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THE ACHIEVEMENT OF EIGHTH-GRADE STUDENTS

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PATTERNS OF TEACHER PREPARATION

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CHAPTER I

THE PROBLEM: ITS BACKGROUND AND SCOPE

Introduction

The amount and kind of preparation that a prospective teacher receives in an institution of higher learning engaged in preparing teachers, whether this is its primary function or not, varies considerably from institution to institution.

In general, preparation of the prospective teacher may be divided into three headings:

(1) General education courses

(2) Professional education courses

(3) Specialized subject-matter courses

According to Lieberman:

> The general education courses are supposed to provide educational experiences which everyone should have regardless of occupational choice. The subject-matter courses are those in the prospective teaching field of specialization, such as English or mathematics or biology. Professional education courses are those oriented to teaching, research, and to education as a social institution.[1]

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[1]Myron Lieberman, Education as a Profession, (Prentice Hall, Inc., Englewood Cliffs, N. J., 1956), pp. 137-138.

Because of overlapping of the content of the courses offered for general education or specialization credit it was difficult to define exactly the category in which some of the courses belonged. An examination of the literature also showed that not all writers agree that the prospective teacher needs all three types of preparation. For instance, Bestor[1] indicated that specialized education is important but that professional-education courses are superfluous. Woodring[2] and Hutchins[3] believed that a general education is sufficient, with Woodring conceding that, perhaps, one or two courses in professional education are necessary. Barr[4] stated that all three types of preparation are necessary in preparing successful teachers. With this diversity of opinion among the experts appearing in the literature, it was not surprising that the requirements with respect to these three types of preparation varied from state to state and from institution to institution. It must be remembered, however, that certification requirements directly controlled only the minimum requirements of teacher preparation. Among teacher education institutions throughout the nation the minimum required courses varied as follows for the elementary certificates:[5]

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[1]Arthur E. Bestor, Educational Wastelands, (Urbana: The University of Illinois Press, 1953), p. 138.

[2]Paul Woodring, New Directions in Teacher Education, (New York: Fund for Advancement of Education, Publishers, 1957), p. 76.

[3]Robert Maynard Hutchins, The Higher Learning in America, (New Haven: Yale University Press, 1936), p. 56.

[4]A. S. Barr, "Characteristics of Successful Teachers, "Phi Delta Kappan, XXXIX:6, (March, 1958), p. 283.

[5]W. Earl Armstrong and T. M. Stinnett, A Mannual on Certification Requirements for School Personnel in the United States, (Washington, D.C.: National Commission on Teacher Education and Professional Standards, National Education Association of the United States, 1961), 219 pp.

(1) General Education

Requirements varied from a low of sixteen hours in Puerto Rico to a high of 104 semester hours in Illinois.

(2) Professional Education

Requirements varied from a low of sixteen semester hours in North Dakota to a high of thirty-six in Mississippi, New Jersey, and New York.

(3) Specialized Subject Matter

Not all of the states specified a required number of hours in a major field. Some merely specified a bachelor's degree from an accredited institution. For those which did specify a major field of specialization, the requirements varied from a low of fifteen hours in New Mexico to a high in Michigan of twenty-four hours in a major field and two minors of fifteen hours each or four minors of fifteen hours each to be in areas taught in elementary schools.

For the secondary certificate, minimum required course work varied as follows:[1]

(1) General Education

Requirements varied from a low of twenty-five semester hours in Missouri to a high of 104 semester hours in Illinois.

(2) Professional Education

Requirements varied from a low of fifteen semester hours in Virginia to a high of twenty-nine hours in Puerto Rico.

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[1]Ibid.

(3) Specialized Subject Matter

Requirements varied from state to state and subject to subject within the state. For example: the minimum requirement to teach physics in Louisiana was twelve semester hours but eighteeen semester hours were required in mathematics and twenty-four semester hours in English. Connecticut required a minimum of thirty semester hours in English and eighteen in mathematics and physics. The smallest minimum requirement in a subject field was six hours in New Hampshire, while the largest minimum requirement for a subject matter field was fifty-four in Wisconsin.

Certification requirements were further complicated by the different types of certificates issued. They were divided into three categories:[1]

(1) According to duration of validity

Examples of these are life, permanent, provisional, probationary and temporary.

(2) According to levels of preparation

Examples of this type of certificate are regular, standard, professional, emergency, and substandard.

(3) According to authorization of teaching position assignment.

Examples of this type of certificate are blanket or general, endorsed, and special field. A special field certificate may be issued for each field, or one certificate may be issued with the special fields listed on the certificate.

The issuance of these types of certificates has the effect of

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[1] Ibid., p. 15.

varying the requirements by allowing a teacher to teach with an emergency or substandard certificate that has less than the standard requirements.

In twenty-eight states, elementary and secondary certificates overlapped the junior high school grades. In most states, the teacher could not teach in the organized junior high school with an elementary certificate without having the required number of semester hours in the subject being taught. However, Oklahoma, Oregon, and Texas permitted a teacher with an elementary certificate to teach the same subjects in grades seven and eight as a teacher with a secondary certificate. North Dakota issued one certificate which was valid for all grades in nonaccredited schools. This, in effect, lowered specialized subject-matter requirements in these four states because elementary certificates did not usually require a large number of semester hours of college work in subject-matter fields to be taught.

The Background and Need for the Study

As the criticism of teacher education have increased in recent years, so have the teacher certification requirements.[1] In many instances, the additional requirements raised standards to the bachelor's degree where many authorities agree it ought to be if teaching is to be regarded as a profession. In those states where the bachelor's degree was already the minimum, the master's degree and beyond often became the minimum. In addition to the increased requirements demanded by the various states for

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[1]W. James Popham and Suzanne W. Greenberg, "Teacher Education; A Decade of Criticism," Phi Delta Kappan, XL:III (December, 1958), pp. 118-120.

certification, other agencies such as the North Central Association of Secondary Schools and Colleges also increased their requirements.

An examination of certification practices in mathematics in Oklahoma revealed the same upward trend in requirements as reported in other states. Teachers with the following types of standard certificates were certified to teach arithmetic in grades seven and eight in the junior high schools of Oklahoma:

1. Standard Mathematics Certificate.

In 1957, twenty-four hours of course work in college mathematics were required for this certificate necessary for the teaching of mathematics in grades seven through twelve. This requirement could be reduced by three semester hours for intermediate algebra and two semester hours for solid geometry and trigonometry when taken in high school. However, not more than six semester hours of such credit could be used in reducing the total requirement, making the minimum requirement eighteen semester hours of course work in college.[1] In October, 1961, this requirement for the standard certificate was raised to twenty-eight semester hours of course work in college mathematics with a minimum of twenty-one to be earned in college.[2]

In addition to the standard certificate, an approval credential was required of all teachers starting with the beginning of the school

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[1]Oliver Hodge, A Handbook on Teacher Certification and Teacher Education Programs, (Oklahoma City, Oklahoma: State Board of Education, Revised July 1, 1957), p. 24.

[2]Oliver Hodge, Teacher Education, Certification, and Assignment Handbook, (Oklahoma City, Oklahoma: State Board of Education, Revised October 1, 1961), p. 12.

year in 1963.[1] The requirements for this specific certificate in mathematics included twenty-four semester hours of course work in mathematics for a teacher with a major teaching assignment in mathematics and eighteen hours for a teacher with a minor assignment in mathematics. Only three semester hours will be deducted for intermediate algebra, trigonometry, or solid geometry earned in high school.

2. Standard Elementary Certificate

Teachers working toward a standard elementary certificate in 1957 were required to take course work in mathematics although no minimum was stipulated.[2] A change was made in October, 1961, raising the minimum to two courses in mathematics with the second course to be in subject matter content and/or methods and materials especially appropriate to preparation for teaching at the elementary level.[3]

3. Standard Certificate in Any Field with a Minimum of Fifteen College Hours in Mathematics.

The minimum number of college hours required for teaching mathematics with a standard certificate in any field was also changed by the State Board of Education. In June, 1955, the minimum number of college hours of college mathematics required was sixteen with a maximum deduction of six hours for work done in the subject in high school.[4] In July

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[1] Ibid., p. 87.

[2] Oliver Hodge, A Handbook on Teacher Certification and Teacher Education Programs, (Oklahoma City, Oklahoma: State Board of Education, Revised July 1, 1957), p. 21.

[3] Oliver Hodge, Teacher Education, Certification, and Assignment Handbook, (Oklahoma City, Oklahoma: State Board of Education, Revised October 1, 1961), p. 8.

[4] Oliver Hodge, Annual High School Bulletin, (Oklahoma City, Oklahoma: State Board of Education, June 30, 1955), p. 12.

1959, the minimum was reduced to fifteen hours with a maximum deduction of six hours for work done in the subject in high school.[1] The minimum was not changed in October, 1961, but a warning was issued that in 1962 the minimum college preparation in that particular field would be eighteen hours.[2]

4. General or Blanket High School Certificate with a Minimum of Fifteen College Hours in Mathematics (this certificate is no longer issued in Oklahoma, but it is still recognized as valid for those teachers who are so certificated).

Changes in requirements for this certificate were identical to the changes made in the requirements for teaching mathematics with a standard certificate in any field. Minimum requirements in 1962 were to be eighteen semester hours of college preparation in mathematics.

A summary of the requirements for teaching mathematics in 1962 revealed that a teacher with a Standard Mathematics Certificate needed a minimum of twenty-one semester hours of college mathematics; a teacher with a Standard Elementary Certificate needed two courses in mathematics; and a teacher with a Standard Certificate in any field or a Life or blanket certificate needed a minimum of eighteen semester hours of college work in mathematics. Therefore, it was possible that in the same school a teacher with six semester hours, a teacher with eighteen semester hours, and a teacher with twenty-one semester hours of mathematics would all be teaching eighth grade arithmetic. Because enforcement of state regulations

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[1]Oliver Hodge, Annual Bulletin for Elementary and Secondary Schools, (Oklahoma City, Oklahoma: State Board of Education, July, 1959), p. 18.

[2]Ibid., p. 18.

is not uniform, an even greater variation is possible.

