A COMPARISON OF TWO SCHEMES FOR SEQUENCING A METHODS COURSE AND STUDENT TEACHING

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CHAPTER I

INTRODUCTION

The Problem

Pre-service teacher education programs, though diverse in many ways, do have a common core. The customary components are course work in the disciplines the participant may eventually teach, general education courses, professional course work including instruction in the materials and methods used in teaching, and a practice experience of some form, generally referred to as student teaching.

The traditional sequential arrangement of the methods instruction followed by student teaching, which is viewed as the capstone of the pre-service program, appears to be based on the assumptions that the student can learn teaching methods divorced from a teaching situation and that the methods learned will and can be applied in a student teaching experience. Recent literature in teacher education reveals that these two assumptions are being questioned frequently. John Zahorik (21) suggests that one of the necessary factors in improving instruction in teaching behaviors is to provide practice, with feedback, in employing these behaviors. Robert C. Putt (10) lists the following as two of the objectives of a pilot study in social studies methods:

1. To relate the course work to directed observation in an elementary grade classroom.

2. To coordinate work in the methods course with actual junior student teaching being experienced while taking the course.

John C. Manning, as reported by Barbara Gross (6), feels that teacher training should be an inductive process; it should move from instances of teacher behavior to principles of behavior.

If it is indeed desirable to bring methods instruction into closer proximity to the practice experience, one solution would be to teach the methods courses in workshops held at periodic intervals during the student teaching experience. A program of this type was initiated by Oklahoma State University for the 1970-71 academic year. Prior to this time Oklahoma State University students in elementary education received their final undergraduate professional training through a nine week block of methods instruction followed by a seven week block of full time student teaching. When the new program was created, student teaching was extended over the full sixteen weeks. Four full days a week were devoted to student teaching with the fifth day being used for workshops in teaching methods related to the areas of language arts, social studies, science, and mathematics. The use of weekly workshops necessitated a substantial reduction in the number of hours devoted to methods instruction.

It was the purpose of this study to isolate and explore, using the above model, some of the effects of offering concurrent methods instruction and student teaching. The domain to be explored was restricted to elementary school mathematics. The study was focused on the degree of meaningful learning that resulted from elementary school mathematics methods instruction.

Since the basic purpose of methods instruction is to enlighten the learner in the art of teaching, the degree of meaningful learning that occurs should be demonstrated by the learner's ability to perform this art, at least on the cognitive level. Therefore, the performance of certain cognitive elementary mathematics teaching tasks considered essential to every elementary school mathematics teacher was used as a measure of meaningful learning. These tasks will be discussed in detail in Chapter II.

For purposes of evaluation, the degree of meaningful learning accomplished by students who received instruction under the above model was compared to that of students who received instruction under a traditional sequential model. Both groups of student teachers did their student teaching over the full sixteen weeks. One group had instruction in mathematics methods prior to student teaching, the other concurrently with student teaching.

Previous Research

Even though numerous programs are in existence, which, in some degree, incorporate methods instruction with student teaching, no research directly applicable to this study was found. Most of the institutions which have employed the arrangement of offering methods instruction during student teaching have also made many other revisions in their professional education curriculum. Thus, when these programs have been evaluated, the evaluations have been in terms of the entire program and the effect of an isolated variable, such as methods instruction, remains unknown. This writer was unable to find any evidence of an attempt at evaluation in most of the programs. Descriptions of several of these programs can be found in a collection of reports on innovative practices in student teaching by Amershek and Barbour (1).

One research study, though having the above deficiencies, does warrant mentioning; the study attempted to evaluate the "Insite Program" at Indiana University. Edward G. Buffie (3) presents the main thrust of the program in the following statement:

> In order to close the gap between theory and practice, a substantial effort was made to integrate various phases of the student's professional work with his student teaching activities. It was hoped that we could make substantial strides toward closing the gap between theory and practice by offering professional methodology and student teaching concurrently.

The basic organizational feature of this program is the acroclinical semester. During this semester the student is in the elementary classroom daily, with the amount of time increasing by jumps as the semester progresses. Formal class work in four methods areas and complementary studies are conducted throughout the semester with the amount of time being devoted to this task decreasing as involvement in the elementary classroom increases.

Students in the first acroclinical semester were asked to respond to the question, "To what extent did your experience with children help make your study of methods more meaningful?" The frequency of their responses on a zero to four rating scale were as follows: 0 - 1, 1 - 1, 2 - 5, 3 - 12, 4 - 21. The results indicate that the students, as a group, felt that their experiences with children helped make methods instruction more meaningful. In addition, Rice (11) reports that a follow-up evaluation of 150 students completing the "Insite Program" showed "Insite" teachers to be superior beginning teachers as compared with other first year teachers. Rice, like Buffie, reported that students felt the opportunity for immediate practice of that learned in methods instruction makes the instruction more meaningful.

Theoretical Basis

The importance of formulating a theory in educational research is emphasized by Travers (13:30) who states: "A study that starts with a theoretical position and then extends knowledge is, inevitable, a contribution to organized knowledge." Travers recommends that the statement of the theory involve a set of definitions and a set of statements that constitute the postulates of the theory. From these postulates hypotheses are formed and tested to provide further validation of the theory.

The following definitions are those related to the theory to be developed; the first three definitions are from the work of Ausubel:

Cognitive Structure: The stability, clarity, and organization of a learner's subject-matter knowledge in a given discipline. (2:26)

Meaningful Learning Set: A learning set (current disposition to learn or perform in a particular way), possessed by the individual learner, to relate substantive (as opposed to verbatim) aspects of new concepts, information, or situations to relevant components of existing cognitive structure in various ways that make possible the incorporation of derivative, elaborative, correlative, supportive, qualifying, or representational relationships. (2:22,202)

Potentially Meaningful Material: Material to be learned which is non-arbitrarily relatable to relevant concepts in cognitive structure and is relatable to the particular cognitive structure of a particular learner. (2:22)

Student Teaching: An experience, 16 weeks in duration, during which the student is placed in an elementary school classroom under the direction of a cooperating teacher. During this time the student observes pupil and teacher behavior, performs routine classroom teaching tasks, and eventually assumes most of the roles of a teacher.

Methods Instruction: Instruction in the areas of relevant learning theory, materials for teaching, and strategies of teaching.

Concurrent Methods Instruction and Student Teaching: The arrangement of methods instruction and student teaching in use at Oklahoma State University during the 1970-71 academic year.

The concurrent methods instruction and student teaching experience is a learning situation, and the theory developed below is a partial theory of learning.

Ausubel (2:22) states that a meaningful learning set, as defined above, is necessary for meaningful learning to take place. However, disposition to learn is a variable quantity and it would appear natural to speak of the magnitude of the meaningful learning set. If a meaningful learning set is necessary for meaningful learning to take place, an increase in the magnitude of the meaningful learning set should increase the probability that meaningful learning will take place.

In a program where methods instruction and student teaching are concurrent, the learner is provided with an opportunity to observe and to assume the role of a teacher. In so doing, the learner should become aware of his present inability to perform certain functions that he must perform once he enters the profession. It is anticipated that the learner's disposition to learn will be greater than that of a learner whose methods instruction is preceding student teaching and that this learning set will be characterized by a desire to relate substantive aspects of the methods instruction to his existing cognitive structure in a manner that will lend support to, or clarification of, what previous knowledge he has gained through classroom experience. If this is true, a major weakness present when methods instruction is followed by student teaching has been overcome; the weakness being that the learner's set may be to internalize material verbatim, a learning set which is not meaningful.

The following postulate has been formulated from the discussion above:

Postulate 1: The learner who studies methods of teaching during student teaching will have a meaningful learning set of greater magnitude than the learner who studies methods of teaching prior to student teaching.

