-

priate background training.

A college or university may request support for In-service Institutes to be held at centers away from the main campus in order to reduce commuting problems for teachers and thus be able to serve an area not otherwise served. The level of instruction, facilities, and direction should be and usually is comparable to that available on the main campus. A typical proposal requesting a grant for the support of an institute is prepared by the prospective director, with the aid of a committee of colleagues, and submitted to the Foundation by the university or college that proposes to serve as the host institution.

Television In-service Training

Television teaching is a new method of initiating new courses of mathematics into the curriculum. The course is followed by both the students and the teacher, therefore it is replacing the in-service training of the teacher, because the course incorporates the new ideas of the material. One school reported doing this one year with the teacher following the course on television then teaching the course from texts using the new ideas the next year and obtaining very satisfactory results. The courses that are being offered on television in your area may be obtained through correspondence with the State Director of Television Instruction, State Department of Education.

Television in-service training is used by the Oklahoma City Schools, Oklahoma City, Oklahoma for the first time this year. These are television lessons for teachers only, and have dealt with both content and pedagogy related to mathematics. Correspondence from teachers taking this type of in-service training acknowledge the fact that it is very

successful. There is a problem of finding a time when all teachers are able to view. There is a big advantage that they are able to view from their own classrooms, without traveling to a central meeting place. The above information was obtained through correspondence with Tom Hill, Director of Mathematics for the Oklahoma City School System.

Short summer conferences or workshops for regional groups of teachers in different parts of the country have been established and conducted for the past few summers. These last for three or four days to a week or ten days. A series of daily lectures on topics in modern mathematics generally are interspersed with single lectures on applications for example, computors.

For teachers who are unable to devote a complete summer or longer to learning about recent developments in mathematics and how they might be incorporated into their teaching, the preceeding shorter organized programs can and must serve as effective sources of information and stimulation to satisfy the needs of the teacher.

Formal Programs of Organized Study

Teachers eager to keep abreast of developments in mathematics often seek to do so through intensive courses during summer months. This longer instructional program ranges in duration from six to ten weeks and therefore allows time for other kinds of activities worth consideration. One type of activity is cooperative work on new classroom materials that the teachers can take back and try out in their own schools.

The National Science Foundation refers to the longer instructional programs during the summers that are supported by the Foundation as Summer Fellowships. They differ from the previously mentioned In-serv-

ice Institutes supported by the Foundation in that the teacher may pursue an individually planned graduate study program at a nonprofit American institution of their choice. The teacher receives stipends computed at the rate of $75. for each week of tenure, with travel and dependency allowances. The Foundation pays their tuition and fees.

Another formal program of organized study that would be classified as in-service training, according to its definition in this paper, would be an Academic Year Institute, if the teacher is able to obtain a leave of absence from his school. This training is supported by the National Science Foundation. Within the general policy of the Foundation each institution establishes its own criteria for selection of participants.[2] The teacher recieves a stipend of $3,000 for the year, with travel and dependency allowances.

The types of training mentioned may be used as guides from teachers that have experienced problems of in-service training. May the burden of your problems of in-service training be lightened by the sharing of these teachers problems with you. Obtaining the top standard of teaching a new program in mathematics may be analogous to reaching the top branch of a solid oak tree. It can be accomplished in two ways: You may climb to the top of the tree by placing one foot on a solid branch then the other foot on the next solid branch and proceed deliberately and rapidly to the top or you may just sit down on the acorn.

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[2]Lowry, W. C. and Redfield, D. D., "Selection of Academic Year Institute Participants at the University of Virginia", The Mathematics Teacher, April, 1960, Vol. 53(4): p. 270-276.

CHAPTER IV

CONCLUSION

Recent developments in the field of mathematics indicate that mathematics is of vital importance to our life in a highly industrialized society. It is also true that education has lagged far behind the realities in the field of mathematics. The teachers and students have the right to be taught modern concepts and also be taught in such a way that they can learn with understanding to see the significance of what they have learned as applied to modern teaching and living.

The step toward modification of the mathematics curriculum should be a cautious step. A well taught traditional program in mathematics is better than a poorly taught new program in mathematics. The goal of a teacher or administrator should be a well taught new program in mathematics. This goal can be achieved by the following conclusions. These conclusions are based on actual experiences of teachers and administrators that are using a new program in mathematics.

Proper motivation must be attained in some way, either by literature or meetings of a professional nature. This motivation is sometimes a continual process, therefore the literature must be made available over a period of time. This can be attained by membership in professional organizations such as the National Council of Teachers of Mathematics (NCTM).

Motivation and training will be obtained by attendance at state

and district meetings of teachers. Consultation with state institutions of higher learning in your area for information concerning curricular revision and teacher training will greatly reduce the number of your problems. This information may lead to special university lectures or courses for training.

The summer workshops and conferences play an important role in teacher training. Whether it be for teacher stimulation or new subject matter. These workshops may be financed by the host institution, a foundation, industry, or the local school boards, but not by the teachers themselves.

The mathematics curriculum can be greatly improved by the hiring of highly qualified people to teach mathematics in junior and senior high school. These high qualifications may be attained by any of the numerous methods of in-service training mentioned in this paper. A qualification of a good teacher is a teacher that is not satisfied with his present teaching. This teacher will be improving all the time. Independent study cannot be over emphasized for teacher and curricular improvement. Several articles are mentioned in the selected bibliography of this paper for the purpose of independent study. This bibliography will not be complete enough for the end, but only a beginning to the means for the end. Independent study can be encouraged by administrators and school or public libraries making the professional journals and books suggested in this paper available.

Modification of the existing mathematics curriculum should not be expected to happen in one year. It should develop steadily and surely over a period of a few well planned years. Remember the teachers and the preparations they must make to initiate revision of the curriculum.

Do not forget the students, they are the product and results of curriculum revision. The reason for in-service training of mathematics teachers is to improve the teaching of mathematics, which will no doubt modify the present mathematics curriculum. This improved teaching should prepare the students to better meet the needs required of him in this modern world.

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