Although the minimum requirements for preparation in subject-matter fields are rising, there has not been a parallel increase in the requirements for professional education. As stated by the Manual on Certification Requirements for School Personnel in the United States in 1959:[1]

> The continuing criticism of overconcentration upon "methodology," a derisive term used to denote all education courses, does not seem to be borne out by reported requirements of the states.
>
> This edition of the Manual reflects a continued trend toward telescoping professional requirements toward practices clustering around 18 semester hours for high-school teachers and 24 for elementary-school teachers.

In a profession which relies heavily on measurement and evaluation to make decisions regarding its clients, it would appear that basic changes in certification should be based on research evidence. However, Earl W. Anderson and Elfreda M. Rusher[2] reported that the major research in teacher certification consisted of studies of current practice or of histories of certification, and that no research was found that tested the value of specific certification practices. They also stated that the effectiveness of certification requirements has not been studied in any experimental sense and that the few available investigations were in terms of opinions of administrators. Although the upward trend in certification requirements was apparent in Oklahoma, there has been no research to

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[1]W. Earl Armstrong and T. M.Stinnett, A Manual on Certification Requirements for School Personnel in the United States, (Washington, D. C.: National Commission on Teacher Education and Professional Standards, National Education Association of the United States), p. 14.

[2]Earl W. Anderson and Elfreda M. Rusher, "Teacher Certification," Encyclopedia of Educational Research, 3rd Edition, (New York City: MacMillan Co., Publishers, 1960), p. 1354.

support such a change. Requirements were increased again in 1963-64 without any basis on research.

This study is concerned with the double certification standards available for teachers in the junior high schools in Oklahoma. It will focus on arithmetic teachers because of the great differences in the requirements for the elementary and secondary certificates in that field and because the shortage of mathematics teachers has forced administrators to use teachers with certificates in other teaching fields to teach mathematics.

Statement of the Problem

The problem of this investigation was: Is the achievement of eighth grade pupils in arithmetic effected by the teacher's preparation in mathematics and professional education courses?

The study involved the testing of the following specific null hypotheses:

Hypothesis 1: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with fewer than eighteen semester hours and by teachers with eighteen or more than eighteen semester hours of preparation in mathematics.

Hypothesis 2: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with fewer than twenty-eight semester hours and by teachers with twenty-eight or more semester hours of preparation in professional education courses.

Hypothesis 3: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers

with ten or less than ten years teaching experience and by teachers with more than ten years teaching experience when the mathematics preparation of the teachers was controlled by matching.

Hypothesis 4: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with ten or less than ten years teaching experience and by teachers with more than ten years teaching experience when the professional education preparation of the teachers was controlled by matching.

Major Assumptions

The assumption was established that scores on the California Achievement Test in Arithmetic, Intermediate Battery, are reliable and valid measures of achievement by eighth grade students in mathematics, and this test was the best available for the purpose intended.

Limitations of the Study

1. The sample was limited to a select sample of students enrolled in eighth grade arithmetic in the public schools of Oklahoma City during the academic year 1957-58. The subjects had to be in the same teacher's class for the entire year.

2. The sample was limited to students with mental maturity scores above eighty.

Procedures

In planning for an investigation which would permit the achievement of the purposes of this study, the following steps were taken:

1. Application was made and granted for permission to test students, contact counselors, and use the pre-test scores of all the Oklahoma

City secondary pupils. Ten schools cooperated in this study. Five of the schools were separate junior high schools, while the other five were six-year secondary schools.

2. Counselors were contacted in order to determine the time and manner in which the test would be administered. After such meetings, a decision was made to use the California Achievement Test in Arithmetic, Intermediate Battery, because it was valid, reliable, and the best available test for the purposes of the study. In addition, the test was suited to the mathematics curriculum in the system and was already in use in the system.

3. The test was administered by the various counselors according to a pre-determined selection of time and method because these individuals were competent in the testing field and able to provide effective administration for the test.

The tests were administered according to the order in which the teachers' names appeared on the schedule. This method of sampling resulted in a total sample of 528 pupils in the mathematics classes of twenty-eight teachers. Fifteen teachers taught in junior high schools; thirteen teachers taught in six-year schools.

4. The answer sheets were made available to the writer for scoring and were manually scored.

5. Permission was granted to examine the personnel records of the teachers involved in the study. The preparation of each teacher was ascertained as well as other information pertinent to this study.

6. Teachers and their classes were grouped as specified in the hypotheses.

Organization of the Study

In order to achieve the purpose of this study, the remaining chapters were determined as follows: Chapter II, Review of Selected Research Studies; Chapter III, Procedure of the Study; Chapter IV, Analysis and Interpretation of the Data; and Chapter V, Summary, Conclusion, and Recommendations.

CHAPTER II

REVIEW OF RELATED LITERATURE

The measurement and prediction of teacher effectiveness has been the object of much research. As reported by Fattu[1] studies on teacher effectiveness started in 1891 and have been summarized and reviewed periodically since 1926. In spite of this, there have been little or no objective evidence gathered that will reliably measure or predict this factor.

Although the major purpose of the present study is not to measure or predict teacher effectiveness, some understanding of this type of research is necessary before the utilization of pupil gains as a criteria for determining effective patterns of teacher preparation can be made. Howsam[2] reported that "there are three distinct ways to measure the effectiveness of the teacher.

1. By the teacher's behavior - what the teacher does.
2. By the characteristics of the teacher - what the teacher is.

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[1]Nicholas A. Fattu, Who's a Good Teacher?, (Washington, D.C.: American Association of School Administrators, Department of Classroom Teachers of the National Education Association, National School Boards Association, Publishers, 1961), p. 12.

[2]Robert B. Howsam, Who's a Good Teacher?, (Burlingame, California: Joint Committee on Personnel Procedures of the California School Boards Association and the California Teachers Association, Publishers, 1960), p. 23.

3. By the effect the teacher has on the pupils."

In the sections that follow, the various methods used to gather evidence to substantiate these hypotheses have been discussed and the disadvantages of each method identified.

Studies of Teacher Behavior

In these studies it was assumed that certain kinds of behavior by the teacher will result in desired changes in behavior by the pupil. Classroom observation was the primary method utilized with rating scales as the instruments used to gather evidence.

Barr[1] analyzed 209 rating scales which were in use prior to 1930 and compiled a list of the ten most commonly rated attributes: (1) choice of subject matter, (2) classroom management, (3) appearance of the room, (4) professional attitudes, (5) personal habits, (6) personal appearance, (7) instruction, (8) discipline, (9) cooperation, and (10) health.

When he gave a list of twelve attributes to sixty supervisors and had them observe an arithmetic class twice for thirty minutes at a time, he discovered that uniform appraisal did not result from the use of a list of observable attritubtes. Barr found that the most significant result of these ratings was that the supervisors did not reach agreement on what they had observed.[2]

A study by Davenport[3] of pupil rating of teaching practices

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[1]A. S. Barr and Dennis H. Cooke, Administering the Teaching Personnel, (Chicago: B. H. Sanborn and Company, 1939), p. 190.

[2]A. S. Barr, W. H. Burton and L. J. Brueckner, Supervision, (New York: D. Appleton-Century Company, 1938), p. 387.

[3]Kenneth Davenport, "An Investigation Into Pupil Rating of Certain Teaching Practices," Purdue University: Studies in Higher Education, XLIX (January, 1944), pp. 1-61.

revealed that pupils are, in rating teachers, competent judges of how much they liked the respective teachers.

The effectiveness of self-rating by teachers was investigated by Cooke[1] in 1937. In his investigation, principals of ten schools in Arkansas, Kentucky, and Tennessee made three separate ratings of the 217 elementary and high school teachers involved; then the teachers rated themselves on a self-administering adaptation of the same rating scale. Cooke averaged the three ratings of the principals into a single rating and compared it with the self-ratings of the teachers. He found that principals and teachers did not agree to any appreciable amount as to who were good teachers.

Pointing out the disadvantages of the use of ratings, Anderson[2] stated that "the bitterest attacks on rating scales pertain to the lack of reliability in these instruments. The variation in results that occur may come as a consequence of change in the teacher, change in the observer, or in the interpretations of the scale. Ratings are certainly affected by the length and conditions of observation, the attitudes of the persons involved, the social and emotional status of the pupils, the prejudices of the observer, and the nature of the occasion when the last rating took place. It is not at all surprising that the statistical reliabilities quoted in the literature show such wide variation."

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[1]Dennis H. Cooke, "How Do Teachers Rate Themselves?", Educational Administration and Supervision, XXIII (September, 1937), PP. 473-476.

[2]Harold Milton Anderson, "A Study of Certain Criteria of Teaching Effectiveness," The Journal of Experimental Education, XXIII (September, 1954), pp. 41-71.

Studies of Teacher Characteristics and Personality

Characteristics are studied in the assumption that effective teachers will display certain traits or characteristics that are substantially different from those of ineffective teachers.

The early research in teacher evaluation made attempts to determine what qualities or traits were possessed by the effective teacher as opposed to those possessed by the ineffective teacher. Such studies investigated such traits or qualities as intelligence, scholastic achievement, knowledge of subject matter, age, experience, educational background, cultural background, sex, marital status, interests, voice, speech, appearance and in later years, personality.

Reporting on studies of teachers' characteristics Tyler[1] reported that "successful teachers are little less than paragons if one is to judge from recent discussions and from reports of empirical observations and experimental research dealing with teachers' personalities. One writer lists nineteen desirable qualities, including integrity, maturity, dominance, and diligence. Another investigator catalogues twenty-nine attributes, such as introversion, vitality, punctuality, and persistence. A third researcher tabulates only six traits, but among them is competence in computing with two digit numbers. A fourth author reports that 'speed of tapping' and 'right and left hand coordination' (supposedly measures of temperament) distinguish effective from non-effective teachers. Another

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[1]Fred T. Tyler, "Teachers' Personalities and Teaching Competencies," The School Review, LXVIII (Winter, 1960), pp. 429-449.

writer thinks that intelligence is important but maintains that we cannot prove that fact. Effective teachers, one states, are peppy and popular, with pleasing voices. One other example: a teacher should have magnetism, self-control, and enthusiasm. A complete listing would contain a finite number of attributes, but the number seems to be approaching infinity as a limit."