The next postulate to be formulated is also based on the work of Ausubel (2:22), who states:

> A meaningful set or approach to learning ... only eventuates in a meaningful learning process and outcome provided that the learning material (task) itself is potentially meaningful.

As stated in the definition, potentially meaningful material must be relatable to the particular cognitive structure of a particular learner. Ausubel claims that for meaningful learning to actually occur the cognitive structure of the particular learner must include the requisite intellectual capacities, ideational content, and experiential background. It is subsumability within a particular cognitive structure of potentially meaningful material that differentiates meaningful from rote learning. Hence, if meaningful learning is to take place, the cognitive structure of the individual learner becomes a major consideration.

As defined, methods instruction involves, among other things, instruction in the strategies of teaching. If the instructional material related to strategies of teaching is to be potentially meaningful and if meaningful learning is to take place, it would appear that the ideal cognitive structure of the individual learner should include both an ideational content through which ideas directly related to the teaching process can be entertained and an experiential background that includes the performance of teaching tasks. For example, consider a learning task which might occur in an elementary school mathematics methods course. The task confronting the student is to learn to recognize the level of difficulty, as related to a primary grade pupil, of any given addition problem. Surely, the cognitive structure of the student includes the ability to solve addition problems. Hopefully, the student can find the solution with ease. However, if the student has never taught elementary school children, his experiential background more than likely contains nothing related to recognizing addition problem difficulty as experienced by a primary grade pupil. In fact, the ease with which the student can add may be a detriment to the task at hand.

The instruction in the above situation might begin with the presentation of a set of rules followed by a set of problems to categorize as to level of difficulty, followed by feedback on performance on the problem set, followed by a new problem set, feedback, etc. Each bit of feedback would relate to a growing experience in actual performance of the task. However, nothing has been done to relate the material to existing ideational content and though performance may improve, the learning remains rote. In this instance, the material could be made potentially meaningful by first developing the rules in such a way that the development may be related to the mathematical background of the individual learner and then proceding to build the experiential background of the learner in the manner suggested.

Had the learner above been a student teacher in an elementary school classroom at the time the learning task was to be accomplished, and had he worked with pupils executing various addition problems, the learner would have encountered some of the difficulties that primary pupils have in addition. In his attempts to help the pupil the student teacher's experiential background would grow, and it is likely that he would begin to develop a theory as to why certain errors were made. From this theory he could then formulate rules, though perhaps incorrect, which would enable him to recognize the level of difficulty of a particular addition problem. In such a case, when the learner is given the correct rules, he has a cognitive structure that includes a theory, a set of rules, and experiences to which these rules can be related. It is feasible that the learner could then refine the theory he has developed and be able to apply the rules with understanding. The result would be meaningful learning.

Although meaningful learning may be the outcome in both cases above, a great distinction exists between the two. In the first case, in order for the material to be potentially meaningful, it was necessary to introduce background material, relating the rules to mathematics, and to build experience into the instruction, thereby requiring more time for instruction than in the second case where the rules alone were potentially meaningful. Even if some elaboration on the rules were necessary in the second case, it would appear to be much less than in the first.

The above discussion has led to the formulation of the following postulate:

> Postulate 2: Potentially meaningful material can be presented more efficiently in the methods course in which the learner is concurrently engaged in student teaching than in the methods course followed by student teaching.

One additional comment is necessary. It may be possible that the instructor in the methods course preceding student teaching may not have the time or may not possess the technique necessary to make the material potentially meaningful and that the same material might be potentially meaningful had the student been exposed to teaching. However, the writer did not feel justified in assuming that potentially meaningful material may appear more frequently in the concurrent methods instruction and student teaching program than when methods instruction is followed by student teaching. It is anticipated that if the same material to be learned is presented in both instances, the material will have greater potential meaning in the concurrent methods instruction and student teaching program.

On the basis of the above postulates, the writer has concluded that more meaningful learning will occur in the concurrent methods instruction and student teaching program than in the program in which methods instruction is followed by student teaching (the time devoted to student teaching being held constant). The reduction in time devoted to methods instruction (see page 2) is justified by postulate 2, and the conclusion that more meaningful learning will occur is a result of postulate 1.

Support for the above postulates from directly related research would be desirable, but as mentioned earlier, such research was not found. The postulates do appear to receive some support from the number of different programs in existence that have employed a concurrent design of some form for methods instruction and student teaching. The collection of reports by Amershek and Barbour (1) lists thirteen programs of this type. This list is not definitive; for example, the "Insite Program" is not included. Inasmuch as a curriculum design most commonly reflects the thinking of a group of educators, it is safe to assume that a substantial number of educators are of the opinion that there is a need to closely relate methods instruction to the experiences of the student in the field. This thinking has been demonstrated in the previous references to the "Insite Program." An additional example is provided by William R. Hazard (7) who reports that Northwestern University has constructed a tutorial-clinical program in which the student spends time in the field all four years. In this program all learning experiences in professional education are planned by a teacher in the field and an on-campus tutor; all formal course work in professional education has been eliminated. The practice of cooperative planning of the student's professional education experiences has provided an opportunity to relate the methods instruction to the field experiences of the student and to the weaknesses exhibited by the student in the field. It was hoped that the program would add relevance and substance to the professional education segment of the student's preservice training.

If similar thinking that is shared by a sizable group of experienced educators can be assumed to be substantive, the formulation of the above programs supports the theory that more meaningful learning will take place in methods instruction that is accompanied by some form of field experience.

Hypotheses to be Tested

The study was conducted as a field study. Two groups of subjects, with group membership determined by self-selection, were used. The first group received 32 class-hours of methods instruction in the teaching of elementary school mathematics prior to sixteen weeks of student teaching; the second group received approximately seventeen class-hours of concurrent methods instruction and student teaching as earlier defined. Behavioral objectives of the two methods courses remained constant. Data were secured from each student on completion of student teaching. The data were taken as evidence of his ability to perform certain cognitive teaching tasks in elementary school mathematics. As stated earlier, the ability to perform these tasks was chosen as a measure of meaningful learning.

In summary, the independent variable in this study was the elementary school mathematics methods course in which the subjects participated. The variable was two dimensional; that is, it varied in its chronological relationship to the student teaching experience and in the number of hours allocated for its instruction. The dependent variable was the meaningful learning accomplished by the student as indicated by his ability to perform certain cognitive teaching tasks.

The initial hypothesis

> H_0: The meaningful learning accomplished by students taught under the concurrent elementary school mathematics methods instruction and student teaching curriculum design will be less than or equal to that of the students taught methods prior to student teaching.

will be tested against the alternate hypothesis

> H_1: The meaningful learning accomplished by students taught under the concurrent elementary school mathematics methods instruction and student teaching curriculum design will be greater than that of the students taught methods prior to student teaching.

The hypothesis H_0 was to be rejected at the 0.05 point of significance using a one tailed test.

The procedure of conducting the study as a field study made it necessary to consider other variables that might have effected performance of the cognitive teaching tasks in elementary school mathematics.

Variables that were considered were intelligence, mathematical competency, and ability to perform cognitive teaching tasks in elementary school reading and science. The null forms of the resulting subhypotheses to be tested were as follows:

SH_1: There is no significant difference in the intelligence of the treatment groups.

SH_2: There is no significant difference in the mathematical competency of the two treatment groups.

SH_3: There is no significant difference in the two treatment groups as related to their ability to perform certain cognitive teaching tasks in elementary school reading and science.

All hypotheses were to be rejected at the 0.05 point of significance using a two tailed test.

