TEACHERS' PERCEPTIONS OF THE COGNITIVE OBJECTIVES OF GRADE NINE ALGEBRA AND GEOMETRY

CENTRE FOR NEWFOUNDLAND STUDIES

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TEACHERS' PERCEPTIONS OF THE COGNITIVE OBJECTIVES OF GRADE NINE ALGEBRA AND GEOMETRY

by

© BRENDA MARIE HICKEY

A Thesis submitted in partial fulfillment of the requirements

for the degree of Master of Education

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ABSTRACT

The study was undertaken to investigate the perceptions of grade nine mathematics teachers with respect to the ranking of 50 cognitive objectives for grade nine algebra and geometry.

Attempts were made to ascertain if any differences existed among the teachers in their perceptions of the importance of the objectives relative to the number of mathematics and mathematics education courses completed, total teaching experience, experience in teaching the grade nine program, grade(s) in which the teachers are presently teaching mathematics, and whether the community can be classified as rural, urban, or semi-urban.

A questionnaire was developed comprising of 50 objectives which was administered to 180 randomly selected grade nine mathematics teachers.

From the data analysis it was concluded that:

1. There was no relationship between teachers' ranking of the objectives and any of the variables examined. The number of mathematics courses completed was the variable that determined the greatest differences among the teachers.
2. Significant differences at the 0.05 level were found between emphasis given to algebra and geometry with algebra receiving more emphasis than geometry.
3. Significant differences at the 0.05 level were found for differences in emphasis given to low level cognitive objectives and high level cognitive objectives with low level

objectives receiving more empahsis.

4. No consensus of opinion was observed among the teachers in relation to listing the five most important and the five least important objectives.

Based on these results, implications concerning the discrepency between the intended and implemented curriculum were discussed. It was recommended that a future study could examine the effect of teachers' attitude towards geometry on their perception of the importance of geometry objectives.

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Chapter I

The Problem

INTRODUCTION

From its earliest beginnings in antiquity mathematics has been a fundamental part of a school's curriculum. Within this period of time, however, mathematics as a discipline has been affected by both educational research and the demands of an ever changing society. The world today demands more mathematical knowledge of more people than ever was true in the past, and the world of the future will undoubtedly make even greater demands. Since no one can foretell what specific requirements will be made of mathematics in any occupation of the future, schools should prepare students for a life of continuous learning. It is important, therefore, that mathematics programs be designed to prepare students to become participants in an adult society of unknown changes. Throughout the past three decades we have witnessed the modification, modernization and improvement of the mathematics curriculum in our schools. Interested curriculum developers, educators, and professional organizations have developed programs which set forth their beliefs concerning new developments in both the content and the teaching of mathematics.

In the early 1950's the National Council of Teachers of Mathematics Commission on Post-War Plans listed twenty-nine items that its members believed should be mastered by the mathematically literate person. These items were designed to guarantee mathematical competence and to bring the youth into a bright new post-war world.

However, throughout the 1950s, particularly in the United States, criticisms about the school mathematics programs were heard from classroom teachers, mathematics educators, and mathematicians. These concerns were generated by increasing demands being placed on mathematics by a society that was becoming increasingly more technical and scientifically based. More and more high school graduates were entering university which required higher levels of mathematical knowledge than had previously been the case. It was recommended that the content of the mathematics curriculum be updated and that teaching techniques which developed thought processes rather than rote learning be emphasized. Small committees were working behind the scenes, but with little financial assistance and no public or government support few changes were effected. "In short, individuals spoke out strongly for reform, but neither the public nor the government took an interest." (Krulik & Weise, 1975, p.4)

It was not until 1957, when the U.S.S.R. successfully launched the first satellite, Sputnik 1, that government took notice and concerted action to improve curricula in science and mathematics was undertaken. Mueller (1967) attributed this flight of Sputnik to be the event that stimulated federal agencies and private foundations to invest heavily in mathematics curricula in grades K-12. He stated:

> As never before, Sputnik focused public attention upon the problems of education in a highly dramatic way. As never before, education found a willing ear. Curriculum planners who had previously recognized the serious need to update the science

> and mathematics offerings in the schools and who had already formed ideas on what to do about it, were suddenly listened to and granted support. (p.696)

The new programs that came out of these reform movements became known as the "new math" or "modern math". The traditional programs with emphasis on drill of fundamental skills were replaced with programs that accented the "why" of mathematics. New concepts and new approaches to the teaching of old concepts found their way into the classroom. Topics were introduced in primary and elementary grades which were previously taught in high school, and high school students were presented with materials previously reserved for university. These changes in what and how mathematics was to be taught at all school levels were so extensive that they have been described as a "revolution" in mathematics education.

> The modern program of mathematics regards mathematics as a system of thinking rather than a set of arbitrary rules, a system better learned by understanding the structure and principles of mathematics than by memorization of facts. (Petronia, 1971, p.25-26)

The main objective and primary concern of the new mathematics was to have the students understand what they did and why they did it. School mathematics of the 1960's emphasized the structure of mathematics, and the fundamental ideas underlying the familiar practices of arithmetic. The need for more sophisticated scientific manpower and a better understanding of the mathematics being taught were major concerns underlying the reform movement of this era. But these new programs were not without criticism. The new programs, claimed the critics, did not devote enough attention to the development of computational skills and that the precision and symbolism were just too demanding for many students. In addition, when many of these new programs were introduced they were sometimes taught by inadequately prepared teachers.

> And so, the 1960's ended in confusion. In the context of a national emergency, New Math programs were introduced into the elementary schools, and "crash" inservice programs were set up for teachers and parents. Consequently, there was a great deal of confusion and controversy over both the mathematical content of the new program, and the methods of teaching that were advocated. (Grossnickle, Reckzeh, Perry, and Ganoe, 1973, p.5)

With the publication of the First National Assessment of Educational Progress in the early 1970's there was a public outcry when it was determined that the "new mathematics" produced graduates who were weak in the basic computational skills. This failure of American youth to perform computational skills on a level that the general public felt to be acceptable resulted in sharp criticism of the New Math by the media. In spite of all the efforts to improve the mathematics curriculum, pupil performance on a nationally standardized test had declined. To counteract these declining test scores, efforts were made in the early 70's to define mathematics curricula in terms of "basic skills" which meant a return to a program which emphasized computation, drill, and practice.

With textbook publishers being attuned to public pressure and concern, a definite change was seen in books that were published in the middle and late 70's. Many of the topics introduced during the "New Mathematics" era were dropped from Back to Basics curricula. Instead, programs of this era tended to stress computational skills. However, mathematics educators were particularly concerned about the danger of stressing computation which neglecting other skills. Taylor (1979) summarized this concern.

> Today we in the schools are being urged (or in some cases pressured) to go back to the basics. With respect to instruction in mathematics, this trend has potential for both progress and peril . . . We cannot go back to the mathematical skills of yesterday for today's students who must live in an increasingly complex technological society. (p.32)

Concerns like this were also expressed by the National Council of Teachers of Mathematics (1978) when it stated: "We are deeply distressed, however, by the danger that the back to basics movement might eliminate teaching for mathematical understanding." (p.147)

Although the results of the Second National Assessment which was completed in 1978 indicated that students had a reasonable mastery of computational skills, the majority of students demonstrated severe deficiencies in the areas of measurement, estimation, probability, statistics, and problem solving. Attention to computation to the neglect of other basic skills produced students who appeared to be learning many mathematical skills, yet lacked an understanding of the concepts underlying the computation.

The National Council of Supervisors of Mathematics was also concerned about the back to basics movement and its effect on mathematics instruction. In their position paper on basic mathematical skills, the Council listed the following as the ten most important skills that students would need to meet the challenges they would face:

Problem Solving

Applying Mathematics to Everyday Situations

Alertness to Reasonableness of Results

Estimation and Approximation

Appropriate Computational Skills

Geometry

Measurement

Tables, Charts and Graphs

Using Mathematics to Predict

Computer Literacy (NCSM, 1978, p.147-152)

In its document An Agenda for Action: Recommendations for School Mathematics of the 1980s, the National Council of Teachers of Mathematics suggested the directions that mathematics programs should take in the future by proposing new objectives for school mathematics. The first two of eight recommendations made by the Council were: "(1) problem solving be the focus of school mathematics in the 1980s;" and "(2) basic skills in mathematics be defined to encompass more than computational facility." (p.1)

Similar demands appeared in articles written by Suydam (1979) and Devault (1981). It was suggested by Edwards & Nichols (1972) that the demand for increased competence in mathematics has become a reality. Therefore, a mathematics program must go beyond mere calculation skills so that students of today are prepared to meet the demands of living in a technological world of the twenty-first century. A mathematics curriculum with a broad base to keep career options open seems essential.