Later on in the same article Tyler proposed that regardless of how we feel about the observed relationships between teacher competence and personality, we may still ask why results are not more positive than those typically reported. Barr[1] concluded that "there is some basis for talking about the effectiveness of teachers in terms of personality traits or the quality aspects of behavior but that much needs to be done with the word personality before this approach can be useful. One might correctly say that, notwithstanding the tremendous amount of time, money, and energy expended in this approach, the adventure has not been particularly successful."

A typical study of teacher personality is the one described by Guba and Getzels.[2] Two hundred and thirty-four officer instructors at the Air Command and Staff School, Air University, Maxwell Air Force Base, Alabama, were rated on their effectiveness by their colleagues and by their superiors. They were also given the following personality instruments: The Guilford-Martin Inventory of Factors GAMIN, the Guilford-Martin

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[1]A. S. Barr, "The Assessment of the Teacher's Personality," The School Review, LXVIII (Winter, 1960), pp. 400-408.

[2]E. G. Guba and J. W. Getzels, "Personality and Teacher Effectiveness: A Problem in Theoretical Research," The Journal of Educational Psychology, XLVI (October, 1955), pp. 330-344.

Inventory of Factors STDCR, the Allport Vernon-Lindzey Study of Values, and the Rosenzweig P-F Study.

Fisher's t test was used to test the comparisons between the mean scores of the effective and ineffective lecturers, discussion leaders, and instructors in general. Seventy-five mean scores were compared on twenty-five variables. Of the sixteen variables tested by the Guilford-Martin Inventory of Factors GAMIN, the Guilford-Martin Inventory of Factors STDCR, and the Allport-Vernon Lindzey Study of Values one was significant for the lecturers, six for discussion leaders, and two for instructors in general. Of the nine variables tested by the Rosenzweig P-F Study and a sentence completeness test, six each were significant for lecturers, discussion leaders, and instructors in general.

Conclusions drawn were as follows:

(1) Extra punitiveness is linked to ineffectiveness.

(2) Intropunitiveness is linked to effectiveness.

(3) Impunitiveness is linked to effectiveness.

(4) Obstacle dominance is linked to ineffectiveness.

(5) Ego defensiveness is linked to ineffectiveness.

(6) Need persistence is linked to effectiveness.

(7) A high negative projective score is linked to ineffectiveness.

(8) A high negative direct score is related to neither effectiveness nor ineffectiveness.

(9) The difference between projective and direct negative scores is linked to ineffectiveness.

Singer[1] investigated the relationship between the teacher's

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[1]Arthur Singer, "Social Competence and Success in Teaching," Journal of Experimental Education, XXIII (December, 1954), pp. 90-131.

social competence and success in teaching. Forty-one in-service teachers in eighteen Wisconsin senior high schools were the subjects for the study. Measuring instruments used to measure teaching effectiveness were the following: (1) administrator's M-Blank rating, (2) qualified person's M-Blank rating, (3) teacher self-evaluation form, (4) pupil reaction to instruction blanks, (5) confidential X-rating of the teacher by an outside agency, and (6) trained persons' rating of audio-recording of teaching presentations. In order to ascertain the social competence of the teacher, the following data-gathering devices were used: (1) teacher-teacher social distance scale, (2) teacher-student social distance scale, (3) student-teacher social distance scale, (4) Minnesota Multiphasic Personality Inventory, and (5) trained persons' rating of recordings of teaching presentations.

Intercorrelations were obtained for all of the variables measured. Mean differences of the fourteen most successful and fourteen least successful teachers were calculated. The three most and the three least successful teachers were next identified, and modified sociograms showing their friendship and social competence status in relation to their respective teaching staffs were constructed. The three most successful teachers appeared to be teaching staff group leaders or to have had at least subgroup status, while the three least successful teachers appeared to be isolates and fringers.

The general conclusions reached in this study were that the use of instruments and techniques in the area of social competence with its aspects of group acceptance, group structures, group interaction, and individual social adjustment appeared to be fruitful in the search for more

adequate criteria of teaching success.

Relying on pupil evaluations rather than tests or colleague and supervisory ratings, Symonds[1] attempted to determine the characteristics of the effective teacher. Pupils were asked to react to their teachers in response to seven questions:

1. Which one of your teachers makes the work most interesting?
2. Which one of your teachers understands you best and likes you most?
3. Which one of your teachers would you most like to have again next year?
4. Which one of your teachers makes you most willing to study or to participate in the work of the class?
5. Which one of your teachers helps you most to learn?
6. Which one of your teachers would you feel most like consulting on some personal matter for guidance and counseling?
7. Which one of your teachers makes you want to continue to go through high school?

Thirty-two teachers and 453 students in grades seven, eight, and nine were involved in the study. The school was a junior high school in one of the suburbs of New York City.

In order to obtain evidence concerning the validity of the ranking of the pupils, the principal was asked to rate the teachers on disciplinary control, relationships with pupils, and success in terms of pupil

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[1]Percival M. Symonds, "Characteristics of the Effective Teacher Based on Pupil Evaluations," Journal of Experimental Education, XXIII (June, 1955), 289-310.

achievement. In addition, the principal, with the aid of the assistant principal, rated each teacher on all-round excellence.

Correlations were made with the following results:

1. Pupil rankings agreedwith each other with coefficients of correlations in the .70's, .80's, or low .90's.
2. Pupil rankings correlated with the principal's ranking in the .60's for principal ratings of teacher discipline, in the .70's for teacher relationships with pupils, and in the .40's for teacher ability to secure pupil achievement.
3. The following characteristics seemed to differentiate superior from inferior teachers:
   a. Superior teachers liked children; inferior teachers disliked children.
   b. Superior teachers were personally secure and self-assured; inferior teachers were not.
   c. Superior teachers were well integrated and possessed good personality organization while the inferior teachers tended to be personally disorganized.

Although the results of the above studies of teacher characteristics and personality seemed to be more successful than those reported in the section on teacher behavior, they have added to rather than limited the number of possible criteria for predicting and measuring the effectiveness of teachers. Added criteria would make those responsible for performing this task unable to do so in the amount of time they have available.

Studies of Teacher Effect on Pupil Gain

Analyzing the problem of measuring the competency of the teacher by the effect the teacher has on the pupil, Mitzel and Gross[1] reported that "although teachers are effective to the extent that they stimulate their pupils to achieve desirable educational goals, research and workers have been slow to seize upon pupil growth toward these goals as a means of evaluating teacher performance. Compared with other studies of procedures for evaluating teachers, there have been relatively few investigations involving comparisons between measured achievement of pupils before and after a period of instruction. The dearth stems in part from the difficulty of isolating the contribution of a single influence -- the teacher -- to the complex of pupil growth. Yet, despite the difficulty, analysis of the effect of the teacher upon the growth of pupils is essential to the function of teacher recruitment, training, selection, and promotion."

Fattu[2] reported that "if the purpose of teaching is to bring about desired changes in pupils, the obvious measure of teacher effectiveness is the extent to which the teacher actually produces such changes. Unfortunately, many difficulties intrude upon this happy prospect: (1) It is difficult to measure pupil growth; and (2) it is difficult to determine precisely how much of the change can be directly attributed to the teacher."

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[1]Harold E. Mitzel and Cecily F. Gross, A Critical Review of the Development of Pupil Growth Criteria in Studies of Teacher Effectiveness (New York: Division of Teacher Education, Board of Higher Education of the City of New York, April, 1956), p. 1.

[2]Fattu, op. cit., p. 15.

In 1956 Mitzel and Gross[1] reported on only twenty studies involving the development of a pupil growth criterion for teacher competency. The most comprehensive of the studies was the one reported by McCall.[2] He used a test battery composed of eight tests developed specifically for the study and compared many characteristics of the seventy-three teachers involved with the growth of their 2,164 sixth grade students in two North Carolina cities (Greensboro and High Point). Concerning teacher effectiveness, the following conclusions were reached:

1. There was little correlation with the amount of training the teacher possessed.
2. There was little correlation with the experience of the teacher.
3. There was no correlation with the teacher's age.
4. There was no correlation with the teacher's salary.
5. There was no correlation with the sex of the teacher.
6. There was a slight correlation in favor of married women teachers over single women teachers.
7. There was no correlation in favor of either mothers or non-mothers.
8. There was no significant correlation in favor of either Negro or white teachers.
9. There was a high correlation in favor of those teachers who made home visits over those who did not make home visits.

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[1]Mitzel and Gross, op. cit., p. 3.

[2]William A. McCall, Measurement of Teacher Merit, Publication No. 284 (Raleigh: North Carolina State Department of Public Instruction, 1952).

10. There was a high correlation in favor of those teachers having conversations with pupils out of school over those having no conversations with pupils out of school.

In the same year, Schunert[1] investigated, among other things, the relation of the mathematics achievement of pupils to the training and experience of their teachers. He took a stratified proportionate sampling of the population of Minnesota's 522 public secondary schools with respect to enrollment size and organizational structure. He then administered an achievement test which he had constructed at the beginning and at the end of the academic year. Using the method of covariance technique on subsamples drawn from the larger population, he adjusted for differences in initial achievement and mental scores of students. Dividing his subsamples into two groups based on the mathematical backgrounds of the teachers involved, he found that no significant differences existed among the achievement records of students in geometry, whether their teachers had less than two or two or more years of college mathematics. In evaluating teachers of high school algebra, he found that the subsamples involved in this comparison were heterogeneous as to their means, and no comparisons could be made.

Taylor[2] investigated the relationships between the growth of interest and achievement among high school science students and the

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[1]Jim Schunert, "The Association of Mathematical Achievement with Certain Factors Resident in the Teacher, in the Teaching, and in the School," Journal of Experimental Education, XIX (March, 1951), 233-234.

[2]Thomas Wayne Taylor, "A Study to Determine the Relationships Between Growth in Interest and Achievement of High School Science Students and Science-Teacher Attitudes, Preparation, and Experience," (unpublished Doctoral dissertation, North Texas State College, 1957).

attitudes, preparation, and experience of their teachers. Student achievement in science was measured by the difference in scores on the science section of the Essential High School Content Battery published by the World Book Company. Eighty-three teachers and 1,632 students were involved in the research.