CHAPTER II

PROCEDURE

The concurrent methods instruction and student teaching curriculum design that was devised at Oklahoma State University and used as a treatment for this study was briefly described in Chapter I. Additional factors, not discussed in Chapter I, resulted in a definite distinction between the fall 1970 program and spring 1971 program. Most of the fall 1970 student teachers had studied mathematics teaching methods prior to student teaching. Consequently, the workshops in mathematics methods were dropped from the fall 1970 program and reinstated in the spring 1971 program. More specifically, most of the fall 1970 students participated in an elementary school mathematics methods course consisting of 32 class-hours of instruction. Their instruction in methods was followed by 16 weeks of student teaching, which was interrupted by weekly one-day workshops in the remaining three methods areas -- language arts, science, and social studies -- and three half-day study periods. Most of the spring 1971 students received 17 class-hours of instruction in elementary mathematics methods through workshops, which were held periodically during the 16 weeks of student teaching. The remaining subject area methods courses were handled essentially in the same manner as the fall 1970 group.

Design of Study

The two organizational schemes, based on the chronological relationship of elementary school mathematics methods instruction to student teaching, provided the two independent variables under study in this investigation. An ideal approach to this study would have been to replicate the above circumstances in a true experimental design. However, random selection of subjects and random assignment of subjects to organizational schemes was not feasible. Faculty need for information that would aid them in an evaluation of the new program led to the decision to conduct the investigation using an ex-post facto design.

Though ex-post facto designs do not demonstrate the control that can be exercised in true experimental designs and causality is less clear, they do have arguments in their favor. Kerlinger (8:373) states:

> If a tally of sound and important studies in psychology, sociology and education were made, it is likely that ex-post facto studies would out number and out rank experimental studies.

Selection of Subjects

The subjects for the study were among those students enrolled in elementary school student teaching during the 1970-71 academic year at Oklahoma State University. Two groups of subjects were identified as the C-group and the S-group. They are described below:

S-group: Those persons student teaching in the fall 1970 term who had previously received instruction in elementary school mathematics teaching methods from the instructor responsible for the instruction of most of the spring 1971 students. There were 50 subjects in this group.

C-group: Those persons student teaching in the spring 1971 term who had not previously received instruction in elementary mathematics methods. A further condition for placement in the C-group was that elementary school mathematics teaching methods instruction was received from the professor responsible for the instruction of those students in the S-group. There were 80 subjects in this group.

The resulting n was 130.

Membership in a particular group was determined by self-selection rather than random assignment. The two groups were assumed to be samples from the same population, but having been drawn at different times. Since equivalency of the two groups could not be assumed on the basis of random selection and random assignment, it was established statistically using independent variables known to effect criterion performance.

During the course of the study, a small number of casualties occurred as a result of absenteeism during testing. These will be discussed in detail at that time when statistical analysis demands the recognition of the reduced n.

Collection of Data

The collection of all data used in this study was accomplished through the administration of three batteries of tests. These were administered at periodic intervals during the semester.

Necessary data for the study can be subdivided into three categories:

1. Data needed for the final comparison of the S-group and the C-group on their abilities to perform certain cognitive elementary school mathematics teaching tasks.
2. Data needed to establish the sensitivity (to methods instruction) of the instrument used in 1.
3. Data needed to establish equivalence of the S-group and C-group on variables related to successful performance on the instrument used in 1.

Each of these will now be discussed in detail in the order in which they appear.

The instrument used for final comparison of the S-group and C-group on their abilities to perform certain cognitive teaching tasks was <u>Intermediate Grade Mathematics Teaching Tasks - Form F</u> by Richard L. Turner (16), henceforth referred to as IGMTT-Form F. The instrument consists of four cognitive level teaching tasks. In task 1 the subject is asked to identify the degree of relevance of 10 stated objectives of arithmetic instruction to six problems composing an arithmetic exercise. In task 2 the subject must examine a set of 10 long division problems worked by a pupil in grade 5. The errors made by the pupil fall systematically in one class and randomly in two other classes. The subject must select what combination of 14 alternative teacher actions would be necessary and sufficient to correct the systematic errors. Task 3 differs from task 2 only in that the exercises include several operations and have been performed by a pupil in grade 4. In task 4 the subject is asked to rank order, according to level of difficulty, seven long division problems.

All testing was conducted during the workshop periods allotted for methods instruction. These workshops were conducted in centers located in Stillwater, Oklahoma; Ponca City, Oklahoma; Tulsa, Oklahoma; and Oklahoma City, Oklahoma. Testing was necessarily performed on different days and in different locations. The availability of the subjects for testing and the testing schedule were determined by faculty members responsible for methods instruction. The IGMTT-Form F was administered to both treatment groups during the final two weeks of each group's student teaching.

The reader should note that the ability to perform the tasks in the IGMTT-Form F instrument was used as the criterion for demonstration of meaningful learning resulting from elementary school mathematics methods instruction.

Since the independent variable in this study was the elementary school mathematics methods course in which the subjects participated, it was, of course, necessary that the IGMTT-Form F instrument be sensitive to that variable. Turner (19:23) reports that methods instruction and student teaching contribute significantly to performance. However, it was possible that the main contributing factor was student teaching. To obtain the effect of methods instruction on performance, the IGMTT-Form E (15), an instrument equivalent to Form F, was administered to both treatment groups during the third and fourth weeks of the subjects' student teaching. At this time the S-group had completed methods instruction while the C-group had had no methods instruction related to the tasks contained in the instrument. Although some student teaching had taken place, it was little and equivalent for both treatment groups. Assuming equivalence of the two treatment groups on other variables pertinent to performance of the teaching tasks (an assumption also tested), differences in results were attributed to the effect of methods instruction.

Although the design was not a pre-test post-test design, the above testing introduced the same problem encountered in such a design; that is, the effect of pre-testing on the dependent variable. The administration of the IGMTT-Form E could have served as an advanced organizer providing the learner with cues through which meaningful learning could be facilitated. Since the learning opportunities for the two treatment groups varied during the lapse of time between taking the IGMTT-Form E and Form F, there existed the possibility that administration of Form E resulted in altering the performance of Form F in different amounts for the two treatment groups. To provide a statistical check for the possibility, both treatment groups were randomly divided into halves. When IGMTT-Form E was administered, it was given only to half of each treatment group; the remaining halves were administered a dummy instrument consisting of selected questions from past examinations given in the elementary mathematics methods course, which the S-group had taken. This procedure provided, in both treatment groups, the opportunity to compare the results on the IGMTT-Form F of those who had completed

Form E and those who had not, thus showing the effect of Form E on performance of Form F.

As mentioned previously, equivalence of the two samples was established statistically using independent variables known to effect criterion (IGMTT-Form F) performance. Turner (19:24-27) explored the effect, on performance of the IGMTT, of the variables intelligence, reading comprehension, arithmetic ability, attitude as measured by the MTAI, and values. None of these was found to be a good predictor of success. However, intelligence, reading comprehension, and arithmetic ability were more consistently correlated (in a positive direction) to performance on the IGMTT than were the other variables. Consequently, it was decided to use intelligence and arithmetic ability as variables to statistically establish equivalence of the treatment groups. The instruments used for obtaining scores on these variables were the Otis Quick-Scoring Mental Abilities Test: Gamma Test (OTIS Gamma) (9) and Structure of the Number System: Form A (4). These tests were administered during the ninth week of the fall semester and the seventh and eighth week of the spring semester. Reading comprehension was not measured since Turner (18:38) reports a high correlation (.74 to .84) between intelligence and reading comprehension in his undergraduate samples.

Since methods instruction in language arts and science remained the same for both treatment groups, it was thought the ability to perform elementary teaching tasks in the combined areas might be a variable on which scores would both correlate highly with the IGMTT scores and be equivalent for the two treatment groups. Thus, scores on this variable were obtained. The instrument used for collection of data was Behavioral Dimensions of Teaching, Instructional Tasks - Intermediate (14), henceforth referred to as BDT. Only those parts of this instrument pertaining to the teaching of reading and science were used. The deletion of a portion of the test resulted in the creation of a new instrument and made it necessary to establish its reliability.