There is not much doubt that throughout the past three decades substantial changes have occurred in both the content and the methodology of teaching school mathematics. This process of change must and should occur to ensure that students acquire the needed competencies and processes deemed essential for living in contemporary society. Future programs should continue to change to meet the challenges of the changing times.

Pressures to initiate curriculum reform can arise from forces within the educational system or from the demands exerted by society. Forces such as the widespread availability of relatively inexpensive technological aids, the extensive uses of mathematics in the outside world, and advances in psychology and pedagogy influence the development and implementation of curriculum. Robitaille & Dirks (1982) emphasized:

> In every place where mathematics is taught, different weight is attached to and different concerns dominate each of these factors. This has the ultimate effect of producing different curricula, each of which is unique to the particular place for which it is developed. (p.12)

Various groups also have an interest in educational change, including politicians, educational administrators, mathematics educators, educational groups, publishers, testing companies, educational researchers and teachers. The importance of involving more than one group in the initiation and subsequent decision-making of curriculum change has been suggested by Lindquist (1984).

> No substantial progress will be made toward curriculum reform until textbook publishers, state agencies, text publishers, teachers and administrators, and math educators all work together. Too often attempts to reform curriculum are impeded by one group blaming another for existing problems. Such attacks fragment resources that could be better spent developing comprehensive strategies to improve the curriculum. (p.607)

However, it is the classroom teachers who are responsible for translating the curriculum reforms into the more specific objectives of instruction. As Gearhart (1975) stated: "Teachers are ultimately responsible for curriculum reform." (p.493). They implement the objectives of any curriculum. It is important, therefore, that teachers be aware of the objectives of a mathematics program if these objectives are to be successfully implemented in the classroom. Of importance, also, is the perception on the part of the teacher as to what is important in mathematics. It was the intention of this study to investigate the objectives of junior high mathematics with particular emphasis on teachers' perceptions of the relative importance of a selected number of objectives.

PURPOSE OF THE STUDY

The purpose of this study was to determine teachers' perceptions of the degree of importance of a selected number of specific content-oriented objectives for Grade 9 algebra and geometry. Of particular importance was the extent of agreement among the teachers relative to education and experience. Specifically, answers were sought to the following questions:

1. Is there a relationship between teacher's rankings of objectives and the number of mathematics courses completed?
2. Is there a relationship between teachers' rankings of objectives and the number of mathematics education courses completed?
3. Is there a relationship between teaching experience and the ranking of objectives?

4. Is there a relationship between the rankings of the objectives by the teachers and the grade(s) in which they teach mathematics?

5. Is there a relationship between classification of the community as rural, urban or semi-urban, and the ranking of objectives by the teachers in the communities where these schools are located?

6. Is there a relationship between teachers' rankings of the objectives and the number of years teaching the Grade 9 mathematics program?

7. What objectives were listed by teachers as being the 5 most important objectives and the 5 least important objectives for Grade 9 algebra and geometry?

8. Is there any difference in emphasis given to algebra and geometry objectives?

9. Is there any difference in emphasis given to objectives of low cognitive behavior and those of high cognitive behavior?

SIGNIFICANCE OF THE STUDY

According to Tyler (1975), curriculum development refers to the many different kinds of activities involved in the process of changing educational programs, including the process of analyzing goals, aims, and objectives together with the translation of these into the content of new courses.

Traditionally teachers have been involved only to a limited extent in the development of curriculum. By the 1970s, however, through teacher union collective negotiations teachers had become involved in curriculum planning. Today there is general agreement that teachers should be involved in curriculum development. Even though teacher participation in curriculum planning has in the past been minimal or nonexistent, teachers have always occupied a central position in curriculum implementation. As Howson (1979) stated:

> The outstanding fact to emerge from twenty years of frantic curriculum development is the crucial role of the teacher. No matter how outstanding the project's team or materials, the success of its work will ultimately hinge on the receptiveness and adaptability of the classroom teacher. (p.152)

The role of the teacher in curriculum decision-making is vital. Every day in their classrooms, hour by hour, minute by minute, teachers make crucial decisions on what is to be taught and how it is to be taught. The single most important variable in any instructional program is the teacher. As Taba (1962) stated: "The functioning curriculum is in the hands of teachers . . . It is they who put flesh on the bare bones of curriculum plans and outlines." (p.239)

The importance of teacher input in curriculum implementation is undeniable. Teachers are ultimately responsible for the implementation of curriculum reform and the meeting of program objectives. Knowledge on what objectives and aspects of the mathematics program are being emphasized at the classroom level is important. For each mathematics period the teacher has to plan the teaching strategies to be used and decide on the objectives, procedures, and evaluation techniques. A statement of objectives will provide a basis for the selection of learning activities. If the emphasis is upon subject matter, activities may concentrate upon memorization and rote manipulation of an algorithm. If attention is focused on problem-solving, then more attention is given in the classroom to an understanding of the processes involved. Thus the teacher's perception of the goals and objectives of mathematics instruction influences every aspect of the instructional program. The Organisation for Economic Cooperation and Development (1975) in its Handbook on Curriculum Development emphasized:

> The teacher's selection, attitudes, postures and language are potentially capable of modifying not only the specific curricula objectives but the curricular ends themselves. (p.105)

It is clear from the literature on curriculum development that there is a discrepancy between the planned curriculum and the implemented curriculum. The goals and objectives that are developed by curriculum specialists and transmitted to teachers in teachers' editions of textbooks and curriculum guides are not always reflected in the curriculum as it becomes operative in the classroom. There is little doubt that teachers present the subject in ways that are significantly different from what was intended by the curriculum writers. As Lindquist (1984) emphasized: "Even when schools use the same material, the underlying philosophy of a school or teacher may lead to different interpretations." (p.606). For the purpose of comparing perceptions of these two levels of curriculum goals, several studies have already been completed among various groups of mathematics teachers and/or educators in Newfoundland.

Robbins' study (1973) compared the perceptions of secondary school geometry teachers in Newfoundland to a group of university educators in Canada and the United States concerning the objectives of deductive geometry in secondary schools. Mercer (1975) analyzed the needs of high school students in Newfoundland as perceived by mathematics instructors at Memorial University and various vocational and technical schools in the province. However, unlike Robbins' study no high school teachers were included in the sample. Chipman (1976) determined the ranking of a selected number of specific content-oriented objectives by a group of Grade Seven and Eight teachers. Of particular importance in Chipman's study was the degree of emphasis teachers placed on computational versus structural aspects of mathematics. Cole (1980) compared the perceptions of the high school teachers of mathematics and the trades school teachers of mathematics in Newfoundland concerning content items for a non-university-preparatory mathematics program for grades 9, 10 and 11. Rose (1982) compared the opinions of teachers of mathematics in Newfoundland high schools with those of teachers of mathematics at the trades schools and at Memorial University pertaining to the objectives of secondary school mathematics. He also examined the differences in opinions of teachers with different mathematical backgrounds to decide if this was a factor contributing to their ranking of a given list of objectives.

One significant aspect of the results of these studies was that there was a discrepancy between the objectives proposed by mathematics educators and curriculum specialists (intended curriculum) as compared to the rankings of objectives by the various groups of teachers sampled (implemented curriculum). In addition, there was a difference in opinion among teachers involved in the particular programs as to the relative importance of the objectives of the mathematics program.

With the exception of Chipman's study (1976) which determined a ranking of the objectives of junior high mathematics by Grade 7 and 8 teachers, all previous studies focused on a comparison of the opinions of high school teachers with those of educators or instructors at a variety of post-secondary institutions. However, no study has been conducted among junior high school teachers in Newfoundland and Labrador to determine both similarities and differences in their perceptions of the objectives of junior high school mathematics. Therefore, it was the intent of this study to compare the opinions of certain subgroups of Grade 9 teachers, for instance the opinions of teachers with different mathematics background and different teaching experience.

This study established a rank ordering of objectives for Grade 9 Algebra and Geometry by a group of Grade 9 teachers thereby determining teachers' perceptions of the importance or non-importance of the objectives used in this study. Of particular importance, this study also determined the extent of agreement among Grade 9 teachers pertaining to the ranking of this list of objectives.