A Pearson Product-Moment correlation coefficient was determined for each of the teacher factors compared with the mean gains (or losses) of science interest and science achievement among students. No statistically significant difference at the 0.05 level of significance was discovered for the following comparisons:

1. Number of hours of professional education and science achievement of the students.
2. Number of hours of college science and science achievement of the students.
3. Years of teaching experience and science achievement of the students.

Significance at the 0.05 level among the composite factors indicated the possibility that interaction of two or more of the foregoing factors had affected science achievement.

Soper[1] investigated certain teacher characteristics in relation to the academic progress of 2,656 elementary students in grades four, five, and six. The factors he investigated among the 128 teachers involved in the study were salary, experience, and training. Using the analysis of

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[1]Earl Francis Soper, "A Study of the Relationship Between Certain Teacher-School Characteristics and Academic Progress, as Measured by Selected Standardized Tests of Elementary Pupils in Grades 4, 5, and 6 of New York State Public Schools in Cities Under 10,000 Population" (unpublished Doctoral dissertation, Syracuse University, 1956).

covariance technique to eliminate the intelligence effect, he found among students of the teachers with higher salaries and more experience, statistically significant higher achievement scores at the 0.01 level, although these teachers had less training when the period of training was dichotomized.

Webb and Bowers[1] conducted research to determine whether student learning could be used as a criterion of teacher effectiveness. Sixty-two students and their twelve instructors were involved in the study. They discovered by using the analysis of variance technique that there was a difference between instructors when the achievement of their students was taken into consideration.

Under the direction of A. S. Barr of the University of Wisconsin, a great many studies were carried out attempting to measure and predict teacher effectiveness. Although many different methods were utilized, only a few of those that depended on pupil gain as a criteria have been discussed here.

Rostker[2] investigated seventh and eighth grade citizenship classes in small nondepartmentalized grades schools. Data were obtained for 24 teachers and 375 pupils on two units of work, "Safeguarding Public Health" and "Community Planning." Specific course objectives were set up, and the pupils were given a pre-test and a post-test for informational gain at the beginning and end of each three-week unit. In addition, the

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[1]Wilse B. Webb and Norman D. Bowers, "The Utilization of Student Learning as a Criterion of Instructor Effectiveness," Journal of Educational Research, LI (September, 1957), 17-29.

[2]L. E. Rostker, "The Measurement of Teaching Ability, Study No.1," Journal of Experimental Education, XIV (September, 1945), pp. 6-51.

pupils were tested at the beginning and at the end of the school year with the Wrightstone Battery which measured long-term noninformational gain and the Hill Battery which measured long term informational gain.

Twenty-eight measures were obtained for each teacher. Among them were intelligence, knowledge of subject matter, personality, attitudes, and ratings. Intercorrelations were computed, and among other things the change in pupil behavior was found to be of two kinds: informational and noninformational. The teacher characteristics of intelligence, knowledge of subject matter being taught, attitudes, and understanding of pupil emotional problems seemed to have greater impact upon noninformational acquisitions of the pupils than upon their informational gains.

Rolfe[1] investigated the relationships of the change in pupil behavior to various characteristics of the teacher, and, like Rostker, studied pupils in one-and two-room rural schools. He studied forty-seven teachers and 404 of their pupils. Changes in pupil behavior were measured by the Wrighstone, Hill, and Unit Batteries used by Rostker. He partialled out pupil intelligence, mental age, and reading ability.

The teacher variables of intelligence, knowledge of subject matter, personality, aptitudes, socio-economic status, and teaching efficiency were included in this study. Two criterion factors of teaching efficiency were found to be pupil gains and ratings.

La Duke[2] studied the validity of certain teacher tests and rating scales as measures of teaching efficiency with pupil change used as the

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[1]J. F. Rolfe, "The Measurement of Teaching Ability, Study No. 1," Journal of Experimental Education, XIV (September, 1945), 52-74.

[2]C. V. La Duke, "The Measurement of Teaching Ability," Journal of Experimental Education, XIV (September, 1945), 75-100.

criterion.

Thirty-one teachers and 200 students in the seventh and eighth grades in one-room rural schools were studied.

Eight units of a course of study outlined by the State Department of Public Instruction were taught by all teachers in a time schedule. Objective tests were constructed to measure appreciations, attitudes, information, and interests. The tests were given at the beginning and at the end of the academic year. The post-test scores were adjusted regressionwise for intelligence, mental age, and pre-test variation.

The teacher variables measured included intelligence, ability to identify and correct pupils' emotional problems, attitudes toward teaching and the professions, educational progressiveness - conservatism and consideration for others. Teachers were also rated for classroom activities, teaching skill, and personality.

These data formed a twelve-by-twelve correlation matrix. By the use of correlation and regression analysis, he found little relationships between rating and pupil gain. However, he did find that teachers' intelligence was significantly related to his criterion of pupil gain.

A study not directly concerned with teacher effectiveness but one which is related to the problem has been made by Bassham.[1] He attempted to evaluate the relationship between the teacher's understanding of basic mathematical concepts and the pupil's ability to master arithmetic.

Sixth grade teachers in a midwestern city were administered the

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[1]Harrell Bassham, "Teacher Understanding and Pupil Efficiency in Mathematics," The Arithmetic Teacher, IX (November, 1962), 383-387.

Test of Basic Mathematical Understanding, and their scores were compared with the post-test arithmetic scores of their pupils after controlling for pre-experimental differences in arithmetic achievement, reading achievement, mental ability, and interest in arithmetic. Twenty-eight sixth grade teachers and their 620 students were involved in the study.

Control of the four pre-experimental pupil variables was effected by an analysis of multiple regression between the pupil post-experimental period arithmetic achievement scores and the four pre-experimental period measures. Each pupil's control variable test scores were then multiplied by the proper coefficient obtained from the multiple regression and the pupil's post-experimental period achievement score computed which would have resulted had all pupils gained during the experimental period at common ratios to their pre-experimental period control variable scores. The multiple correlation of .827 explained only about sixty-eight per cent of the variation of pupil post-experimental achievement scores. The remaining unexplained variation was considered to have resulted from lack of test reliability and other factors. One of the other factors was considered to be the teacher's understanding of basic mathematical concepts.

The results demonstrate a significant relationship between teacher scores and pupil efficiency to master arithmetic as measured in an unmodified classroom situation. Despite large differences among the teachers in other characteristics such as size of classes, home environment of pupils, and many other factors not controlled, the understanding of basic mathematical concepts by the teacher was demonstrated to be significantly related to pupil efficiency in learning.

Although the limitations of the use of pupil gains as a method of

measuring and predicting teacher efficiency have been demonstrated in the studies described above, none of the methods have demonstrated any superiority. The pupil gain method, however, has advantages that the other methods lack:

1. Although the objectives of the educational program vary from locality to locality and from individual to individual, the expectations of pupil growth do not.
2. The assessing of teaching competence is a complex task and should be based on objective measures rather than on more subjective measures.

CHAPTER III

PROCEDURE OF THE STUDY

This study was designed to determine the influence of certain variables inherent in selected patterns of teacher preparation on the achievement of a select sample of eighth grade students in arithmetic. A pre-test and post-test were administered to the classes of twenty-eight teachers chosen at random from the teachers of eighth-grade methematics in ten secondary schools in Oklahoma City.

Four null hypotheses were formulated:

Hypothesis 1: There is no statistically significant difference in mean arithmetic achievement of pupils in classes taught by teachers with fewer than eighteen semester hours and by teachers with eighteen or more than eighteen semester hours of preparation in mathematics.

Hypothesis 2: There is no statistically significant difference in mean arithmetic achievement of pupils in classes taught by teachers with fewer than twenty-eight semester hours and by teachers with twenty-eight or more semester hours of preparation in professional education courses.

Hypothesis 3: There is no statistically significant difference in mean arithmetic achievement of pupils in classes taught by teachers with fewer than eleven years teaching experience and by teachers with eleven or more than eleven years teaching experience when the mathematics preparation of the teachers was controlled by matching.

Hypothesis 4: There is no statistically significant difference in mean arithmetic achievement of pupils in classes taught by teachers with ten or less than ten years teaching experience and by teachers with more than ten years teaching experience when the professional education preparation of the teachers was controlled by matching.

Eighteen hours was chosen as the minimum number of total semester hours in mathematics for two reasons:

1. Starting in 1962, teachers in Oklahoma had to have this minimum in order to teach arithmetic in the secondary schools of Oklahoma.[1]
2. The North Central Association of Secondary Schools and Colleges now requires that teachers of arithmetic in accredited schools must have this number of hours.[2]

Ten years was chosen as the dividing point for the number of years of experience chiefly because the number of teachers in this study with lesser amounts of experience was too small to permit generalizations from the data involved.

Since all teachers in Oklahoma must have a minimum of twenty-one semester hours of professional preparation for a standard teaching certificate, and since all but two of the teachers in the study had more than twenty-one, the median number of hours for these twenty-eight teachers was arbitrarily chosen as the dividing point. A second reason for

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[1]Oliver Hodge, Annual Bulletin for Elementary and Secondary Schools, (Oklahoma City, Oklahoma: State Board of Education, July, 1961), p. 18.

[2]North Central Association of Secondary Schools and Colleges, Policies and Criteria for the Approval of Secondary Schools, (The Association, 1961), p. 15.

choosing this point of division was to determine what effect, if any, this many hours had on achievement since much of the criticism of teacher preparation involves the amount of professional education preparation.

The factor of preparation in general education was not included in the study due to the extremely wide variation generally present in the preparation of the teacher in this area. In Oklahoma, the requirement in 1961 was fifty hours of general education in six of ten fields of study.[1] One of the subject-matter fields included in the general education pattern was mathematics which made it possible for some prospective elementary teachers to acquire as many hours in this field as prospective secondary teachers working on a second teaching area in mathematics. It would be difficult to separate the effects of the general education preparation of the one from the specialized preparation of the other.

Description of the Teacher Sample

The information collected was employed as a basis for the classification of the groups compared in the statistical analysis. Utilizing the classification depicted in the hypotheses, the following summary describes the qualifications of the total group from which the sub-groups were chosen.

1. Specialized Subject-Matter Preparation.

Thirteen of the twenty-eight teachers had standard mathematics certificates with twenty-four or more college hours of mathematics. Of the six teachers with elementary certificates, one had twenty-six college hours of mathematics and a standard mathematics certificate, one had thirteen hours of mathematics, and the other four had six or less hours.