Statistical Tests

To avoid making the assumptions necessary for the use of parametric statistics, non-parametric statistics were used in all tests that made use of scores on the IGMTT instruments and the BDT instrument.

To ascertain the sensitivity of the IGMTT instruments to method instruction, the Mann-Whitney U test, as outlined by Siegel (12:123), was used to test the hypothesis:

> SH_4: The performance on the IGMTT-Form E of subjects who had received instruction in elementary school mathematics teaching methods will not be significantly different (0.05 level) from those who had not received instruction.

A one tailed test of significance was used.

The Spearman coefficient of rank correlation, as described by Siegel (12:204), was used to determine whether performance on the Otis Gamma or Structure of the Number System test would serve as a predictor of performance on the IGMTT-Form F. As a result of the work of Turner, referred to previously, positive correlations were expected. Therefore, the correlations were tested for significance (0.05 level) by using a one tailed test as outlined by Siegel (12:210-212). These computations were made for verification of Turner's findings, using different instruments and testing procedures.

The Spearman coefficient of rank correlation was also used to determine whether performance on the BDT instrument would serve as a predictor of performance on the IGMTT-Form F. Again, due to the nature of the BDT instrument, positive correlation was expected, and significance (0.05) of the coefficient was tested using a one tailed test.

The assumption was made that the distribution of the populations as related to intelligence and mathematical ability would, in both cases, be normal. The t-test, as described by Walker and Lev (20:155-157), was used to test hypotheses SH_1 and SH_2. Scores on the Otis Gamma were used as the measure of intelligence and scores on the Structure of the Number System test were used as the measure of mathematical ability. Use of the t-test for the differences in the means of independent samples requires the assumption that the observed sample variances are not inconsistent with the hypothesis that the samples come from populations with the same variance. Following the procedure suggested by Walker and Lev, (20:85) the F-test was used to test this hypothesis.

The Mann-Whitney U test was used to test hypothesis SH_3. Scores on the BDT instrument were used as the measure of ability to perform cognitive teaching tasks in reading and science.

The reliability of the BDT instrument was computed using a split halves technique and the Spearman coefficient of rank correlation. An estimate of the reliability for a full length test was made using the Spearman-Brown Prophecy Formula as described by Ferguson (5:378).

To determine the effect of pre-testing, the Mann-Whitney U test was used to test the hypothesis:

SH_5: Performance on the IGMTT-Form F of those subjects administered the IGMTT-Form E will not be significantly different (0.05) from those administered the dummy instrument.

Finally, the Mann-Whitney U test was used to test the research hypothesis, H_0. Scores on the IGMTT-Form F were used as the measure of ability to perform cognitive teaching tasks in elementary school mathematics.

Assumptions and Limitations

A major assumption in an expost-facto design is that the experimenter can recognize and will explore all alternative variables that might have a significant effect on the dependent variable. The assumption in this study was that intelligence, arithmetic ability, and ability to perform teaching tasks in reading and science are the major alternative variables and that other variables that might be significant are randomly distributed or highly correlated with the three named.

The selection of the IGMTT as the criterion instrument made additional assumptions necessary. First, the assumption was made that scores on this instrument would be indicative of the learners' ability to perform these tasks. In addition, the limited scope of the IGMTT must be considered. Conduct of the final statistical test in the preceding section served as a test of the research hypothesis only if it can be assumed that performance of the four tasks contained in

IGMTT-Form F was indicative of the total meaningful learning outcome resulting from elementary school mathematics methods instruction.

An additional assumption was made with respect to the learning opportunities existent in the elementary school mathematics methods course. Although the instructor was the same for all subjects, it was necessary to assume that the behavioral objectives set forth by this instructor remained constant during the times subjects were enrolled in the various sections of the course.

Since it was necessary to administer the IGMTT-Form F on completion of student teaching, it is likely that learning resulting from student teaching effected scores. It was assumed that the learning opportunities resulting from student teaching (unless related to the chronological relationship of the elementary school mathematics methods instruction to student teaching) remained constant for both treatment groups.

Assumptions resulting from the testing procedure were as follows:

1. Testing at varying times in varying locations had no effect on scores.
2. Group response to the testing procedure remained constant for both treatment groups.
3. Subjects lost from the study as a result of absenteeism during testing were so few they had no effect on the study.

The C-group and S-group were considered to be samples from the same population but having been drawn at different times. The population to which the writer wished to apply the results of this study was all individuals who have received or will receive elementary school mathematics methods instruction at Oklahoma State University under the concurrent curriculum design studied, the methods instructor remaining constant. Generalizations to other populations cannot be statistically justified.

The stated purpose of this study was to determine the effect of the concurrent elementary school mathematics methods instruction and student teaching program at Oklahoma State University on meaningful learning resulting from the methods instruction. It was anticipated that information obtained would be of use to the elementary education faculty at Oklahoma State University in making decisions related to future implementation of the program. It is with these purposes in mind that the importance of the above assumptions and limitations must be considered.

CHAPTER III

ANALYSIS OF THE DATA

The analysis of the data is divided into four sections. The first two sections contain the analysis of data related to the Otis Gamma, Structure of the Number System test, and BDT instrument. The first section is a report of the relationship of criterion instrument scores (IGMTT-Form F) to scores on the above instruments. The next section is an analysis of the comparability of the treatment groups as related to performance on the three tests. The third section is an analysis of the sensitivity of the IGMTT instruments to methods instruction. The final section is an analysis of the difference between the C-group and the S-group performance on the criterion instrument. An analysis of the effect of administration of the pre-test (IGMTT-Form E) on criterion performance is included in this final section.

With the exception of the IGMTT-Form E, complete sets of scores were obtained for 121 of the 130 subjects included in the original treatment groups, 48 subjects in the S-group and 73 in the C-group. The remaining nine subjects were absent for at least one phase of the testing, and for various reasons could not be tested at another time. The relatively small size of the latter group led to the assumption that they would not have an effect on the study. On the basis of this assumption, these subjects were not considered in any analysis of the data obtained on the Otis Gamma, Structure of the Number System, BDT, or IGMTT-Form F instruments. Data on the IGMTT-Form E was sought from a random half of each treatment group. It was successfully obtained for 23 subjects of the S-group and 39 subjects of the C-group. All of these subjects were used in testing the sensitivity of the IGMTT instruments. Only those for which all other data was available, 22 of the 23 subjects and 38 of the 39 subjects, were used in the analysis of the pre-testing effect on Form F performance. Again, the assumption was made that subjects lost from the study did not effect the results.

The use of both parametric (t and F tests) and non-parametric (Spearman coefficient of rank correlation and Mann-Whitney U test) statistics necessitated the use of both raw scores and ranks in various computations. Therefore, in addition to tabulating raw scores for all subjects, scores were arranged according to rank order. The rank ordering of scores involved several different schemes, depending on the groups of subjects whose performances were to be compared.

The Effect of Selected Variables on Criterion Performance

Intelligence, mathematical ability, and ability to perform cognitive teaching tasks in reading and science were selected by the writer as variables which might effect performance on the criterion instrument. The work of Turner, referred to previously, exhibited a positive correlation between IGMTT-Form F performance and the variables intelligence and arithmetic ability. The purposes of this section are (1) to provide verification of the work of Turner, using different instruments and procedures for obtaining data, and (2) to establish the relation of the third variable, ability to perform cognitive teaching tasks in reading and science, on IGMTT-Form F performance.