DEFINITION OF TERMS

List of Objectives

- a list of statements of general expected outcomes of a junior high mathematics program based on pertinent literature

Teaching Experience

- number of years of teaching

Mathematics Course

- semester course in mathematics

Mathematics Education

- semester course in the theory and practices of teaching mathematics

Classification of Community

- area where school is located as described by either urban, semi-urban, or rural

LIMITATIONS

The sample of Grade 9 Mathematics teachers is unbiased to the extent that they were selected randomly from the total list of schools in Newfoundland and Labrador in which Grade 9 is taught. However, no attempt is made to extrapololate the data to represent mathematics teachers beyond this group. Consequently, this limits the interpretation of results to the Grade 9 level.

The list of objectives used in the study was not exhaustive. Neither was it intended that all of these objectives reflect what was obtained from the literature as being the desired goals of mathematics instruction in the junior high school. Consequently, it was not the intention of this study to present absolute judgments pertaining to the rating of the objectives but rather to present a comparison of teachers' perceptions with respect to the objectives selected for the study.

The collection of data by means of questionnaires sent out by mail may have introduced a limitation. No assumption can be made about the nature of the respondents. One cannot assume that the people who respond to a survey have the same opinion as the people who do not respond. Also, due to limited control over the response rate, care must be exercised in generalizing the results.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter is to briefly discuss the role of objectives in curriculum development and to indicate certain factors which influence the formulation of such objectives with specific reference to mathematics. In addition, a summary of the objectives for school mathematics from a historical perspective and their influence on the content of the mathematics curriculum is presented. The final section of this chapter examines other studies that have been carried out pertaining to the relative importance of goals and objectives in mathematics.

ROLE OF OBJECTIVES IN EDUCATION

Goals and objectives play an important role in the development of curriculum and in instruction and evaluation. Goals give direction to a teaching program outlining broad reasons why a particular course is being done or why particular activities are being organized whereas objectives are more directly concerned with what is being attempted over a short period of time. Objectives are statements regarding the behaviour expected of a learner at the end of instruction in a particular area. Taba (1949) suggested that objectives change individuals in some way "to add to the knowledge they possess to enable them to perform skills which otherwise they would not perform, to develop certain understandings, insights and appreciations." (p.194) Tyler (1949) proposed an equally relevant definition. To him, objectives "become the criteria by which materials are selected, content is outlined, instructional procedures are developed and tests and materials are prepared." (p.3)

The literature, related to program development, frequently proposes the idea that program development is more likely to succeed if development has been guided by a predetermined set of objectives. As Robitaille & Dirks (1982) stated: "Successful adoption and implementation of a revised curriculum requires, as a prerequisite, careful weighing of the reasons for change and an indepth evaluation of the goals of the curriculum." (p.3)

The idea of stating a set of general objectives before any curriculum development can be successfully implemented is not new but can be traced to the beginning of this century. Reeve (1925) stated that "a clear statement of the general and specific objectives of every phase of school work is the first step toward the achievement of worthwhile results." (p.192)

Tyler (1949) saw the selection of objectives as the beginning point in curriculum planning. He stated: "If an educational program is to be planned and if efforts for continued improvements are to be made, it is very necessary to have some conception of the goals that are being aimed at." (p.3)

Wood (1967) suggested that since the purpose of a course of instruction is to help students acquire certain skills, then formulating a list of objectives would be an essential step in the planning stages of that particular program.

To summarize the rationale for developing a list of objectives as a starting point in any curriculum development, Allendoerfer (1971) stated:

> It is a general principle of rational behaviour that no one should start activity in any field of human endeavour until he has thought through just what he wishes to accomplish. Indeed, some of the great follies of our time have been perpetrated by those who act just for the sake of action, with no thought of their objectives. Thus, in every aspect of teaching and curriculum development, we should begin by stating our general objectives. (p.686)

Therefore, the formulation of both goals and objectives are important and necessary steps in curriculum planning. A clear statement of objectives plays a key role in the total instructional process for it can serve as a guide for both teaching and evaluation. Furthermore, objectives can serve as aids in selecting both instructional materials and teaching methods as well as designing evaluation techniques that will monitor and assess pupils' learning.

Krathwohl (1965) suggested that specifying educational objectives as student behaviors is a powerful and useful tool as it forces the teacher to spell out the instructional goals in terms of the kinds of behaviour that is hoped to develop in the classroom.

Edling (1971) proposed that educational objectives serve the following five important functions for the teacher:

> First, they are essential in preparing criterion tests to

> determine whether or not the desired behaviors have been learned. Second, they make possible the further analysis of intended learning into those essential components which the learner must master if he is to demonstrate the criterion behaviour. Third, they provide an invaluable basis for producing and/or selecting appropriate materials. Fourth, they help identify alternative sequences of instruction for individual learners. And fifth, they enable the teacher to evaluate the effectiveness of various procedures for various kinds of learners in various settings. (p.211)

Instructional objectives can be classified into three broad categories or domains according to the kind of skill or student characteristic described by the objective. Each of these three domains - cognitive, affective, and psychomotor is further divided into categories and subcategories ranging from the simple to the more complex types of behaviour.

In relation to mathematics education, cognitive objectives represent various levels of mathematical behaviour: knowledge of facts and algorithmic skills, comprehension of concepts and principles, and solving routine (application) problems and non-routine (process) problems. "To develop an understanding of basic concepts and skills of introductory algebra" is an example of a cognitive objective for grade nine mathematics. Affective objectives emphasize attitudes and values, feelings and emotions. "To develop a positive attitude towards mathematics" and " to develop selfconfidence in doing mathematics " are two affective objectives for any mathematics program. Psychomotor objectives involve muscular and motor skills. In mathematics these objectives can be attained by using manipulative aids and mathematical instruments. "To manipulate measuring instruments such as the ruler and protractor with speed and accuracy " is one of the psychomotor objective for a mathematics program.

Objectives representing these three domains should be present in any course of mathematics with any group of students. Instructional objectives in mathematics instruction should be much broader than mere knowledge or low level cognitive objectives. Equally important are high level cognitive objectives and affective objectives.

SOME CONSIDERATIONS IN THE FORMULATION OF SPECIFIC OBJECTIVES

Tyler (1949) noted that to be useful in the classroom setting, objectives must be stated in terms which identify both the kind of behaviour to be developed and the content area in which development should occur. He contended that clearly defined objectives provide a concrete basis for the selection and planning of learning experiences as indicated when he wrote:

> It should be clear that a satisfactory formulation of objectives which indicates both the behavioral and the content aspects provides clear specifications to indicate just what the educational job is. By defining these desired educational results as clearly as possible the curriculum-maker has the most useful set of criteria for selecting content, for suggesting

> learning activities, for deciding on the kind of teaching procedures to follow, in fact to carry on all the further steps of curriculum planning. (p.62)

Taba (1962) discussed the criteria to be used as a guide in formulating and stating objectives. Of prime importance she noted that objectives should describe both the kind of behaviour expected, the context and content to which the behaviour applies. In addition, they need to be specific enough so that there is no doubt as to the kind of behaviour expected. Finally, the objective must be focused on what can be translated into classroom experience.

One approach to the writing of objectives that is widely used calls for attention to the characteristics of a clearly stated objective. According to Mager (1984) a meaningfully stated objective includes the following characteristics:

1. An objective indicates the terminal behaviour - that is, what the student will be doing when the objective is achieved.
2. An objective describes any important conditions that must exist for the behaviour to be considered acceptable.
3. An objective specifies the level of acceptable performance - that is, how will the student perform for the behaviour to be considered acceptable.

The adequacy of the final list of objectives for a particular course can be appraised, according to Gronlund (1985), by evaluating them in relation to the following questions:

1. Do the objectives include all important outcomes?

2. Are the objectives in harmony with the general goals of the school?

3. Are the objectives in harmony with sound principles of learning?

4. Are the objectives realistic in terms of the abilities of the pupils and the time and facilities available?

5. Are the objectives defined in terms of changes in pupil behaviour? (p.36-37)

However, it is important to realize that no matter how comprehensive a set of instructional objectives may be, there are likely to be some unplanned events and some unanticipated outcomes of instruction. Thus, although instructional objectives provide a useful guide for instruction, teachers need to be flexible enough in their teaching and testing to allow for these unplanned events.

A HISTORICAL REVIEW OF THE OBJECTIVES FOR SCHOOL MATHEMATICS

The nature of today's mathematics program has been influenced by the differing and increased needs of society, and the findings of educators and psycho.gists concerning the way in which children learn. At various times stress was placed on skills, applications, or mathematical understanding by the learner. This review will be a summary of the changes in the objectives and content of the mathematics program since 1900 with attention focused on more recent developments. Such a perspective is necessary to illustrate how the objectives of today's mathematics programs have been influenced by the reforms of the past.