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[1]Oliver Hodge, Teacher Education, Certification, and Assignment Handbook, (Oklahoma City, Oklahoma: State Board of Education, Revised October 1, 1961), p. 11.

The nine teachers who were teaching eighth grade arithmetic with certification in another field had from zero to twenty-three hours of mathematics. At one particular junior high school, teachers of eighth grade arithmetic had the following number of hours of college mathematics: 6, 18, 6, 39, 9. At a certain six-year school, the range was 0, 3, 6, 24, 26. The mean number of hours of mathematics for the twenty-eight teachers was 16.9 while the median was eighteen hours.

2. Professional Education Preparation.

Only two of the teachers in the study had less than twenty-one hours of professional education now required for a standard certificate in Oklahoma. Ten of the twenty-eight teachers had less than twenty-six hours of professional education. The mean number of hours of professional education for all teachers was 29.8, while the median was twenty-eight hours.

3. Experience.

Twenty-four of the twenty-eight teachers had more than five years experience. The mean number of years of teaching experience was 18.8, with two teachers possessing thirty-five years. The median was seventeen years. Eleven teachers had ten or less than ten years experience.

4. Most Recent College or University Enrollment of Teachers Involved in the Study.

Twelve teachers had attended school during the five years preceding the study. Six of these received bachelor's degrees at that time, while six had returned for further study. Only seven of the teachers had not attended school at some time after receiving bachelor's degrees;

four of them had had interruptions in their teaching careers, while the other three had taught continuously since graduation.

5. Type of School.

Thirteen of the teachers taught in a six-year school while fifteen taught in a separate junior high school. Of the thirteen teachers who taught in the six-year school, seven had standard mathematics certificates. Of the fifteen who taught in the junior high school, six had standard mathematics certificates. Four of the teachers with elementary certificates taught in a junior high school; the other two taught in a six-year school that began as a junior high school and retained its students until it became a six-year school.

Description of the Pupil Sample

The data collected from the pupil sample consisted of pre-test and post-test scores on the California Arithmetic Test, Intermediate Level. Whole classes were administered the test in order that as normal a classroom situation as possible would be approximated during the testing and, in addition, that any teacher-pupil interaction would be sampled. Students who had not been in the class during the entire academic year were tested, but their scores were not used.

The range of the scores on the pre-tests and post-tests are presented in Table I. An examination of the data discloses that the grouping appeared to be heterogeneous in all the classes with the possible exceptions of classes six and twenty-two with uniformly low raw scores, and classes eighteen and nineteen with uniformly high scores. The pre-test scores varied from a low raw score of six to a high raw score of 126 while the post-test scores varied from a low raw score of thirty-three to a high

TABLE I

THE RANGE, MEANS, MEAN DIFFERENCES, AND STANDARD DEVIATIONS OF PRE-TEST AND POST-TEST SCORES IN ARITHMETIC ACHIEVEMENT OF 528 EIGHTH GRADE PUPILS BY TEACHER NUMBER

Teacher Number	N	Pre-Test Range	Post-Test Range	Pre-Test Mean	Post-Test Mean	Difference Between Means	Pre-Test Standard Deviation	Post-Test Standard Deviation
1	17	69-102	75-111	85.47	98.35	12.88	10.37	10.52
2	30	30-109	33-124	76.93	86.26	9.33	22.60	23.88
3	34	69-126	93-132	106.05	115.97	9.92	13.55	9.05
4	11	58-110	64-110	83.73	97.45	13.72	13.78	10.58
5	24	41-113	49-126	74.66	82.29	7.63	18.40	18.11
6	12	53- 85	73-100	69.50	81.66	12.16	9.80	6.43
7	31	59-102	65-115	78.68	89.80	11.12	11.56	13.78
8	10	62- 96	76-110	78.30	96.90	18.60	10.34	9.26
9	15	66-106	81-108	87.53	96.80	8.27	10.30	9.60
10	25	70-107	66-114	87.12	95.00	7.88	10.43	11.78
11	13	66-104	83-110	84.69	94.62	9.93	11.40	8.15
12	20	52-105	65-121	81.85	90.55	8.70	13.20	14.75
13	21	24-111	47-128	66.92	82.51	16.59	21.48	21.36
14	30	57-104	66-112	76.90	87.47	10.57	12.97	11.30
15	13	47-117	38-101	71.85	79.23	7.38	19.67	20.47
16	21	14-122	45-119	85.62	90.71	5.09	22.50	23.92
17	12	35-100	41-111	70.00	83.16	13.11	20.54	21.10
18	12	95-120	98-118	110.00	109.00	-1.00	6.95	5.82
19	12	81-106	75-113	94.50	99.42	4.92	7.11	12.37
20	16	56-106	46-114	83.38	95.50	2.12	16.01	17.21
21	21	31- 93	34-121	65.38	80.19	14.81	15.21	10.08
22	13	6- 64	44- 76	47.38	64.07	16.69	15.11	8.92
23	16	61-104	46-112	84.25	95.44	11.19	13.12	17.19
24	23	49-102	66-117	77.48	88.48	11.00	12.85	14.29
25	14	61-113	79-121	81.79	95.64	13.85	16.22	14.19
26	30	51-105	71-108	79.53	96.00	16.47	12.12	9.39
27	14	57-107	68-107	79.00	96.50	17.50	12.40	8.97
28	12	53-100	56-119	74.42	78.08	3.66	14.76	19.47
Overall	528							

raw score of 132. The range of the pre-test scores was 121 as compared to the range of 100 for the post-test scores.

Although the range of the pre-test scores was greater than that of the post-test scores, contrary to the expectations that the range of pupil achievement becomes greater as the pupils progress in school, an examination of the means revealed that on the average the post-test scores were larger than the pre-test scores. The one exception was class number eighteen where the post-test mean was smaller than the pre-test mean.

The mean of the post-test scores was 91.00 which was 10.54 greater than 80.46, the mean of the pre-test scores. The pre-test means varied from 47.38 to 110.00. The post-test means varied from 64.07 to 115.97. The range of the means of the pre-test score was 63.62 whereas the range of the means of the post-test scores was 52.90 which, again, was contrary to expectations.

The standard deviations of the pre-test scores varied from 6.95 to 22.60 with a range of 16.65. The standard deviations of the post-test scores varied from 5.82 to 23.92 with a range of 19.10. This increased range was due to the efforts of thirteen of the twenty-eight teachers whose classes had greater post-test standard deviations than pre-test standard deviations. If the range of the raw scores and the mean had increased as expected, the standard deviation would be expected to become larger. However, in fifteen of the classes the standard deviation became smaller.

The number of pupils in each of the classes is the residual of the pupils in each class that was present when both tests were administered. Absentees, transfers, and dropouts reduced the classes to the number presented in Table I.

Selection of the Subsamples

In order to reduce any bias due to the manner of selecting the sample and to introduce and hold constant certain variables inherent in the process of certification of teachers, subsamples of classes were selected to represent the larger group using the method of stratified-proportionate sampling.

In the selection of these variables, care was taken to choose those that appeared to be common practices among the fifty states. An analysis of these practices as revealed in a Manual on Certification Requirements for School Personnel in the United States[1] revealed that although there is no one requirement that is precisely the same in all fifty states, there is general agreement on some of the kinds of requirements although quantitative criteria differed. These may be classified as follows:

1. Minimum requirements for professional education, specialized subject-matter, and general education courses. Professional education courses include practice or directed teaching.
2. Types of certificates issued to include specialized subject-matter fields and/or certain grades.
3. Experience and/or further education required in order to retain the initial certificate or to earn a more permanent certificate.

The variables chosen were:

1. Number of hours of professional education.

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[1]W. Earl Armstrong and T. M. Stinnett, A Manual on Certification Requirements for School Personnel in the United States (Washington, D.C. National Commission on Teacher Education and Professional Standards, National Education Association, 1962).

2. Number of hours of specialized subject-matter preparation.
3. The type of school in which the teacher is now teaching.
4. Number of years of teaching experience.
5. Number of years since the teacher attended a college or university.

In addition to the above teacher variables, the initial mathematics achievement level of the students as represented by scores on a pretest was introduced into the analysis.

In selecting the subsamples for the four hypotheses, a procedure similar to that illustrated in Table I was utilized, and a sample of sixteen classes was drawn.

TABLE II

DISTRIBUTION OF 28 TEACHERS BY ASSIGNED NUMBERS ACCORDING TO RECENCY OF COLLEGE ATTENDANCE AND MATHEMATICS PREPARATION

Last Time in University or College	Teachers with Less Than 18 Hours Mathematics Preparation		Teachers with 18 or More Hours of Mathematics Preparation	
	Junior High	6 Year School	Junior High	6 Year School
Five or Less Years	12 14 18 19	22 24 25	13 28	2 3 5
More Than Five Years	6 7 10 17	1 26	4 8 9 11 15	16 20 21 23 27

(Classes drawn in the subsample are underlined.)

The teachers were divided into two groups based on their subject-matter preparation and then placed in the correct cells of Table II according to the type of school in which they taught and the last time they

attended a college or university. The subsamples of sixteen classes were then drawn using a table of random numbers from within cells so that representation within each pair of cells was equal. The classes drawn are underlined in Table II.

The same procedure was utilized in the selection of subsamples for the other three hypotheses. Tables III, IV, and V show the representation by class number in each subsample.

TABLE III

DISTRIBUTION OF 28 TEACHERS BY ASSIGNED NUMBERS ACCORDING TO MATHEMATICS PREPARATION AND TEACHING EXPERIENCE

Specialized Subject-Matter Preparation	Teachers with Ten or Less Years Experience	Teachers with More Than Ten Years Experience
Teachers with less than eighteen hours of mathematics preparation	1 12 22 24	6 7 10 14 17 18 19 15 16
Teachers with eighteen or more hours of mathematics preparation	2 3 8 13 20 21 18	4 5 9 11 15 16 23 27

The Evaluation Instrument

The California Achievement Test in Arithmetic, Intermediate Battery, was given to all student subjects. The test consists of 135 objective-type problems, fifty-five of which pertain to Arithmetic Reasoning and eighty of which pertain to Arithmetic Fundamentals.