The Spearman coefficient of rank correlation was used for the statistical treatment of the data. Calculation of this coefficient involves placing in rank order the scores on each of the two variables to be compared. Computation of the coefficient of correlation is based on the sum of the squares of the difference in ranks achieved by each subject, and the number of subjects. Only the scores for the 73 subjects in the C-group for whom all data were available were used in obtaining these coefficients.

Since the work of Turner indicated that positive correlations could be expected between the IGMTT-Form F and the variables intelligence and arithmetic ability, and since both the BDT and the IGMTT-Form F measure ability to perform cognitive teaching tasks; positive coefficients of correlation were expected. Therefore, the statistical significance of each coefficient was computed using a one tailed test.

The resulting coefficients of rank correlation and their levels of statistical significance are reported in Table I.

The coefficients or rank correlation were not large enough for scores on the selected instruments to be considered as good predictors of success in performing the IGMTT-Form F instrument. However, it is worth noting that the correlations are all positive as predicted and are statistically significant. These findings verify the results of Turner related to intelligence and arithmetic ability. Also, it would appear that the ability to perform cognitive teaching tasks in reading and science is related to IGMTT-Form F performance. Scores on the <u>Structure of the Number System</u> test were more highly correlated with

TABLE I

CORRELATION BETWEEN CRITERION SCORES AND SCORES ON SELECTED VARIABLES

Instrument	Coefficient	df	Level of Significance
Otis Gamma	0.21	71	$p < 0.05$
Structure of the Number System	0.30	71	$p < 0.025$
BDT	0.24	71	$p < 0.01$

scores on the IGMTT-Form F instrument than were the other two tests, while the correlation between scores on the Otis Gamma and scores on the IGMTT-Form F was the lowest and least significant of the three selected instruments. The 0.05 level of statistical significance indicates that the observed positive coefficient of correlation could have occurred by chance only five times out of 100 if the ability to perform the Otis Gamma was not positively associated with the ability to perform the IGMTT-Form F.

The BDT instrument was constructed by selecting three out of five of the original tasks comprising the Behavioral Dimensions of Teaching: Instructional Tasks-Intermediate instrument. The reliability of the new instrument thus formed was calculated by using a split halves technique. Raw scores for the split halves may be found in Appendix A. The Spearman coefficient of rank correlation for the split halves was 0.43. The Spearman Brown Prophecy Formula yielded a corrected reliability of 0.60 for the full length BDT instrument.

Comparability of Treatment Groups

The use of an ex-post facto design required that variables (other than the independent variable) that might effect criterion performance be explored. To meet this requirement, subhypotheses SH_1, SH_2, and SH_3 (see page 14) were formulated and tested. These hypotheses are related to the comparability of the treatment groups on the variables intelligence, mathematical ability, and ability to perform cognitive teaching tasks in reading and science respectively.

The t-test for differences in mean scores was used to test SH_1 and SH_2. The t-test, as used, is a test of the hypothesis that the difference in mean scores is zero. The test requires the assumption that the variance of scores for the two variables are equal. This assumption must be tested; one procedure is to conduct an F-test based on the ratio of the variances; the smaller the F, the more tenable the assumption. An additional assumption of normality of the sample distributions must be made. The results of the statistical tests of SH_1 and SH_2 are contained in Table II and Table III.

TABLE II

DIFFERENCE BETWEEN MEAN SCORES
ON THE OTIS GAMMA

	N	Mean	Variance	t	df	Level of Significance
S-group	48	56.19	81.19	-0.99	129	$p > 0.20$
C-group	73	57.38	62.48			

TABLE III

DIFFERENCE BETWEEN MEAN SCORES ON THE STRUCTURE OF THE NUMBER SYSTEM TEST

	N	Mean	Variance	t	df	Level of Significance
S-group	48	24.44	31.04	-0.81	129	p > 0.20
C-group	73	25.43	34.49			

The ratio of the variances yielded an $F = 1.30$ for scores on the Otis Gamma and an $F = 1.11$ for scores on the Structure of the Number System test. Both resulted in an $F < F_{.95}$. These F's are small enough to support the assumption of homogeneity of variance made in using the t-test. The level of significance of the values of t were computed using a two tailed test. The difference in the S-group and C-group mean scores were not statistically significant for either of the tests analyzed. Therefore, subhypotheses SH_1 and SH_2 are tenable. The reader should note that the hypotheses could not be rejected even at the 0.20 level of statistical significance. This is a strong indication that the existing differences in the mean scores were little more than chance differences and that the two groups may be assumed to be samples from the same population with respect to intelligence and mathematical ability.

The Mann-Whitney U test was used to test SH_3. This statistical test is a test of the hypothesis that the distributions of two sets of scores are equivalent. The statistic is a non-parametric statistic and requires only the assumption that ordinal level of measure has been obtained; that is, the ranks of the scores provide an ordering of the scores through which one score can be said to be better than another. The numerical difference in the raw scores may be meaningless. To calculate U, all scores are placed in rank order without regard to the treatment group to which subjects belong. The ranks are then summed for one of the treatment groups. The selection of the group has no bearing on the outcome of the test. Calculation of U is then based on the sum of the ranks for one treatment group and the number of subjects in each group. As sample sizes become large (greater than 20), the distribution of U approaches the normal distribution. In this case, a z can be calculated from U, and the level of significance of the test can be obtained from a table for the normal distribution with zero mean and unit variance. This procedure was the one employed by the writer. The sum of ranks used in calculating U was the S-group sum of ranks. A two tailed test was used to determine the level of statistical significance of the test. The results are reported in Table IV.

TABLE IV

DIFFERENCE BETWEEN DISTRIBUTIONS
OF SCORES ON THE BDT

	N	Sum of Ranks	Median Scores	U	z	Level of Significance
S-group	48	2693	35	1987	1.25	$p > 0.20$
C-group	73		37			

The difference in the distributions of the S-group and C-group scores on the BDT was not statistically significant. Therefore, subhypothesis SH_3 was not rejected. Inspection of Table IV reveals that the level of statistical significance was the same as that of the tests of subhypotheses SH_1 and SH_2. Again, this is a strong indication that the existing difference, indicated by the median scores, is little more than a chance difference and that the two groups may be assumed to be samples from the same population with respect to ability to perform cognitive teaching tasks in reading and science.

One additional observation should be made. Examination of Tables II, III, and IV reveals existing differences are all in favor of the C-group. The probability of this occurring by chance when the distributions of the samples are equivalent is $p = 0.125$, the same as the probability of obtaining three consecutive heads when flipping a coin. Although this probability does not meet the 0.05 level of statistical significance, it does suggest the possibility that differences in ability, although small, did exist and that the C-group was the more able of the two groups. To assert that the difference in ability is real would be much the same as concluding that the above coin was biased only on the basis of the three observed trials.

Sensitivity of IGMTT Instruments to Methods Instruction

The Mann-Whitney U Test was used to test subhypothesis SH_4 (see page 22). It was expected that instruction in methods of teaching elementary school mathematics would have a positive effect on the performance of the IGMTT-Form E instrument. Therefore, a one tailed test of statistical significance was used. The reader should recall that only half of each treatment group was administered the IGMTT-Form E. The sum of the ranks for the half of the S-group was used in the computation of U. The results of the test are contained in Table V.

TABLE V

DIFFERENCE BETWEEN DISTRIBUTIONS OF SCORES ON THE IGMTT-FORM E

	N	Sum of Ranks	Median Scores	U	z	Level of Significance
S-group	23	793	22	380	-1.00	$p < 0.16$
C-group	39		19.5			

Failure to attain the 0.05 level of statistical significance implies that hypothesis SH_4 cannot be rejected. However, the difference in median scores and the value of z (the fact that z is negative) indicate a shift in distribution in the expected direction. The 0.16 level of statistical significance attained means that these observed differences could occur, by chance, 16 times out of 100 if samples were drawn from populations of equal distribution.