Period Prior to 1920

Initially the mathematics introduced into the school curriculum, consisted almost entirely of arithmetic to satisfy the needs of the settlers for some knowledge of the subject to transact their many activities in trade and commerce. As the country developed, so did the mathematics curriculum, so that by the end of the nineteenth century algebra, geometry, and trigonometry had been introduced into the curriculum.

The objectives of teaching mathematics in the early 1900's reflected a belief in mental discipline as a goal of all mathematics. The principal purpose in teaching mathematics in the schools was to cultivate pupils' mental powers so that they would learn to reason correctly. Brooks (1883) described the philosophy of mental discipline as follows:

> The mind is cultivated by the activity of its facilities . . . Mental exercise is thus the law of mental development. As a muscle grows strong by use, so any faculty of the mind is developed by its proper use and exercise. An inactive mind, like an unused muscle, becomes weak and unskillful . . . let the mind remain inactive, and it acquires a mental flabbiness, that unfits it for any severe or prolonged activity. To develop the faculties of the mind and secure their highest activity and efficiency there must be a constant and judicious exercise of

these faculties. (p.84)

Algebra would seem, to the teacher of the 1980's, generally consistent with the concept of mental discipline. Smith, an influential writer on mathematics education in the early 1900's, saw the dominating value of algebra to be that of mental discipline. In 1904 he suggested the following purposes for teaching algebra: (1) to foster the habit of concentration and the development of mental powers; (2) to train in logic; and (3) to prepare for other mathematics courses.

The geometry course in the early 1900's was also based on the concept of mental discipline. Consequently, the main objective was to train students to think logically, to observe, and to concentrate. This is evident in the report of the Conference on Mathematics, a subcommittee of the persons appointed by the Committee of Ten to study the mathematics curriculum. It emphasized the importance of elegance in both written and oral proofs. It further recommended "that ample opportunity for recitation should be provided and that all proofs that were not formally perfect be rejected." (Osbourne & Crosswhite, 1970, p.167)

Throughout the first two decades of this century there was gradual rejection of a curriculum based on the concept of mental discipline. By the 1920's, "the three step process of "state of rule, give an example, practice" was yielding to inductive reasoning, and discovery-teaching processes." (Jones & Coxford, 1970, p.32)

Period 1920 - 1940

The first significant report on mathematics education in this period was published by the National Committee on Mathematical Requirements in 1923. In its report " The Reorganization of Mathematics in Secondary Education", the committee discussed the aims for mathematics education in reference to three categories: (1) practical aims, (2) disciplinary aims, and (3) cultural aims.

For algebra the practical aims included: (1) an understanding of the language of algebra, (2) development of the ability to understand and use algebraic methods, and (3) understanding and interpreting graphic representation. Included in practical aims for geometry were: (1) familarity with geometric forms common in nature, industry, and life, (2) knowledge of properties and relations of these forms, and (3) development of spatial perception.

Disciplinary aims were related mainly to the theory of mental discipline and included such things such as the acquisition of mental habits and attitudes, and the ability to analyze.

Cultural aims were mainly concerned with the development of appreciations, insights, and ideals such as appreciation of beauty in geometrical forms, and appreciation of the power of mathematics.

Throughout the 1920's and 1930's many educators did extensive work in defining the objectives of mathematics education. For the junior high school Allen (1923) recommended an extensive three year course in General Mathematics which aimed:

> . . . first to give instruction and training in mathematics useful to the average, intelligent citizen; second, to disclose mathematical ability or the lack of it, so that pupils may be guided in their choice of later work. (p.72)

Smith and Reeve (1927) proposed that for junior high school a course in mathematics should introduce students to the general nature and uses of different branches of mathematics; and with this should come an increase in certain mathematical powers, an appreciation of the power of mathematics, and certain attitudes of mind such as accuracy in reasoning and originality in thought.

Barber (1927) expressed the view that the development of the powers of thinking and an "understanding attitude of mind" were important objectives for junior high mathematics.

In consideration of the fact that for many Grade Nine would be the final year of schooling, Hassler and Smith (1937) saw the purpose of junior high mathematics as not just to prepare students for future mathematics but rather to give them the kind of mathematical training most valuable to them. The main objective of these courses was " the growth of the pupils' mind."(p.200)

Towards the end of this period, however, the objectives of mathematics education began to reflect the social conditions of the time resulting in greater emphasis on social utility aims in the design of the curriculum. As Kinsella (1965) stated:

> In the depression years of the 1930's, practical aims had to be given major emphasis. When many did not have enough to eat, education had to justify itself in practical terms . . . Teachers of mathematics were urged to show the practical value of each topic. These were the days when social utility was a major factor in determining what was taught. (p.11)

In junior high mathematics the practical aim was dominant. The ability to compute, and the ability to apply this skill to problems of the wage-earner, homemaker, and consumer were definitely practical. In elementary algebra the practical topics included interpreting and evaluating formulas, and solving simple equations.

Period 1940 - 1955

Two major curriculum reports for secondary school mathematics were published in 1940. The more widely known of these was the report of the Joint Commission of the Mathematical Association of America and the National Council of Teachers of Mathematics. The Commission was organized in 1935 to take over the work of separate committees of the two organizations that had been appointed to study the problems of secondary school mathematics.

In its report the Joint Commission expressed the view that the secondary school mathematics program should encompass the following content areas: (1) number and computation, (2) geometric form and space perception, (3) graphic representation, (4) elementary analysis, (5) logical-thinking, (6) relational thinking, and (7) symbolic representation and thinking.

With reference to both utilitarian and disciplinarian goals the Commission listed the following as objectives of the secondary mathematics program: (1) to think clearly, (2) to use information, concepts, and general principles, (3) to use fundamental skills, (4) to develop interests and appreciations, and (5) to develop desirable attitudes.

In its final report the Commission proposed a mathematical curriculum for grades 7 to 14. Two alternative curricula plans were proposed for the college-bound track in grades 9 - 12 along with a recommendation for a "two-track" program in grade 9.

The second report, which appeared in 1940, was the report of the Progressive Education Association (PEA) entitled "Mathematics in General Education". Its report described the functions of mathematics in terms of the following " four basic aspects of living":

1. Personal living
2. Immediate personal-social relationships
3. Social-civic relationships
4. Economic relationships

(Butler, Wren & Banks, 1970, p.25)

The report listed those concepts involved in problem solving such as formulating the problem, collecting and using data, understanding approximation, understanding the nature of proof, using symbols, and understanding concepts basic to fundamental operations as categories of mathematical behaviour applicable to the problem solving of life. Unlike the Joint Commission which outlined a program in terms of specific subject-matter recommendations, the PEA report was a guide for future program development. Skills and the application of mathematics to situations faced in life would determine the content of mathematics programs.

However, the advent of World War II curtailed the influence of these reports as emphasis on education shifted to training manpower for the war. The induction testing for World War II presented evidence that many youths were incompetent in mathematics. Consequently, towards the end of the war the board of directors of the National Council of Teachers of Mathematics appointed the Commission on Post War Plans whose purpose was to make recommendations concerning the mathematical education for all youth in the schools. One of its main theses was that "the school should guarantee functional competence in mathematics to all who can possibly achieve it." (Commission on Post-War Plans, 1945, p.196). Included in the list of twenty-nine key items that defined functional competence were the following concepts: (1) computation, (2) statistics, (3) estimating, (4) integers, (5) formulas, (6) nature of measurement, and (7) algebraic symbolism.

According to the Commission, ninth grade mathematics should offer algebra for those who were college bound and general mathematics for the rest. The purpose of this general mathematics course stated the Commission "is to provide such experience as will insure growth in understanding of the basic concepts and improvement in the necessary skills." (Commission on Post-War Plans, 1945, p.195). With its accent on the development of functional competence and mathematical power, the Commission stressed utilitarian goals of mathematics education. After this report there were no significant committee reports until the 1950's and the introduction of modern mathematics programs.

Period of Reform (1955-1970)

Modern mathematics, new mathematics, revolution in math, and Sputnik are words and phrases which permeated the decades of the 50's and 60's. During these years, a number of important new programs were initiated. As proposed by Kinsella (1965) these changes were the result of many forces including : (1) The revolutionary development of science and technology during this century; (2) an awareness of the great technological and mathematical progress of the U.S.S.R.; (3) the hugh financial support given by the federal government and large foundations to the improvement of mathematics education.