The Arithmetic Reasoning part of the test is divided into four subtests: (1) Number Concepts, (2) Symbols and Rules, (3) Numbers and

Equations, and (4) Problems. The Arithmetic Fundamentals part of the test is divided into four subtests: (1) addition, (2) subtraction, (3) multiplication, and (4) division.

TABLE IV

DISTRIBUTION OF 28 TEACHERS BY ASSIGNED NUMBERS ACCORDING TO RECENCY OF COLLEGE ATTENDANCE AND PROFESSIONAL EDUCATION PREPARATION

Last Time in University or College	Teachers with Less than 28 Hours Professional Education		Teachers with 28 or More Hours of Professional Education	
	Junior High	6 Year School	Junior High	6 Year School
Five or less than five years	12 13 28	2 3 5 22	14 18 19	24 25
More than five years	4 6 8 11 15	1 16	7 9 10 17	20 21 23 26 27

TABLE V

DISTRIBUTION OF 28 TEACHERS BY ASSIGNED NUMBERS ACCORDING TO TEACHING EXPERIENCE AND PROFESSIONAL EDUCATION PREPARATION

Professional Education Preparation	Teachers with Ten or Less Years Experience	Teachers with More than Ten Years Experience
Teachers with less than twenty-eight hours of professional education	1 2 3 8 12 13 22	4 5 6 11 15 16
Teachers with twenty-eight or more hours of professional education	20 21 24 28	7 9 10 14 17 18 19 23 25 26 27

According to the Manual of the California Achievement Tests, Complete Battery, the reliability of the arithmetic test has a correlation of .95 with the complete test battery for grade eight.

According to the Manual:

> In their final form the norms for the California Achievement Tests, Intermediate Battery, have been based on a controlled (stratified) sampling which constituted a normal distribution of mental ability, typical age-grade relationships, and other characteristics as follows:
>
> 1. The median I.Q. for grades 7 and 8 was 100 and for grades 9 was 101.5. The standard deviation of I.Q.'s was 16 points.
> 2. Seventy per cent of the students were making normal progress through the grades; about 20 per cent were retarded one-half year or more; and 10 per cent were accelerated one-half year or more.
> 3. About 85% of the population was Caucasian and the remainder was Mexican, Negro, and other minority groups.

The decision to use this particular test was based on the following reasoning:

a. This test had been used in the system for many years; consequently, the counselors who administered the test were familiar with its use.

b. An examination of the test showed that it covered a wide variety of material, making it suitable for the wide range of ability present in the eighth grade in a large city school system.

Procedure for the Treatment of the Data

In this study, four hypotheses were tested using the analysis of variance and covariance techniques. In each comparison the null hypothesis was under investigation. Whenever analysis of variance and covariance techniques is employed, the data to be analyzed must satisfy certain basic assumptions.[1] They were:

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[1]Quinn McNemar, Psychological Statistics, (Second Edition; New York: John Wiley and Sons, 1955), p. 344.

1. The variables under consideration must be approximately normally distributed in the population.
2. The classes to be grouped together or pooled must be homogeneous with respect to the variances of the dependent variable and also with respect to the means of the dependent variable.

The first basic assumption was tested by application of the chi square tests to the distribution of achievement of the pupils as represented by the post-test scores. Raw data for the first, third, and fourth hypotheses may be found in Appendices A, B, and C respectively.

The homogeneity of the variances was tested using Bartlett's Test.[1] Raw data may be found in Appendices, D, E, F, G, H, and I for the first, third, and fourth hypotheses.

The homogeneity of the means of the dependent variable of the classes to be grouped together was tested using the analysis of variance technique.[2] Raw data may be found in Appendices J, K, L, M, N, O, and P for the four hypotheses.

The final step was the testing of the hypotheses using the analysis of covariance technique.[3] Raw data may be found in Appendices Q, R, and S for the first, third, and fourth hypotheses. The second hypothesis was rejected because the data did not meet the assumptions.

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[1] Ibid., p. 247.

[2] Allen L. Edwards, Experimental Design in Psychological Research, (New York: Rinehart and Company, Inc., 1953), pp. 174-181.

[3] McNemar, loc. cit., pp. 343-356.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF THE DATA

This study was concerned with determining whether certain patterns of teacher preparation and certification requirements significantly influenced student achievement in arithmetic. The first hypothesis was related to the specialized subject-matter requirement; the second hypothesis was related to the professional-education requirement; the third hypothesis was related to experience and the specialized subject-matter requirement; and the fourth hypothesis was related to experience and the professional-education requirement.

A summary of the calculations is presented in Tables VI, VII, VIII, and IX. The results of the calculations for the analyses of the first, second, and fourth hypotheses are presented in Tables VI, VII, and IX. Table VIII summarizes the calculations for the analysis of the homogeneity of the means for the third hypothesis.

Specialized Subject-Matter Requirement

Hypothesis 1 was: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with fewer than eighteen semester hours and by teachers with eighteen or more than eighteen semester hours of preparation in mathematics. The obtained F value was 2.83, and the required value for significance was 3.88. The major hypothesis was accepted, and it was concluded

that no real differences in achievement in arithmetic existed between the group taught by teachers with fewer than eighteen semester hours and those taught by teachers with eighteen or more than eighteen semester hours of mathematics. Therefore, it was concluded that the amount of preparation in mathematics was not significant with regard to pupil achievement in arithmetic. The data for the analysis of covariance are presented in Table VI.

TABLE VI

ANALYSIS OF COVARIANCE OF SUBJECT-MATTER REQUIREMENT

Source of Variation	Sums of Squares of Error of Estimate	df	Mean Square	F
Total	41,202.84	344		
Within Groups	40,864.68	343	119.13	
Adjusted Means	338.16	1	338.16	2.83

Professional Education Requirement

Hypothesis 2 was: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with fewer than twenty-eight semester hours and by teachers with twenty-eight or more semester hours of preparation in professional education courses. The obtained "F" value was 11.04, and the required value for significance was 3.88. The major hypothesis was rejected, and it was concluded that mean achievement in arithmetic was significantly greater for pupils taught by teachers with twenty-eight or more hours of preparation in professional education courses. The data for the analysis of covariance are presented in Table VII.

TABLE VII

ANALYSIS OF COVARIANCE OF PROFESSIONAL EDUCATION REQUIREMENT

Source of Variation	Sums of Squares of Error of Estimate	df	Mean Square	F
Total	10,454.74	314		
Within Groups	10,098.49	313	32.26	
Adjusted Means	356.25	1	356.25	11.04*

*Significant at the 0.01 level.

Experience and Specialized Subject-Matter Requirement

Hypothesis 3 was: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with ten or less years teaching experience and by teachers with more than ten years teaching experience when the mathematics preparation of the teachers was controlled by matching.

An analysis of the homogeneity of the means of the subgroup of eight classes whose teachers had ten or less years teaching experience produced an "F" of 12.55. The required value for significance was 2.07. It was concluded that the means were heterogeneous and the analysis was not concluded. The data for the testing of the means are presented in Table VIII.

Experience and Professional Education Requirement

Hypothesis 4 was: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with ten or less years teaching experience and by teachers with more than ten years teaching experience when the professional education

preparation of the teachers was controlled by matching. An analysis of the distribution of the dependent variable of both subgroups resulted in a chi square value of 20.72 which was larger than the required value for significance at the 0.05 level at seven degrees of freedom. According to Cochran[1], slight departures from normality of distribution among the variables causes only moderate reductions in the efficiency of the analysis. Since the deviation was not great, the next steps in the analysis of the data were undertaken.

TABLE VIII

ANALYSIS OF HOMOGENEITY OF MEANS OF EIGHT CLASSES WHOSE TEACHERS HAD TEN OR LESS YEARS EXPERIENCE

Source of Variation	Sums of Squares of Error of Estimate	df	Mean Square	F
Among Means	21,964.72	7	3,137.96	
Within Means	37,011.03	148	250.07	12.55*
Total	58,975.75	155		

*Significant at the 0.01 level.

An analysis of covariance of the data for the two subgroups was determined, and the obtained "F" value was 0.47. The required value for significance was 3.88, and the major hypothesis was therefore accepted. It was concluded that no real difference in mean achievement existed between the two categories of classes studied which suggested that the

[1]W. G. Cochran, "Some Consequences When the Assumptions for the Analysis of Variance are not Satisfied," Biometrics, III (March, 1947), p. 24.

experience factor was not important with respect to teaching arithmetic as measured by pupil achievement in arithmetic. The data for the analysis of covariance are presented in Table IX.

Table IX

ANALYSIS OF COVARIANCE OF EXPERIENCE AND PROFESSIONAL EDUCATION REQUIREMENTS

Source of Variation	Sums of Squares of Errors of Estimate	df	Mean Square	F
Total	46,969.75	299		
Within Groups	46,895.25	298	157.37	
Adjusted Means	74.50	1	74.50	.47

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The problem of this investigation was: Is the achievement of eighth grade pupils in arithmetic effected by the teacher's preparation in mathematics and professional education courses?

The study involved the testing of the following specific null hypotheses:

Hypothesis 1: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with fewer than eighteen semester hours and by teachers with eighteen or more than eighteen semester hours of preparation in mathematics.

Hypothesis 2: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with twenty-eight or more semester hours of preparation in professional education courses.

Hypothesis 3: There is no statistically significant difference in mean achievement in arithmetic of pupils in classes taught by teachers with ten or less years teaching experience and by teachers with more than ten years teaching experience when the mathematics preparation of the teachers was controlled by matching.

Hypothesis 4: There is no statistically significant difference

in the mean achievement in arithmetic of pupils in classes taught by teachers with ten or less years teaching experience and by teachers with more than ten years teaching experience when the professional education preparation of the teacher was controlled by matching.

The statistical technique of analysis of variance and covariance was used in analyzing the data. Subsamples of sixteen teachers were chosen for the analysis of each of the four hypotheses using a table of random numbers and the stratified-proportionate method of selection. The number of students selected for each of the hypotheses varied according to the teachers selected.

The instrument used in the study was the California Achievement Test in Arithmetic, Intermediate Battery. Pre-test scores were obtained from the various schools and post-test scores were obtained from the answer sheets scored by the writer. Teachers and students were not aware that they were to be given post-tests at the end of the academic year.