Differences in Criterion Performance

The Mann-Whitney U Test was used to test the research hypothesis, H_0. The theory developed in Chapter I dictated the use of a one tailed statistical test. The results were expected to show a higher level of performance on the IGMTT-Form F by the C-group. The sum of the ranks for the S-group was used in the computation of U. The results are reported in Table VI.

TABLE VI

DIFFERENCE BETWEEN DISTRIBUTIONS OF SCORES ON THE IGMTT-FORM F

	N	Sum of Ranks	Median Scores	U	z	Level of Significance
S-group	48	3016.5	21.5	1663.5	-0.45	$p < 0.68$
C-group	73		20.5			

On the basis of the above results, hypothesis H_0 could not be rejected. In fact, the median scores and value of z obtained indicate a shift in the distributions in a direction opposite to the expected direction. The reader should also note that the level of statistical significance obtained was very large.

It is possible that pre-testing (administration of the IGMTT-Form E) may have had an effect on the scores used in the above analysis. If so, the above results may not provide a valid basis for consideration of the research hypothesis.

The hypothesis relating to the effect of pre-testing was sub-hypothesis SH_5 (see page 24). The Mann-Whitney U Test was used as the statistical test of this hypothesis. Since each treatment group had a different opportunity to interact with the pre-test (a result of the two levels of treatment), SH_5 was tested for each treatment group. S-group scores on the IGMTT-Form F were placed in rank order and the sum of ranks was computed for the random half administered Form E. Calculation of U was then based on this sum and the number of subjects in each random half. The fact that the halves were not equal was a result of absences during testing. The same procedure was followed for the C-group. A two tailed test of statistical significance was used in both cases. The results of these tests are contained in Table VII.

TABLE VII

EFFECT OF THE ADMINISTRATION OF IGMTT-FORM E ON FORM F PERFORMANCE

Subjects[1]	N	Sum of Ranks	Median Scores	U	z	Level of Significance
S-group						
F_1	22	643	22.5	182	-2.15	$p < 0.05$
F_2	26		19.75			
C-group						
F_1	38	1373.5	20.25	697.5	0.36	$p > 0.36$
F_2	35		20.5			

[1] F_1 denotes those subjects who were administered both IGMTT-Form E and Form F. F_2 denotes those subjects administered only IGMTT-Form F.

A statistically significant difference existed in the distributions of scores on the IGMTT-Form F for the S-group but not for the C-group. This was an interesting and unexpected result. However, the relevance of these results to this study lies only in the fact that hypothesis SH_5 must be rejected and the effects of pre-testing should be considered in the analysis of data obtained with the criterion instrument.

There were 26 subjects in the S-group and 35 subjects in the C-group who were not pre-tested. The size of these subgroups were thought to be large enough to provide a valid statistical analysis of the research hypothesis. Interpretation of results thus obtained would not necessitate consideration of the pre-testing effect. Therefore, the decision was made to test the hypothesis H_0, using only the IGMTT-Form F scores of these subjects. The statistic used, again, was the Mann-Whitney U. The sum of the ranks of those subjects from the S-group not pre-tested was used in calculating U. The results of the test are contained in Table VIII.

TABLE VIII

DIFFERENCE IN DISTRIBUTIONS OF SCORES ON IGMTT-FORM F FOR SUBJECTS NOT ADMINISTERED FORM E

Sample to Which Subjects Belong	N	Sum of Ranks	Median Scores	U	z	Level of Significance
S-group	26	759	19.75	502	0.70	$p > 0.24$
C-group	35		20.5			

The difference in the two distributions was not statistically significant. Again, hypothesis H_0 was not rejected. However, some differences in this test of H_0 and the previous test of H_0 are worth noting. Observed shifts in the distributions of the previous test indicated a higher level of performance by the S-group. The observed shifts in the distributions in the present test indicate a higher level of performance by the C-group. The latter result was the expected result.

The random procedure in which subjects were assigned to the respective halves should allow all tests of equivalence of the S-group and C-group to be extended to the halves of these samples which were not administered the IGMTT-Form E.

Summary

The analysis of the data can be summarized as follows:

1. Statistically significant positive correlations did exist between ranks of scores on the IGMTT-Form F and ranks of scores on the Otis Gamma, Structure of the Number System, and BDT instruments. However, the correlations were small, indicating that no one of the three instruments would provide scores that would serve as a good predictor of success on the IGMTT instruments.
2. Subhypotheses SH_1, SH_2, and SH_3 are tenable although the consistency in which the C-group performed higher than the S-group suggests that, as a group, the C-group may have possessed greater ability in the areas explored.

3. Subhypothesis SH_4 was not rejected. However, observed shifts in the sample distributions indicated a higher level of performance on the IGMTT-Form E by subjects who had received methods instruction in the teaching of elementary school mathematics.

4. Subhypothesis SH_5 was rejected, indicating that administration of Form E did effect Form F performance.

5. The null form of the research hypothesis was not rejected. The analysis of performance on the IGMTT-Form F was conducted two ways; (1) using all S-group and C-group scores and (2) using only the scores of those not pretested. In the latter analysis there was an observed shift in sample distributions that indicated a higher level of performance by the C-group; this was the expected outcome.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Summary

During the 1970-71 academic year, Oklahoma State University conducted a pre-service elementary teacher education program in which instruction in methods of teaching and student teaching were concurrent. This program replaced the traditional program in which methods instruction was prior to student teaching. The primary purpose of this study was to determine the effect of the concurrent methods instruction and student teaching program on the degree of meaningful learning accomplished by students in the area of methods of teaching elementary school mathematics. The degree of meaningful learning that the student had accomplished was demonstrated by his ability to perform certain cognitive level elementary school mathematics teaching tasks.

A partial theory of learning related to instruction in elementary school teaching methods and student teaching was developed by the writer. The theory was based on the work of Ausubel. The following two postulates formed the core of the theory:

1. The learner who studies methods of teaching during student teaching will have a meaningful learning set of greater magnitude than the learner who studies methods of teaching prior to student teaching.

2. Potentially meaningful material can be presented more efficiently in the methods course in which the learner is concurrently engaged in student teaching than in the methods course followed by student teaching.

On the basis of the above postulates, it was hypothesized that the degree of meaningful learning attained by students receiving methods instruction in the teaching of elementary school mathematics concurrent to student teaching would be greater than that of students receiving methods instruction prior to student teaching, even if the number of hours devoted to student teaching were reduced.

The independent variable was the methods instruction in elementary school mathematics received by the subject. The variable was two dimensional; that is, it varied in its chronological relationship to student teaching and in the number of hours allocated for its instruction. The dependent variable was the meaningful learning accomplished by the subject as indicated by his ability to perform certain cognitive level teaching tasks in elementary school mathematics.

An ex-post facto design was used to conduct the study. Subjects for the study were among those students doing their student teaching at Oklahoma State University during the 1970-71 academic year. These subjects, through a process of self-selection, were divided into two groups, the S-group and the C-group. The S-group, consisting of 50 students, received 32 hours of methods instruction in the teaching of elementary school mathematics prior to 16 weeks of student teaching. Student teaching was during the fall of 1970. The C-group, consisting of 80 students, received 17 hours of methods instruction concurrent with 16 weeks of student teaching. Student teaching for this group was during the spring of 1971. The professor providing the methods instruction and the behavioral objectives for the instruction was the same for both groups. With the exception of the instruction in elementary school mathematics teaching methods, the programs in which the subjects student taught were identical.

The two organizational schemes above, based on the chronological relationship of elementary school mathematics methods instruction to student teaching, provided the two levels of the independent variable. Performance on the dependent variable, the meaningful learning accomplished by the student as indicated by his ability to perform certain cognitive teaching tasks, was measured by the Intermediate Grade Mathematics Teaching Tasks - Form F by Richard L. Turner. This instrument was administered to all subjects on completion of student teaching.