The changes that occurred in the mathematics curriculum were accelerated by the Soviet launching of Sputnik 1 in 1957 and the inability of the United States to lead in the space race. However, several major movements to improve the quality of mathematics education were under way before this event occurred.

Within this era of reform, it is possible to divide efforts at improving the mathematics program into two types: (1) general planning groups such as The Commission on Mathematics of the College

Entrance Examination Board whose chief purpose was to make general, long-range suggestions for an improved mathematics curriculum, and (2) implementation groups such as The School Mathematics Study Group which produced materials to be used in the classroom.

One of the most significant reports of this era was the report of the Commission on Mathematics appointed in 1955 by the College Entrance Examination Board to study the existing secondary school mathematics curriculum and make recommendations for its improvement.

The major proposals of the Commission included: (1) strong preparation in the concepts and skills of college calculus and analytic geometry, (2) appreciation of the structure of mathematics, (3) incorporation of plane and co-ordinate geometry, and (4) use of unifying ideas of sets, variables, functions and relations.

In addition, the committee presented detailed outlines of recommended courses for grades nine through twelve. The program suggested for grade nine was mainly algebraic in nature, plus additional topics on variation, descriptive statistics, and numerical trigonometry were also recommended.

One of the most important examinations of goals in mathematics that has appeared in the history of mathematics education was the bulletin Goals for School Mathematics: the Report of the Cambridge Conference on School Mathematics. This report was prepared by a group of mathematicians and mathematics educators who met during the summer of 1963 to propose a school mathematics program for the future. Their report presented a K - 12 sequence which would give the graduating high school student the equivalent of what was then three years of college mathematics training.

The proposed course of study in which sixteen years of mathematical work would be compressed into thirteen could be attained, according to the conference committee, "through a new organization of the subject matter and the virtual total abandonment of drill for drills' sake, replacing the unmotivated drill of classical arithmetic by problems which illustrate new mathematical concepts." (Report of the Cambridge Conference on School Mathematics, 1963, p.42)

The guiding principles that were used in the preparing of the report included the following: (1) the use of a spiral curriculum, (2) integration of algebra and geometry, (3) replacement of drill with new, meaningful mathematical situations, (4) use of discovery techniques, (5) development of a growing awareness of the nature of logical reasoning, and (6) careful and precise use of language.

Critics of the report such as Allendoerfer (1965) asserted that the proposed curriculum was beyond the capabilities of the vast majority of students and that these students would have neither the need nor interest in such a level of mathematics instruction.

By 1961 the reform in mathematics education was of sufficient proportions to be labeled a revolution by the National Council of Teachers of Mathematics. Dozens of institutions and organizations had been created to improve the mathematics curriculum. An unprecedented level of financial support for curriculum development allowed these groups to conduct research, write textbooks, and produce instructional materials for experimental use in centres across the nation.

As cited by Davis (1965) among the many curricular projects initiated during the fifties and sixties were: University of Illinois Committee on School Mathematics (1951), Ball State Program for Geometry (1955), University of Maryland Mathematics Project (1957), School Mathematics Study Group (1958), and the Secondary School Mathematics Curriculum Improvement Study (1966).

While each program had unique features, they all shared common elements and all were aimed at the improvement of mathematics instruction. The National Council of Teachers of Mathematics (1968) identified the following as general characteristics of the new mathematics program: (1) attention to structure; (2) introduction of many new topics; (3) more emphasis on understanding major mathematical concepts, (4) participation by the student in learning mathematics; and (5) emphasis on precision of mathematical language.

However, the goals and effectiveness of the new programs did not go unchallenged. The decrease in emphasis on most of the social applications of mathematics was seen as a major failing of these new programs. Kemeny (1963) in his report to the International Congress of Mathematics noted this weakness and suggested immediate consideration of the place of applications in the curriculum. Kline (1966) severely criticized the changes and indicated that these new programs had begun to put too much emphasis on the abstract and to neglect computational skills.

Throughout the seventies public expectations would focus on assuring that all students acquire basic computational skills and their applications to practical life situations.

Themes in School Mathematics since 1970

The revolution of the sixties was successful in introducing numerous changes into the mathematics curriculum. Yet the public was not satisfied - to them it was a failure. Student achievement, as measured by performance on certain tests, had declined in the late 1960's and early 1970's, and this decline was blamed on the new curriculum. (Usiskin, 1985). To counteract the perceived declining test scores, efforts were made in the early 70's to define mathematics curricula in terms of "basic skills".

By the middle of the 1970's a back to basics philosophy had begun to influence the curriculum. Textbooks published in these years emphasized memorization and drill and practice procedures. In addition, state and local school systems had initiated proficiency testing as a special criterion for graduation. Such tests were usually dominated by paper - and - pencil computation skills.

As the back to basics rebellion gained momentum, several mathematics professional groups responded by issuing statements aimed at providing a framework of mathematical skills needed to live in a technological world.

In 1975 the National Institute of Eduction sponsored a conference to determine basic mathematical skills and learnings. The list of the basic goals for mathematics education were :

1. Appropriate computational skills
2. Links between mathematical ideas and physical situations
3. Estimation and approximation
4. Organization and interpretation of numerical data, including using graphs
5. Measurement
6. Alertness to reasonableness of results
7. Qualitative understanding of and drawing inferences from functions
8. Computer uses
9. Problem solving (Volume II, pp 17 - 20)

At about the same time the Conference Board of the Mathematical Sciences appointed the National Advisory Committee on Mathematic Education (NACOME) to prepare an overview and analysis of mathematical education in the United States. In describing the direction that mathematics education should take in the future the committee stated that the challenges for the future revolved around the four main issues of curriculum, instruction, teacher education, and evaluation. The content recommendations of NACOME included:

- That logical structure be maintained as a framework for the study of mathematics.
- That concrete experiences be an integral part of the acquisition of abstract ideas.
- That the opportunity be provided for students to apply

mathematics in as wide a realm as possible.

The National Council of Supervisors in Mathematics (1978) concerned about the back to basics movement and its effect on mathematics instruction prepared a position paper that defined basic skills beyond the very narrow viewpoint of computation. Their published list of basic skills, with one exception, coincided with the list developed at the Euclid conference. The seventh goal was deleted and replaced by geometry. The NCSM concluded their report by stating: " . . . any effective program of basic mathematical skills must be directed, not back, but forward to essential needs of adults in the present and future." (p.152)

Not long afterward, the National Council of Teachers of Mathematics (1980) published An Agenda for Action, a guide for concerted action in mathematics throughout the eighties. Four of the eight recommendations dealt directly with curriculum content:

1. That problem solving be the focus of school mathematics in the 1980's.
2. That basic skills in mathematics be defined to encompass more than computational facility.
3. That mathematics programs take full advantage of the power of calculators and computers.

.

6. That more mathematics study be required for all students and a flexible curriculum with a greater range of options be designed to accommodate the diverse needs of the student

population. (p.1)

All these documents referred to in this section outline the essential characteristics of mathematics education goals for the 1980's. Key words and phrases give direction for mathematics programs of the future: estimate, solve problems, apply, judge, interpret, and relate. Students must have programs that teach the general principles of thinking so that they can deal with new situations. These documents present the same message: back to basics is a dangerous move for mathematics education.

PRESENT TRENDS FOR ALGEBRA AND GEOMETRY

OBJECTIVES IN JUNIOR HIGH MATHEAMTICS

Algebra is considered an integral part of the mathematics curriculum of junior high school. The Department of Education for Newfoundland and Labrador (1984) suggested that algebra was a branch of mathematics serving many purposes.

> As a process - analytical tool, it enhances critical thinking and mental maturity. Due to its links with formulae, algebraic processes and skills are applicable across the disciplines. It provides a strategy for problem solving and equally important it provides the student with the necessary language to express mathematical ideas. (p.23)

Since Sputnik the algebra curriculum has been changing regularly so that by the 1980's it has become relatively standard. (Coxford, 1985). An examination of various curriculum guides in mathematics published in the United States and Canada within the past five years revealed that the following are emphasized in Grade 9 algebra.

- to use variables and the language of algebra.
- to evaluate and simplify expressions
- to solve linear equations and inequalities in one variable
- to represent problem situations by using variables, equations, and inequalities
- to develop proficiency with basic operations of polynomials
- to simplify algebraic expressions
- to construct graphs of linear sentences in one or two variables
- to solve problems in relation to all appropriate topics.