The hypothesis concerning the relationship of teaching experience to mean achievement in arithmetic when specialized subject-matter preparation was held constant by equal representation was not completed because the means of the subgroup of teachers with ten or less years teaching experience could not meet the assumption that they were from a common population, and consequently they could not be grouped for testing. Of the remaining three hypotheses, only that analysis concerned with the professional-education preparation of the teachers resulted in a statistically significant difference at the 0.05 level.

Major Findings

From the results of the investigations, three major findings

seemed tenable in respect to the mean achievement of eighth grade students in arithmetic. First, differences in specialized subject-matter preparation had no apparent influence when the variables of last time the teacher attended school and type of school in which the teacher taught were held constant. Second, when the same variables were held constant the differences in professional preparation had an apparent influence on the mean achievement. Third, when the variable of amount of professional education was held constant, differences in years of teaching experience had no apparent influence on the mean achievement.

Conclusions

It was concluded that the number of hours of professional education did have a significant statistical influence on the achievement of eighth grade students in arithmetic. It was also concluded that the number of hours of professional education acquired by teachers was twenty eight or more before a significant positive influence was apparent on the mean achievement of eighth grade students.

Teachers with many years of experience and many hours of professional education apparently exerted a more positive influence on the mean achievement of eighth grade students in arithmetic than teachers with fewer hours of professional education and fewer years experience. It was evident from the study that many teachers with many years of teaching experience returned to school to accumulate additional preparation which was generally in the area of professional education.

It was further concluded that the mean achievement of eighth grade students in arithmetic was not significantly influenced by the total amount of the mathematics preparation of their teachers.

Implications of the Study

The implications exist chiefly for teacher preparation and for the assignment of teachers. In the statistical phase of the study the data revealed that teacher preparation in professional education was significantly associated with achievement in eighth grade arithmetic. This would seem to indicate that the preparation of the eighth grade arithmetic teacher should be similar to that of the elementary teacher. It would also seem to indicate that the position of the eighth grade arithmetic teacher should be filled by the candidate with the greater amount of professional education.

Recommendations for Future Studies

The results of the investigation have significance for further research concerning the teaching of mathematics:

1. Is there any relationship between the amount of specialized subject-matter preparation and the achievement of other objectives of eighth grade mathematics?
2. Is there any relationship between the amount of professional education preparation and the achievement of other objectives of eighth grade mathematics?
3. What are the implications of the newer mathematics programs for the preparation of teachers in the area of mathematics education?

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APPENDIX A

TEST FOR NORMALITY OF DISTRIBUTION OF THE POST-TEST SCORES OF 346 EIGHTH GRADE STUDENTS IN ARITHMETIC IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM 1957-58 ACADEMIC YEAR FOR THE TEACHER CERTIFICATION IN MATHEMATICS

RAW SCORE	OBSERVED FREQUENCY fo	EXPECTED FREQUENCY fe	REGROUPED FREQUENCIES fo	fe	$\frac{(fo-fe)^2}{fe}$
Above - 134.4	0	1.6954)			
		)			
126.5 - 134.4	3	5.2938)	15	22.6630	2.5910
		)			
117.5 - 126.4	12	15.6738)			
108.5 - 117.4	32	34.7730	32	34.7730	.2211
99.5 - 108.4	60	57.9896	60	57.9896	.0696
90.5 - 99.4	75	63.1104	75	63.1104	2.2399
81.5 - 90.4	73	69.0962	73	69.0962	.1747
72.5 - 81.4	41	52.1768	41	52.1768	2.3941
63.5 - 72.4	29	29.0640	29	29.0640	.0001
54.5 - 63.4	12	12.1792	12	12.1792	.0026
45.5 - 54.4	8	3.8060)			
		)			
36.5 - 45.4	1	1.1072)	9	4.9478	3.5590
		)			
Below - 36.5	0	.0346)			
	N = 346				$\chi^2 = 11.2521$

APPENDIX B

TEST FOR NORMALITY OF DISTRIBUTION OF THE POST-TEST SCORES OF 316 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR FOR THE TEACHER CERTIFICATION IN PROFESSIONAL EDUCATION

RAW SCORE	OBSERVED FREQUENCY fo	EXPECTED FREQUENCY fe	REGROUPED FREQUENCIES fo	fe	$\frac{(fo-fe)^2}{fe}$
Above - 144.4	0	.3476)			
		)			
133.5 - 144.4	0	2.0224)			
		)	32	36.9720	.66
122.5 - 133.4	4	8.7216)			
111.5 - 122.4	28	25.8804			
100.5 - 111.4	66	53.9412	66	53.9412	2.69
89.5 - 100.4	78	72.1428	78	72.1428	.47
78.5 - 89.4	63	72.4904	63	74.4904	1.24
67.5 - 78.4	40	48.7588	40	48.7588	1.57
56.5 - 56.4	23	22.6256	23	22.6256	.00
45.5 - 56.4	11	7.2048)			
		)			
34.5 - 45.4	2	1.6116)			
		)	14	9.0692	2.68
23.5 - 34.4	1	.2212)			
		)			
Below - 34.4	0	.0316)			
	N = 316				$\chi^2 = 9.31$

APPENDIX C

TEST FOR NORMALITY OF DISTRIBUTION OF THE POST-TEST SCORES OF 301 EIGHTH GRADE STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR, WHOSE TEACHERS ARE GROUPED ACCORDING TO EXPERIENCE WITH PROFESSIONAL EDUCATION PREPARATION HELD CONSTANT BY MATCHING

RAW SCORE	OBSERVED FREQUENCY fo	EXPECTED FREQUENCY fe	REGROUPED FREQUENCIES fo	fe	$\frac{(fo-fe)^2}{fe}$
Above - 137.4	0	.1505)			
		)			
137.5 - 137.4	0	.8729)			
		)	17	17.1570	.00
126.5 - 137.4	2	3.7324)			
		)			
115.5 - 126.4	15	12.4012)			
104.5 - 115.4	45	29.1669	45	29.1669	8.59
93.5 - 104.4	59	50.8389	59	50.8389	1.31
82.5 - 93.4	69	64.1431	69	64.1431	.36
71.5 - 82.4	48	62.0963	48	62.0963	3.19
60.5 - 71.4	34	43.5547	34	43.5547	2.09
49.5 - 60.4	14	19.7456	14	19.7456	1.67
38.5 - 49.4	12	8.3979			
27.5 - 38.4	3	2.3177	15	11.2775	1.22
Below - 27.5	0	.5719			

$\chi^2 = 18.43$*

*Significant at the 0.01 level of significance.

APPENDIX D

BARTLETT'S TEST OF HOMOGENEITY OF VARIANCES OF THE MEANS OF THE POST-TEST SCORES OF 190 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD LESS THAN EIGHTEEN COLLEGE HOURS OF MATHEMATICS

CLASS NUMBER	VARIANCE S^2	(n_i-1)	$\log S^2$	$(n_i-1) \log S^2$
12	217.45	19	2.33736	44.40984
14	131.42	29	2.11867	61.44143
10	137.44	24	2.13811	51.31464
7	164.47	30	2.21609	66.48270
24	210.23	22	2.32269	51.09918
25	204.34	13	2.31035	30.03455
1	111.39	16	2.04685	32.74960
26	90.57	29	1.87146	56.75242
	1267.31	182		394.28436

APPENDIX E

BARTLETT'S TEST OF HOMOGENEITY OF VARIANCES OF THE MEANS OF THE POST-TEST SCORES OF 156 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD EIGHTEEN OR MORE COLLEGE HOURS OF MATHEMATICS

CLASS NUMBER	VARIANCE S^2	(n_i-1)	$\log S^2$	$(n_i-1) \log S^2$
13	457.50	26	2.65039	68.91014
28	401.59	11	2.60378	28.64158
2	511.27	29	2.75684	79.94836
5	329.15	23	2.51740	57.90020
9	92.42	14	1.96577	27.52078
16	556.41	20	2.74540	54.90800
27	96.82	13	1.98597	25.81761
11	67.41	12	1.82872	21.94464
	2,572.57	148		365.59130

APPENDIX F

BARTLETT'S TEST OF HOMOGENEITY OF VARIANCES OF THE MEANS OF THE POST-TEST SCORES OF 165 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD LESS THAN TWENTY-EIGHT COLLEGE HOURS OF PROFESSIONAL EDUCATION

CLASS NUMBER	VARIANCE S^2	(n_i-1)	log S^2	(n_i-1) log S^2
1	111.39	16	2.04685	32.7490
2	511.28	29	2.75684	79.94836
5	329.15	23	2.51740	57.90020
11	67.41	12	1.82872	21.94464
12	217.45	19	2.33736	44.40984
13	457.50	26	2.65039	68.91014
15	418.50	12	2.62133	31.45596
16	556.41	20	2.74540	54.90800
	2,728.74	157		392.22674

APPENDIX G

BARTLETT'S TEST OF HOMOGENEITY OF VARIANCES OF THE MEANS OF THE POST-TEST SCORES OF 151 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD TWENTY-EIGHT OR MORE COLLEGE HOURS OF PROFESSIONAL EDUCATION

CLASS NUMBER	VARIANCE S^2	n_i-1	log S^2	(n_i-1) log S^2	$\frac{1}{n_i-1}$
10	137.44	24	2.13811	51.31464	.04166
9	92.42	14	1.96577	27.52078	.07142
14	131.41	29	2.11863	61.44027	.03448
19	155.57	11	2.19193	24.11123	.09090
20	291.62	15	2.46482	36.97230	.07142
25	204.34	13	2.31035	30.03455	.07692
23	292.43	15	2.46603	36.99045	.06666
24	210.23	22	2.32269	51.09918	.04545
	1,515.46	143		319.48348	.49891

APPENDIX H

BARTLETT'S TEST OF HOMOGENEITY OF VARIANCES OF THE MEANS OR THE POST-TEST SCORES OF 159 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD TEN OR LESS THAN TEN YEARS TEACHING EXPERIENCE