To determine if the above instrument was sensitive to methods instruction, an alternate form, the Intermediate Grade Mathematics Teaching Tasks - Form E, was administered to a random half of each group of subjects at the beginning of student teaching. At this time the S-group had received methods instruction on the teaching of elementary school mathematics; the C-group had not received instruction. The use of random halves was employed to provide a test of the effect of pre-testing on the performance of subjects on the criterion instrument.

The use of an ex-post facto design required that other variables, those that might effect performance on the criterion instrument, be explored. Previous work by Turner suggested that the major variables to be considered were intelligence and arithmetic ability. To provide a comparison of the two groups of subjects on these variables, they were administered the Otis Quick-Scoring Mental Ability Test: Gamma

Form and the Structure of the Number System: Form A. In addition, the groups were compared on their ability to perform cognitive level teaching tasks in the areas of elementary school language arts and science. The instrument used for this comparison, referred to as BDT instrument, was constructed by deleting from the Behavioral Dimensions of Teaching: Instructional Tasks - Intermediate instrument those tasks related to the teaching of arithmetic. The original instrument was designed by Turner. The reliability of the BDT instrument was established using a split halves technique.

Spearman coefficients of rank correlation were computed to determine the correlation between performance of the above instruments and performance on the Intermediate Mathematics Teaching Tasks Form F.

Conclusions

A basic assumption made in this study was that intelligence, arithmetic ability, and ability to perform cognitive level teaching tasks in elementary school language arts and science would encompass those variables, other than the independent variable, that would have a major effect on criterion performance. The statistically significant positive coefficients of rank correlation found between the IGMTT-Form F and each of the tests -- Otis Gamma, Structure of the Number System, and BDT -- indicate that these variables do have a direct relationship with criterion performance. Of the three variables studied, arithmetic ability appears to be the variable having the greatest effect on criterion performance while intelligence appears to have the least effect on criterion performance. The magnitude of these coefficients would indicate that no one variable in the three is a good predictor of performance on the IGMTT. However, extensive work by Turner (19:24-27) has not revealed a variable more highly correlated to IGMTT performance than are intelligence and arithmetic ability. Therefore, the above assumption would appear to be tenable, and all conclusions related to IGMTT performance are based on this assumption.

There was no statistically significant difference in the mean scores achieved by the two groups of subjects, the S-group and the C-group, on either the Otis Gamma or the Structure of the Number System. Also, there was no statistically significant difference in the distributions of scores achieved by the two groups on the BDT instrument. Therefore, hypotheses SH_1, SH_2, and SH_3 are tenable. These results support the assumption that the two groups may be treated as samples from a single population. However, it should be noted that the C-group mean scores on the Otis Gamma and Structure of the Number System and the C-group median score on the BDT instrument were all higher than the respective scores for the S-group. The consistency in which these scores favored the C-group suggest the possibility that the C-group had greater ability in these areas.

The test of the sensitivity of the IGMTT instruments to methods instruction was disappointing. No statistically significant difference, at the 0.05 level, was detected between the distributions of scores on the IGMTT-Form E for subjects who had received methods instruction in the teaching of elementary school mathematics and those who had not received instruction. As a result, hypothesis SH_4 could not be rejected. There are at least three possible explanations for the failure to obtain the 0.05 level of significance. First, the instruments may not be sensitive to methods instruction. Second, as a result of the limited scope of the instruments, they may be sensitive to methods instruction but not sensitive enough to attain the 0.05 level of significance. This explanation receives some support from the existing differences in the median scores for the two groups and the fact that the 0.16 level of significance was attained. The third explanation is that the abilities in the three areas shown to effect IGMTT performance were greater for the random half of the C-group than for the S-group. If this were true, the C-group scores could have been raised to the point where no statistically significant difference existed in Form E distributions. The existence of such a possibility has been suggested in the above discussion of the equivalence of the two groups as related to these three variables. The only statement that can be made with assurity is that the existing differences in the two sample distributions could occur only sixteen times out of one hundred if samples of the same size as those used were drawn from two populations of equal distribution. Any conclusions based on these instruments must take into consideration the chance differences.

Administration of the IGMTT-Form E as a type of pre-test effected scores on the IGMTT-Form F. A statistically significant difference existed in the distributions of IGMTT-Form F scores achieved by the random halves of the S-group. Therefore, SH_5 was rejected. The difference in the distributions of scores for the C-group was not statistically significant. Inspection of the median scores for the random halves revealed that, as a group, those subjects in the S-group who were administered the IGMTT-Form E instrument performed significantly higher on the Form F instrument than did those subjects in the S-group administered the dummy instrument. Why pre-testing effected the

S-group and did not appear to effect the C-group is a question that remains unanswered and would appear to be a question worthy of further investigation.

As a result of the pre-test's effecting performance on the IGMTT-Form F instrument, the analysis of subject performance on this instrument was conducted in two ways. First, the distribution of all the S-group scores were compared to the distribution of all the C-group scores. Next, the distribution of the scores achieved by the random half of the S-group not administered Form E was compared to that of the random half of the C-group not administered Form E. The size of the n for each of the latter groups was 26 and 35 respectively. This was thought to be large enough to provide a valid comparison. No statistically significant difference existed in the distributions for either analysis. Therefore, the null form of the research hypothesis

> H_0: The meaningful learning accomplished by students taught under the concurrent elementary school mathematics methods instruction and student teaching curriculum design will be less than or equal to that of the students taught methods prior to student teaching.

was not rejected.

One purpose of this study was to provide information that would aid the faculty of the Department of Education at Oklahoma State University in their evaluation of the new program. The statistical test of the above hypothesis would indicate that there is little difference in the two programs studied. However, other considerations must be made. Examination of the median scores and the value of z reported in Table VIII, reveals a shift in distributions that would indicate a higher level of performance on the IGMTT-Form F by the post-test only subjects in the C-group than by the post-test only subjects in the S-group. In view of the previous discussion of the sensitivity of the IGMTT instruments, these differences, although small, may indicate that a greater degree of meaningful learning did result from the concurrent elementary school mathematics methods instruction and student teaching curriculum design.

Implications for Future Research

The necessity of speculation as to the sensitivity of the IGMTT instruments in the interpretation of the statistical results implies the need for additional developmental research in the area. A more sensitive instrument would facilitate this kind of research. As this study progressed, it became apparent that certain aspects of its design could be improved. First, the amount of testing conducted was burdensome to the subjects. Results on the criterion instrument might be improved if this burden were reduced. Next, a different criterion instrument should be used. The criterion instrument selected must have two qualities; (1) it must be highly sensitive to learning that results from elementary school mathematics methods instruction, and (2) it must measure meaningful (as opposed to rote) learning. An additional suggestion is that the number of hours devoted to methods instruction be increased in the concurrent curriculum design. In the present study the C-group received approximately half the number of hours of instruction on the methods of teaching elementary school mathematics as did the S-group. To expect more meaningful learning to have occurred in the C-group was a rather ambitious goal.

An additional area for exploration is the effect of the concurrent curriculum design on the student's attitude toward the teaching of elementary school mathematics. Although the meaningful learning accomplished by the student may not have increased, an improvement in attitude would serve as a major argument for the use of the design.