Chambers (1986) suggested that the major objectives for algebra should centre on three major topics: language and symbolism, relations and functions, and graphs. He stated: " The use of variables, functions, relations, and graphs are among the prime tools of problem solving, and constitute a common core in the mathematics curriculum K - 12. " (p.54)

Geometry, also, is an important branch of mathematics and considered an integral part of the junior high mathematics curriculum. The goals of teaching and learning of geometry as envisioned by the Department of Education for Newfoundland and Labrador (1984) were:

. . . it contributes to the mental development of the student,

> especially right hemispheric functions which include spatial perception and visualization. It is a life skill, since it is used in many occupations. The concepts and relationships in geometry can be used to illustrate other mathematical notions in numeracy, measurement, graphing, and algebra. It includes appropriate content to develop reasoning abilities. It provides a vehicle for modelling or pictorially representing abstract situations in problem solving. Finally, geometry is a part of our cultural heritage and has played an important role in the development of civilization. (p.20)

At the junior high level, the study of geometry includes Euclidean (plane), co-ordinate, and transformational geometries. The geometry of grade 9 stresses intuition, informality, induction, discovery, and observation. Student awareness of geometric ideas and relationships are developed in an informal manner by measuring, constructing, and model building. (Dept. of Education, 1984).

The following are the objectives that are recommended for emphasis in the various curriculum guides reviewed for this study:

- to know and apply the basic properties of circles and triangles
- to know and apply the concepts of parallelism, perpendicularity, congruence, and similarity
- to perform basic constructions

- to identify and illustrate the properties of figures under a translation, rotation, reflection, and dilation
- to use informal reasoning in geometric situations
- to select and use appropriate geometric models in problem solving situations
- to solve problems using geometric formulas
- to demonstrate an understanding of the terminology associated with the co-ordinate plane
- to demonstrate an understanding of the postulates for congruency
- to graph linear equations
- to graph two linear equations, on the same graph in order to determine the point of intersection
- to apply geometric concepts and skills to solve both routine and non-routine problems.

Chambers (1986) suggested that the goals of mathematics education were to develop informed, thinking citizens capable of making decisions on personal, community, national, and world issues. He stated:

> The most important goal of mathematics instruction is the development of students' ability to solve problems . . . Because it is impossible to anticipate all the future needs of children, the school mathematics program should provide a balanced emphasis on recall of facts and definitions, use of algorithms,

and routine and non routine problem-solving strategies. It should not focus exclusively on the acquisition of specific skills and procedures. (p.12)

RESEARCH ON TEACHERS' PERCEPTION OF OBJECTIVES IN MATHEMATICS

The purpose of a study conducted by Olson & Freeman (1976) was to determine which objectives for junior high school mathematics were considered most important by parents, students, teachers, and a group of education professors and mathematics supervisors. The resulting rankings were analyzed to determine within and between - group differences. From these rankings it was determined that the perceptions of the objectives by students, parents, and teachers were very similar with these groups choosing the same six objectives as most important. In relation to specific topics, parents and students indicated that fundamental skills used in daily life were the most important content of the mathematics courses whereas educators and teachers indicated that process skills of mathematics were most important.

A study conducted in British Columbia (Robitaille & Sherrill, 1977) collected information about teachers of mathematics and the teaching of mathematics. In this study teachers of Grades 1, 3, 5, 7, 8, and 10 were asked to rate the importance of a number of objectives for their own grade level. The results published in 1980 indicated a discrepancy between educators and teachers. The curricular objectives rated as most important by teachers were those concerned with "traditional" topics such as computational skills and algebraic manipulations. Topics introduced during the reform movement in mathematics education were seen as being of lesser importance. Furthermore, the results indicated that both elementary and secondary teachers felt that geometry was not an essential component of the mathematics curriculum of the elementary school. This would indicate that while mathematics educators considered geometry to be of value in the elementary mathematics program, practicing teachers placed little emphasis on it.

On the Newfoundland scene, several studies have been conducted among different groups of teachers to determine their perceptions of the objectives of mathematics in junior and senior high school. Robbins (1973) conducted a study that examined how the objectives of high school geometry were perceived by two important groups - high school geometry teachers and university mathematics educators. The results indicated that there were many differences of opinion between these two groups on what should be emphasized most in high school geometry. In general geometry teachers seemed to put more stress on those objectives which are at a low taxonomic level while mathematics educators stressed those at higher levels. The major exception to this was rote memorization of theorems which was rated very low by teachers as well as educators. However, they did agree on those aspects of geometry which are not important and therefore would not be emphasized.

Mercer's study in 1975 compared the perception of trade school mathematics instructors and university mathematics instructors relative to a set of general objectives for secondary school mathematics. In the subsequent comparison between the two groups it was found that there was disagreement on the relative importance of the objectives. Trade school mathematics instructors indicated that objectives dealing with applications and measurement were most important whereas university mathematics instructors indicated that the objectives associated with algebra were of the highest relative importance. Both groups agreed that objectives dealing with probability and statistics were of the least relative importance.

The purpose of Chipman's study (1976) was to determine the perceptions of a group of grade seven and eight teachers relative to the degree of importance of a comprehensive list of content objectives for junior high school mathematics. Of particular importance was the degree of emphasis that teachers placed on computational versus structural aspects of mathematics. In general, the results of this indicated that teachers tended to place more emphasis on the lower level objectives. In addition there tended to be more emphasis on traditional topics than on other topics. Objectives associated with algebra, functions, graphs, logic and proof were rated low. Geometry was rated very highly but emphasis was on fundamental concepts with topics such as congruence being rated relatively low.

In a study by Rose (1982) the perceptions of three groups of educators with respect to the importance of objectives for the secondary school matriculation mathematics program was studied. The three groups of educators were the instructors of first year mathematics at Memorial University, the instructors of mathematics at trade and vocational schools, and teachers of matriculation mathematics. It was also sought to determine if there were differences in the ranking of the objectives between teachers who had completed a minimum of 10 university mathematics credits and those who had not. It was concluded that there was a wide difference in opinion among the respondents, both within and between the three groups studied. However, no difference was found between the teachers who had completed a minimum of 10 university mathematics credits and those who had not.

Thus it can be seen from these studies that perceptions of teachers regarding the importance of various mathematics objectives do differ with each other and with teachers at post-secondary institutes. It is the intention of this study to determine the ranking of a set of objectives for grade 9 algebra and geometry by just one group of teachers, namely those who teach the grade 9 mathematics program and to determine if differences of opinion exist among this group. With this study then Grade 9 mathematics teachers are given the opportunity to show what their perceptions are with respect to the objectives of the Grade 9 mathematics course in our schools. From the ranking of the objectives it can be determined which objectives are considered very important and therefore emphasized in the grade 9 program as well as those considered non-important and therefore not emphasized. This study, can provide the opportunity to determine what is functionally happening in the curriculum and the extent to which the planned objectives of the mathematics educators and curriculum specialists have become the implemented curriculum in the schools of the province. With just one exception (Rose,1982), these previous studies did not examine the effect of teacher variables such as experience, academic background, and professional training on their perception of what is important in mathematics. A comparison of various subgroups of teachers relative to the variables being considered would provide information on the extent to which these variables influence teachers' perceptions of the importance and non-importance of the mathematics objectives used in the study.

CHAPTER III

DESIGN OF THE STUDY

This study was designed to answer questions pertaining to the perceptions of teachers of Grade 9 Mathematics regarding objectives for the Grade 9 Mathematics program. In order to answer these questions an instrument was constructed consisting of a list of objectives for Grade 9 mathematics.

This chapter gives a description of how the list of objectives was formulated, how the sample was selected, and how the survey of teachers was carried out. Also included are the methods employed to analyze the data relative to the questions presented in Chapter 1.

THE INITIAL FORM OF THE OBJECTIVES

The list of objectives used in this study was formulated as a result of a review and analysis of literature pertinent to the objectives of junior high school mathematics. Special reference was made to the writings found in journals published by the National Council of Teachers of Mathematics, the Intermediate Mathematics Curriculum Guide published by the Newfoundland and Labrador Department of Education, and also to Curriculum Guides for Mathematics published by various educational agencies in Canada and the United States. Consequently, the objectives used in this study were not reprints from one source, but rather were a synthesis of the different sources reviewed.

An analysis of the various curriculum guides and reports written in the 1980s indicated that the intermediate mathematics program is composed of the following eight program strands: (a) numeration, (b) measurement; (c) geometry-including plane, transformational and co-ordinate geometries; (d) algebra; (e) statistics; (f) problem-solving; (g) applications; and (h) computer literacy.