CLASS NUMBER	VARIANCE S^2	(n_i-1)	$\log S^2$	$(n_i-1) \log S^2$
8	85.69	9	1.93293	17.39637
12	217.45	19	2.33736	44.40984
13	457.50	26	2.65039	68.91014
2	571.28	29	2.75684	79.94836
20	291.62	15	2.46482	36.97230
28	401.59	11	2.60378	28.64158
21	454.03	20	2.65709	53.14180
24	210.23	22	2.32269	51.09918
	2,689.39	151		380.51957

APPENDIX I

BARTLETT'S TEST OF HOMOGENEITY OF VARIANCES OF THE MEANS OF 142 EIGHTH GRADE STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD MORE THAN TEN YEARS TEACHING EXPERIENCE

CLASS NUMBER	VARIANCE S^2	(n_i-1)	log S^2	(n_i-1) log S^2
5	329.15	23	2.51740	57.90020
4	178.00	10	2.5042	25.04200
15	418.15	12	2.62133	31.45596
16	556.41	20	2.74540	54.90800
25	204.34	13	2.31035	30.03455
7	164.47	30	2.21609	66.48270
17	446.41	11	2.64973	29.14703
23	292.43	15	2.46602	36.99030
	2,589.56	134		331.96074

APPENDIX J

DATA FOR ANALYSIS OF VARIANCE OF THE POST-TEST SCORES OF 190 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD LESS THAN EIGHTEEN COLLEGE HOURS OF MATHEMATICS TO DETERMINE THE HOMOGENEITY OF MEANS FOR PURPOSE OF POOLING

CLASS NUMBER	N	Y	Y^2	SUM OF SQUARES AMONG
12	20	1,811	168,335	163,986.05
14	30	2,624	233,420	229,512.33
10	25	2,375	229,061	225,625.00
7	31	2,784	255,084	250,021.16
24	23	2,035	184,855	180,053.26
25	14	1,339	130,919	128,065.78
1	17	1,672	166,330	164,446.11
26	30	2,677	241,577	238,877.63
	190	17,317	1,609,581	1,580,587.32

APPENDIX K

DATA FOR ANALYSIS OF VARIANCE OF THE POST-TEST SCORES OF 156 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD EIGHTEEN OR MORE COLLEGE HOURS OF MATHEMATICS TO DETERMINE THE HOMOGENEITY OF MEANS FOR PURPOSES OF POOLING

CLASS NUMBER	N	Y	Y^2	SUM OF SQUARES AMONG
13	27	2,228	196,166	183,851.25
28	12	937	77,977	73,164.08
2	30	2,588	240,362	223,258.13
5	24	1,975	170,419	162,256.04
9	15	1,452	141,940	140,553.60
16	21	1,905	184,479	172,810.71
27	14	1,351	131,727	130,371.50
11	13	1,230	117,240	116,376.92
	156	13,666	1,260,360	1,202,642.23

APPENDIX L

DATA FOR THE ANALYSIS OF VARIANCE OF POST-TEST SCORES OF 156 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD LESS THAN TEN YEARS TEACHING EXPERIENCE WITH SUBJECT-MATTER PREPARATION HELD CONSTANT BY MATCHING

CLASS NUMBER	N	Y	Y^2	SUM OF SQUARES AMONG
12	20	1,811	168,335	163,986.05
24	23	2,035	184,855	180,053.26
1	17	1,672	166,330	164,446.11
22	13	833	54,411	53,376.07
8	10	969	94,753	93,896.10
20	16	1,528	150,590	145,924.00
2	30	2,588	240,362	233,258.13
13	27	2,228	196,166	183,851.25
	156	13,664	1,255,802	1,218,790.97

APPENDIX M

DATA FOR THE ANALYSIS OF VARIANCE OF THE POST-TEST SCORES OF 165 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD LESS THAN TWENTY-EIGHT COLLEGE HOURS OF PROFESSIONAL EDUCATION

CLASS NUMBER	N	Y	Y^2	SUM OF SQUARES AMONG
1	17	1,672	166,330	164,446.11
2	30	2,588	240,362	223,258.13
5	24	1,975	170,419	162,526.04
11	13	1,230	117,240	116,376.92
12	20	1,811	168,335	163,986.05
13	27	2,228	196,166	183,851.25
15	13	1,030	87,042	81,607.69
16	21	1,905	184,479	172,810.71
	165	14,439	1,330,373	1,268,862.90

APPENDIX N

DATA FOR ANALYSIS OF VARIANCE OF THE POST-TEST SCORES OF 151 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD TWENTY-EIGHT OR MORE COLLEGE HOURS OF PROFESSIONAL EDUCATION

CLASS NUMBER	N	Y	Y^2	SUM OF SQUARES AMONG
10	25	2,375	229,061	225,625.00
9	15	1,452	141,940	140,553.60
14	30	2,624	233,420	229,512.33
19	12	1,193	120,455	118,604.08
20	16	1,528	150,590	145,924.00
25	14	1,339	130,919	128,065.78
23	16	1,527	150,389	145,733.06
24	23	2,035	184,855	180,053.26
	151	14,073	1,341,499	1,314,071.11

APPENDIX O

DATA FOR THE ANALYSIS OF VARIANCE OF THE POST-TEST SCORES OF 159 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR WHOSE TEACHERS HAD LESS THAN TEN YEARS TEACHING EXPERIENCE

CLASS NUMBER	N	Y	Y^2	SUM OF SQUARES AMONG
8	10	969	94,753	93,896.10
12	20	1,811	168,335	163,986.05
13	27	2,228	196,166	183,851.25
2	30	2,588	240,362	223,258.13
20	16	1,528	150,590	145,924.00
28	12	937	77,977	73,164.08
21	21	1,684	144,574	135,040.76
24	23	2,035	184,855	180,053.26
	N = 159	13,780	1,257,612	1,199,173.63

APPENDIX P

DATA FOR THE ANALYSIS OF VARIANCE OF THE POST-TEST SCORES OF 142 EIGHTH GRADE ARITHMETIC STUDENTS IN THE OKLAHOMA CITY PUBLIC SCHOOL SYSTEM, 1957-58 ACADEMIC YEAR, WHOSE TEACHERS HAD MORE THAN TEN YEARS TEACHING EXPERIENCE

CLASS NUMBER	N	Y	Y^2	SUM OF SQUARES AMONG
5	24	1,975	170,419	162,526.04
4	11	1,072	106,420	104,471.27
15	13	1,030	87,042	81,607.69
16	21	1,905	184,479	172,810.71
7	31	2,784	255,084	250,021.16
25	14	1,339	130,919	128,065.78
17	12	998	88,344	83,000.33
23	16	1,527	150,389	145,733.06
	142	12,630	1,173,096	1,128,236.04

APPENDIX Q

DATA FOR ANALYSIS OF VARIANCE AND COVARIANCE - CLASSES GROUPED ACCORDING TO TEACHER CERTIFICATION IN MATHEMATICS

Teachers with Less than Eighteen College Hours of Mathematics					Teachers with Eighteen or More College Hours of Mathematics				
CLASS NUMBER	N	X_1	Y_1	X_1Y_1	CLASS NUMBER	N	X_2	Y_2	X_2Y_2
12	20	1,637	1,811	151,559	13	27	1,807	2,228	160,378
14	30	2,197	2,624	204,831	28	12	893	937	66,658
10	25	2,178	2,375	208,591	2	30	2,308	2,588	213,994
7	31	2,439	2,784	222,859	5	24	1,792	1,975	154,768
24	23	1,782	2,035	161,232	9	15	1,313	1,452	128,246
25	14	1,145	1,339	112,216	16	21	1,798	1,905	171,382
1	17	1,453	1,672	143,581	27	14	1,106	1,351	107,677
26	30	2,386	2,677	214,332	11	13	1,101	1,230	105,032
	190	15,217	17,317	1,419,201		156	12,118	13,666	1,108,135

APPENDIX R

DATA FOR THE ANALYSIS OF VARIANCE AND COVARIANCE - CLASSES GROUPED ACCORDING TO TEACHER CERTIFICATION IN PROFESSIONAL EDUCATION

TEACHERS WITH LESS THAN TWENTY-EIGHT COLLEGE HOURS OF PROFESSIONAL EDUCATION					TEACHERS WITH TWENTY-EIGHT OR MORE COLLEGE HOURS OF PROFESSIONAL EDUCATION				
CLASS NUMBER	N	X_1	Y_1	X_1Y_1	CLASS NUMBER	N	X_2	Y_2	X_2Y_2
1	17	1,453	1,672	143,581	10	25	2,178	2,375	208,591
2	30	2,308	2,588	213,994	9	15	1,313	1,452	128,246
5	24	1,792	1,975	154,768	14	30	2,197	2,624	204,831
11	13	1,101	1,230	105,041	19	12	1,134	1,193	136,820
12	20	1,637	1,811	151,559	20	16	1,334	1,528	131,012
13	27	1,807	2,228	160,378	25	14	1,145	1,339	112,216
15	13	934	1,030	78,256	23	16	1,348	1,527	130,801
16	21	1,798	1,905	171,382	24	23	1,782	2,035	161,232
	165	12,830	14,439	1,178,959		151	12,431	14,073	1,213,749

APPENDIX S

DATA FOR THE ANALYSIS OF VARIANCE AND COVARIANCE - CLASSES GROUPED ACCORDING TO TEACHERS' YEARS OF EXPERIENCE WITH PROFESSIONAL EDUCATION PREPARATION HELD CONSTANT BY MATCHING

Teachers with Ten or Less Than Ten Years of Teaching Experience					Teachers with More Than Ten Years of Teaching Experience				
CLASS NUMBER	N	X_1	Y_1	X_1Y_1	CLASS NUMBER	N	X_2	Y_2	X_2Y_2
8	10	783	969	76,560	5	24	1,792	1,975	154,768
12	20	1,637	1,811	151,559	4	11	921	1,072	91,032
13	27	1,807	2,228	160,378	15	13	934	1,030	78,256
2	30	2,308	2,588	213,994	16	21	1,798	1,905	171,382
20	16	1,334	1,528	131,012	25	14	1,145	1,339	112,216
28	12	893	937	66,658	7	31	2,439	2,784	222,859
21	21	1,373	1,684	115,210	17	12	840	998	74,166
24	23	1,782	2,035	161,232	23	16	1,348	1,527	130,801
	159	11,917	13,780	1,076,603		142	11,217	12,630	1,035,480