The observed pre-testing effect on IGMTT-Form F scores resulting from the earlier administration of Form E was a result that warrants further investigation. The fact that the pre-testing effect occurred only in the group of subjects receiving methods instruction prior to student teaching suggests that an interaction occurred between performance of the Form E instrument and existing knowledge in the area of elementary school mathematics teaching methods. Since no feedback on the results were provided to the students, it would appear that the improved performance was the result of a greater degree of learning rather than memorization of responses. The writer would hypothesize that prior methods instruction resulted in a cognitive structure through which the learner was able to subsume the tasks contained in the IGMTT-Form E. In this way, the tasks, if not the solutions to the tasks, became a part of the learner's cognitive structure. As a result, the nature of the tasks were recalled when similar tasks were encountered in student teaching. Previous difficulty with these tasks may have motivated the learner to seek the knowledge necessary to perform the tasks successfully. If this hypothesis is true, it should have great implications related to the nature of review at the end of methods instruction (if directly followed by student teaching) or to the nature of the introduction to student teaching where student teaching follows methods instruction. In either of these cases the goal would be to duplicate, on a larger scale, those circumstances that resulted in a greater degree of learning of the four tasks in the IGMTT-Form F accomplished by the pre-tested half of the S-group.

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APPENDIX A

INDIVIDUAL SCORES OF SUBJECTS

PARTICIPATING IN THE STUDY

S-Group

SNS[1]	OTIS GAMMA	BDT	E BDT[2]	O BDT[3]	IGMTT-E	IGMTT-F
30	67	39	22	17	26	23
23	61	40	21	19		19.5
34	60	33	19	14	25	24.5
24	64	27	15	12		18.5
18	40	27	17	10	7	22
28	53	27	14	13	24	26
32	61					
28	63	39	19	20	26.5	27.5
27	66	42	23	19	23	18
20	55	36	17	19		11
31	60	26	10	16	15.5	27
19	54	25	15	10	11	14.5
37	56	28	14	14		21
28	46	23	12	11	23	21.5
30	63	39	20	19		20
20	50	35	18	17		15
21	65	35	19	16	18	20
28	66	34	21	13	21.5	21.5
17	52	42	27	16		22.5
28	68	46	23	23		21.5
24	52	41	20	21		13
34	71	28	17	11		29.5
22	51	39	15	24		22.5
25	55	38	13	25		24.5
22	57	45	20	25		19.5
23	54	21	12	9		17.5
28	50	44	23	21		21
32	68	36	20	16	24	22
23	66	34	16	18		24.5
25	59	23	10	13		19.5
31	61	50	23	27	24	22.5
25	45	43	25	18		18.5
21	36	41	23	18		14.5
22	59	32	17	15	18	13
12	58	28	12	16		22
29	51	32	20	12		20
23	39	28	14	14	22	24.5
25	51	30	17	13	22	22.5
20	47	35	17	18		7.5

[1] Score on <u>Structure of the Number System Test</u>.

[2] Score on even half of BDT instrument.

[3] Score on odd half of BDT instrument.

SNS	OTIS GAMMA	BDT	E BDT	O BDT	IGMTT-E	IGMTT-F
25	67				25.5	
17	68	27	18	9	16	24.5
23	68	39	19	20		23
36	72	46	22	24	26	29
21	58	36	17	19	21	26.5
19	37	39	21	18		11
14	54	32	13	19	18	15.5
22	52	30	15	15	18.5	21.5
15	41	43	22	21	18.5	17.5
22	56	19	5	14		11.5
27	52	27	11	16		26.5

C-Group

SNS	OTIS GAMMA	BDT	E BDT	O BDT	IGMTT-E	IGMTT-F
22	51	42	22	20		22.5
33	63	30	13	17		17.5
18	51	30	13	17	19	20
28	63	38	18	20	12.5	13.5
23	55	43	18	25		16.5
30	54	55	24	31		14.5
30	65	38	21	17	24	24
24	53	46	22	24	19	22
37	74	47	25	22	23	23.5
27	52	32	18	14		22.5
24	55	36	18	18	12	16.5
18	62	32	18	14		18
		36	18	18	30	
25	72	24	17	7	21	18
22	57	28	17	11	21	17
24		37	17	20		
26	49	32	18	14		17
27	58	43	22	21		26
21	44	33	19	14		15.5
17	50	33	14	19		17.5
23	71	33	17	16	20.5	22.5
29	62	40	18	22		16.5
25	54					
23	54	22	7	15	22.5	20
27	61	35	18	17	26	23
27	55	40	14	26	24	23.5
16	63	26	8	18		18
24	47	43	21	22	21	21.5
34	62	30	16	14		28.5
30	58	28	10	18	15	15.5
22	56	41	18	23		29
25	54	37	14	23	18.5	26
26	56	48	28	20	21	22.5
30	63	24	15	9	17	12.5
20	50	51	25	26		23.5
20	51	41	20	21		19.5
19	50	16	11	5	13.5	20.5
29	67	40	17	23	20	21.5
22	50	35	19	16	13.5	14.5
10	48	24	12	12	19.5	11
19	40	16	9	7		21.5
32	56	35	17	18		26
25	60	37	20	17		10.5
22	50	29	12	17		18
30	72	26	13	13	27.5	23
20	47	41	20	21	14.5	19
13	49	36	20	16	18.5	23

SNS	OTIS GAMMA	BDT	E BDT	O BDT	IGMTT-E	IGMTT-F
29	57	37	17	20	16.5	18.5
16	57	37	20	17		23
30	56	40	20	20		22.5
32	74	25	11	14		24
25	63	48	22	26	17.5	23
33	61	41	20	21		24.5
27	65	39	18	21	17	22
31	62	39	22	17	15	19
39	71	46	23	23	28	24.5
17	50	40	19	21	22.5	14.5
24	54	33	17	16		21
27	48	29	14	15		20
34	49	39	22	17		20.5
21	61	43	26	17		17
24	59	35	18	17	15.5	15
29	68	45	23	22	16	23.5
35	62	33	20	13		24
17	51	37	21	16	22	23
20	43	31	8	23		21.5
		33	16	17		
33	58	41	20	21	19	17.5
28	63	42	18	24	26	17.5
37	69	45	27	18		26
30	58	39	18	21		24
23	59					
31	67	44	22	22	22.5	20
22	52	33	15	18		15.5
25	71	32	20	12		17
27	56					
20	46	23	10	13	17	20
29	63	39	19	20	28.5	27
23	51	36	16	20		18

VITA 3

Donald Lee Mahaffy

Candidate for the Degree of

Doctor of Education

Thesis: A COMPARISON OF TWO SCHEMES FOR SEQUENCING A METHODS COURSE AND STUDENT TEACHING

Major Field: Higher Education

Biographical:

Personal Data: Born in Coffeyville, Kansas, October 18, 1934, the son of Everett David and Anne Lois Mahaffy.

Education: Graduated from Monmouth High School, Monmouth, Illinois, in 1952; received the Bachelor of Science degree from Midwestern University, Wichita Falls, Texas, with a major in mathematics, in May, 1960; received the Master of Arts degree from North Texas State University, Denton, Texas, with a major in mathematics, August, 1964; completed requirements for the Doctor of Education degree at Oklahoma State University in July, 1971.

Professional Experience: Employed as a mathematics teacher at Zundelowitz Junior High School, Wichita Falls, Texas, from January, 1960 to June, 1961; employed as a mathematics teacher at Rider High School, Wichita Falls, Texas, from September, 1961 to June, 1968; was chairman of the Department of Mathematics at Rider High School from September, 1966 to June, 1968; attended the National Science Foundation Institute in Astronomy at Sam Houston State College, Huntsville, Texas, Summer, 1966; employed as director of the planetarium at the Wichita Falls Museum and Art Center, Wichita Falls, Texas, from September, 1968 to August, 1968; employed as a graduate assistant in the Department of Mathematics, Oklahoma State University, Stillwater, Oklahoma, from September, 1968 to January, 1971; employed as a graduate assistant in the Department of Education, Oklahoma State University, from January, 1971 to June, 1971.