Such a comprehensive program presented a major difficulty in the process of formulating a list of objectives. It was attempted to make the list comprehensive and representative of the total mathematics program but if objectives from all program strands were included, each respondent would have to rank approximately 150 objectives. This was thought to be unrealistic and impractical. Therefore, it was decided to limit the objectives to certain content areas. In deciding what areas to include in the formulation of the objectives, recommendations made in the Intermediate Mathematics Curriculum Guide published by the Department of Education for Newfoundland and Labrador (1984) were considered. According to this guide, 70% of the instructional time in mathematics should be allocated to the two areas of algebra and geometry. It was also stated that :

> In the intermediate school, mathematics is a unified discipline. As such, the concepts, skills, and principles of arithmetic, and informal geometry are interwoven to provide an integrated view of mathematics at this level. (p.12)

Therefore, since the majority of work in Grade 9 is within the two areas of algebra and geometry with algebraic techniques being used to describe geometric concepts and geometry being used to represent algebraic operations, it was deemed appropriate and realistic to develop the list of objectives for just these two areas.

From an analysis of the literature and an examination of textbooks on algebra and geometry, a comprehensive list of behavioral objectives was prepared. In an attempt to limit the respondent's interpretation of the objectives, an example was written for each.

In addition to the classification of objectives by content area, they were also classified according to cognitive levels of complexity. The particular model used in this study was developed by the School Mathematics Study Group in its National Longitudinal Study of Mathematics Abilities and is referred to by Wilson (1971) as the Table of Specifications for Secondary School Mathematics.

The essential idea of the model is that objectives for mathematics can be classified by: (a) categories of mathematical content, and (b) levels of behaviour which reflect the cognitive complexity and not simply the difficulty of a task. The levels of behaviour included within this model are: (a) computation, (b) comprehension, (c) application and (d) analysis.

According to Wilson computation objectives representing the least complex behaviour that would be expected from students include recall of basic facts or terminology and the rote manipulation of an algorithm. The outcomes included in this level require no decision making or complex memory processing on the part of the student. Designed to demand a more complex set of behaviors than computation, comprehension objectives require the student to demonstrate an understanding of the concepts and their relations.

In the third level of cognitive complexity, application, students are required to select and perform appropriate operations. An item placed in this level should be familiar to the student because it is similar to material that has been encountered in class. If certain items have not been studied in class, then these items would have to be classified at the next level of cognitive complexity - analysis.

In Wilson's model the last and highest of the cognitive levels, analysis, encompasses the behaviors described in Bloom's Taxonomy as analysis, synthesis, and evaluation (Wilson, 1971). The objectives on this level differ from those on the application level in that they require a non-routine application of concepts. This essentially means that students are required to go beyond what has been encountered in previous instruction. Within this level are included all items that involve nonroutine problem solving, discovering relationships, constructing proofs, or providing generalization.

A careful analysis of this preliminary list of these objectives demonstrated that there were repetitious and ambiguous statements in the list. Furthermore, by slightly rewording some of the objectives it was possible to combine some items, resulting in a list of 55 items for piloting.

It should be noted that it was not a purpose of this study to compile an exhaustive or definite list of objectives for the algebra and geometry programs in Grade 9. Neither was it intended that all of the proposed objectives be necessarily the best or even most desired ones. Rather it was intended that they be representative of what is suggested in the analysis of the literature as being appropriate objectives to be attained at a Grade 9 level.

PILOT STUDY

Since the list of objectives used in this study were selected by the investigator from the sources referred to earlier, it was necessary that they be checked for content validity and also reliability.

Validity of the Instrument

The initial list of objectives, together with the instruction sheet and the proposed 4 point rating scale were submitted to three mathematics coordinators and three Grade 9 mathematics teachers in early March, 1988, to make suggestions, if necessary, about the objectives based on the following questions:

1. Have important concepts been omitted?
2. Are the objectives representative of the algebra and geometry courses in Grade 9?
3. Can the list be shortened by either omitting or combining certain objectives?
5. Does each objective clearly indicate the learning outcome that is to be achieved?
6. Does each example reflect the meaning implied by the

objectives?

7. Are the instructions clear in their indication of what is required from the respondents?

The changes that were made resulted from questions about the meaning of certain objectives or from objections to certain words or phrases in the objective. Based on the suggestions of the individuals contacted, changes were made in the initial list producing a final list of objectives consisting of 50 items. This final list of objectives, the accompanying instructions, and recording sheet can be found in Appendix A. As previously mentioned these objectives were placed in an appropriate category according to Wilson's Table of Specifications for Secondary School Mathematics. This classification of the final list of objectives used in the study is included in Appendix B.

Reliability of the Instrument

Following a revision of the instrument based on suggestions offered by the group involved in determining the validity of the instrument, a reliability study was then carried out. In May and June of 1988, ten Grade 9 teachers involved in Grade 9 mathematics program for the 1987-1988 school year were selected and the instrument was administered to them on two occasions with a three week interval between the administrations. Spearman's rank-correlation coefficient between the two sets of rankings was then calculated resulting in a reliability of 0.78.

Final Form of the Instrument

Each of the objectives in the final list with its corresponding example was reproduced on a 7.6 cm X 12.7 cm card through the process of off-set printing. Cards were chosen rather than a booklet form to give the respondents greater flexibility in reclassifying objectives reflecting changes in their thinking as they proceeded through the list. By using cards, respondents were provided the option of changing an initial rating by simply moving the card to a new category.

The teachers in the sample were asked to arrange the cards according to a four point scale of importance with 1 being the most important and 4 being the least important. After the respondents had placed all cards in the category of their choice and had ensured that the final arrangement was a true reflection of their thinking on objectives for Grade 9 algebra and geometry, they could then record this arrangement on the Recording Sheet. Respondents were also asked to list the five objectives they considered to be most important as well as the five objectives they considered least important.

Population and Sample

This study involved Grade 9 teachers who were teaching the mathematics program for Grade 9 during the 1988-1989 school year.

The list of the educational districts in Newfoundland and Labrador was obtained from the Department of Education. During the second week of September, 1988, letters were sent to the thirty-three school board superintendents requesting permission to include the schools in their districts in the study. A copy of this letter is included in Appendix C.

Using The Newfoundland and Labrador Schools Directory 1987-1988 and with reference to the thirty-one school boards from which a positive reply had been received, a list of 230 schools which offered Grade 9 was obtained. From this list of schools a random sample of 138 schools was chosen using a table of random numbers.

Packages containing the objective cards, the instructions, recording sheet, and questionnaire together with an explanatory letter (Appendix D) were sent to the schools during the first two weeks of November, 1988. Enclosed with each package was a letter from Mr. Wilbert Boone, Provincial Mathematics Coordinator, supporting the study and encouraging teacher participation. A copy of this letter is found in Appendix E.

During the third week of December a follow-up letter requesting teachers' cooperation by completing and returning the forms at their earliest convenience was sent to all schools from which replies had not been received. This follow-up letter resulted in some additional replies.

On January 4, 1989 a final letter was sent to schools. After allowing for some delay, the collection of data was terminated on February 3, 1989. Copies of these follow-up letters are found in Appendix F.

ANALYSIS OF THE DATA

This study was concerned with the perceptions of teachers regarding the ranking of objectives for the algebra and geometry components of Grade 9 mathematics. More specifically, the analysis was done to determine if a relationship existed between teachers' ranking of the objectives and various factors such as experience and academic and professional training. The questions proposed in the study, along with the methods used to analyze the data are given below.

Analysis Procedure for Question 1

Question 1: Is there a relationship between teachers' rankings of the objectives and the number of mathematics courses completed?

Respondents to this study were divided into three groups depending on the number of mathematics courses they had completed, reflecting a broad range of mathematical background from those with minimal mathematical background to those who would have completed either a major or minor in mathematics. The following grouping of teachers was chosen: Group 1 consisted of those who had completed two or fewer than two mathematics courses, Group 2 consisted of those who had completed from three to seven mathematics courses, and Group 3 consisted of those who had completed eight or more mathematics courses.

To determine the rankings of the objectives, mean ratings were calculated for each objective for each of the three groups. The means were then used to rank the fifty objectives in order of importance. These results made it possible to examine what type of objective was rated very high and very low by each group, and to what extent there was agreement on these objectives among the groups.

Based on these three rankings, a correlation coefficient, Kendall's Coefficient of Concordance (W), was calculated to determine if there was agreement among the three groups.

To further examine the relationship between the responses of the three groups, a one-way analysis of variance was applied to the data to determine whether the groups differed in relation to the mean rating obtained for each objective. When a significant difference was obtained, the Newman-Keul's procedure was then applied to determine which groups differed significantly from one another.

Parallel procedures were used to analyze Questions 2-6. These questions, previously listed in Chapter 1, were the following:

(2) Is there a relationship between teachers' rankings of objectives and the number of mathematics education courses completed?

(3) Is there a relationship between teaching experience and the ranking of objectives?

(4) Is there a relationship between the rankings of the objectives by the teachers and the grade(s) in which they teach mathematics?

(5) Is there a relationship between classification of the

community as rural, urban or semi-urban, and the ranking of objectives by the teachers in the communities where these schools are located?

(6) Is there a relationship between teachers' rankings of the objectives and the number of years teaching the Grade 9 mathematics program?

In relation to question 2, respondents were divided into the following groups depending on the number of mathematics education courses completed: (a) 0 courses; (b) 1 or 2 courses; and (c) more than 2 courses. For analyzing question 3, respondents were divided into the three groups based on the following intervals : (a) 1-10 years; (b) 11-20 years; and (c) more than 20 years. The same intervals were used in analyzing the results pertaining to question 6 which examined the ranking of objectives by teachers with different years of experience teaching the Grade 9 mathematics program. For analyzing question 4, respondents were divided into three groups depending on the grade(s) in which they were teaching mathematics for the 1988-1989 school year : (a) Grade 9 only; (b) Grade 9, and any other grade(s) at the junior high level; and (c) junior and senior high. In analyzing question 5, respondents were divided into three groups depending on the classification of the community in which the school was located, namely rural, semi-urban, or urban.

Analysis Procedure for Question 7

Question 7: What objectives were listed by teachers as being the 5 most important objectives and the 5 least important objectives for Grade 9 algebra and geometry?

To obtain an answer to this question, a frequency distribution showing the number of times each objective was selected as being either the most important or least important was constructed. Thus, it was possible to obtain a list of the 5 objectives ranked as most important and the 5 objectives ranked as least important by the teachers sampled. Furthermore, it was possible to compare the listing of objectives relative to the groups studied in question 1 to 5. Rankings between the groups were thus compared and discussed.

Analysis Procedure for Question 8

Question 8: Is there different emphasis given to algebra and geometry objectives?

Each objective in the study was designed as representing algebra or geometry. The following hypothesis was proposed:

Hypothesis: There is no significant difference in the emphasis given to algebra and geometry objectives.

A t-test for dependent samples was used to determine if the calculated difference in the means for the algebra and geometry objectives wns significant in relation to the entire sample. Similarly, t-tests were also used to determine if there was a significant difference in the means for objectives of algebra and geometry for the various subgroups in the sample.

Analysis Procedure for Question 9

Question 9: Is there different emphasis given to high and low cognitive items?

Each objective used in this study was designated as representing either a low or high cognitive level of behaviour as classified on Wilson's (1971) Table of Specifications for Secondary School Mathematics. Objectives within the categories of computation, comprehension, or application were considered a low level of cognitive behaviour whereas analysis represented a high level of cognitive behaviour. Based on this classification the following hypothesis was proposed.

Hypothesis: There is no significant difference in the emphasis given to high and low cognitive level objectives.

A t-test for dependent samples was used to determine if the calculated difference in the means for the low and high cognitive level objectives was significant in relation to the entire sample. Similarly, t-tests were also used to determine if there was a significant difference in the means for low and high cognitive level objectives for the various subgroups in the sample.

Chapter IV

Analysis Of The Data

In this chapter an analysis of the data, collected through the use of the instrument described in Chapter III is presented.

Response To The Survey

The instrument used in the study was sent to 180 Grade 9 Mathematics teachers during the first two weeks of November, 1988. One hundred five teachers returned the questionnaire, but five of these questionnaires could not be used because information pertaining to academic and professional training had not been completed. Thus the questionnaires from one hundred Grade 9 mathematics teachers were utilized in the data analysis.

Information on the Sample

Respondents were asked to supply information concerning years of experience, academic and professional training, and grade(s) in which they were presently teaching mathematics. The basic information is presented in Table 1.

The information presented here would tend to indicate that the various groupings of the sample are of sufficient size that an analysis of the data pertaining to the rankings of the objectives in relation to varying levels of experience, academic and professional training is possible.

Table 1

Experience, Academic and Professional

Background of Respondents

Variable	Sub-Group	Number of Respondents
Number of Courses in Mathematics	2 or Fewer than 2	15
	3 - 7 Courses	34
	8 or more	51
Number of Courses in Math Education	0 Courses	31
	1 or 2 Courses	51
	More than 2 Courses	18
Total Teaching Experience	1 - 10 Years	20
	11 - 20 Years	51
	More than 20 Years	29
Experience Teaching Grade 9 Math	1 - 10 Years	53
	11 - 20 Years	36
	More than 20 Years	11
Classification of Community	Rural	50
	Semi-urban	23
	Urban	27

Treatment of Responses

Teachers who responded to the questionnaire were asked to rate each of the fifty objectives on a four point scale of importance. Rating "1" indicated that the objective was considered very important, rating "4" indicated unimportance, and the other two ratings represented points along the continuum. Each point on the scale was assigned a value according to the following:

objectives rated as "1" - 4 points

objectives rated as "2" - 3 points

objectives rated as "3" - 2 points

objectives rated as "4" - 1 point

A mean rating was calculated for each objective and the objectives were then ranked with the first item being the one with the highest mean score and the last item being the one with the lowest mean score. These rankings were determined for the various groupings of teachers in relation to their experience and academic and professional training. With these basic data the questions proposed in Chapter 1 were investigated.

Results Relating to Question 1

Question 1: Is there a relationship between teachers' ranking of objectives and the number of mathematics courses completed?

Respondents were divided into the following three groups depending on the number of mathematics courses completed.

Group 1 . . . . 0, 1 or 2 courses

Group 2 . . . . 3 - 7 courses

Group 3 . . . . 8 or more courses

Since the objectives were rated on a 4 point scale of importance with "1", most important, being assigned a value of 4 points and 4, not important, being assigned a value of 1 point, the objectives could be classified as follows:

Mean Rating 3.5-4.0 . . . . . Very Important

Mean Rating 2.5-3.5 . . . . . Trend towards importance

Mean Rating 1.5-2.5 . . . . . Trend towards non-importance

Mean Rating 1-1.5 . . . . . . Not Important

Table 2 contains the mean ratings and the rank of each objective for each of the three groups under discussion. A study of this table would reveal that for Group 1, 44 of the objectives had a mean rating of 2.5 or more (important range) and that 36% of these objectives were considered to be very important. For the objectives placed in the important range, the distribution between algebra and geometry was approximately equal with 52% of the objectives in these first two categories of the rating scale being associated with

Table 2

Mean Ratings and Ranks for Teachers with Varying Levels of Mathematics Courses

Objective	Group 1		Group 2		Group 3	
	Mean Rating	Rank	Mean Rating	Rank	Mean Rating	Rank
1	3.867	4.5	3.441	8	3.843	3
2	3.133	30	3.029	20	3.196	21.5
3	3.000	34	2.382	41	2.333	44
4	3.067	32	2.676	36.5	3.059	24
5	3.867	4.5	3.64	4	3.804	4
6	3.267	23	3.029	20	2.941	27
7	3.867	4.5	3.353	11	3.490	12
8	3.467	16	3.765	2	3.784	5
9	3.533	13	3.265	13	2.882	28
10	3.733	10	3.681	5	3.780	6
11	3.933	1.5	3.788	1	3.961	1
12	3.467	16	3.353	11	3.216	20
13	2.533	44	2.412	40	2.784	32
14	2.867	37	2.059	46	2.392	43
15	3.933	1.5	3.676	3	3.863	2
16	2.667	42.5	2.273	43.5	2.060	46
17	3.200	27	2.970	22	3.373	15
18	3.200	27	2.939	25	2.880	29
19	3.267	23	3.485	7	3.340	17
20	2.733	40.5	2.697	35	3.157	23
21	2.067	47.5	2.273	43.5	2.569	37.5
22	2.000	49.5	2.250	45	2.265	45
23	2.800	38.5	2.788	30	3.196	21.5
24	3.000	34	2.794	29	2.725	34
25	3.000	34	2.706	34	3.039	25
26	3.467	16	3.353	11	3.686	7.5
27	3.800	8	3.029	20	3.510	11
28	3.800	8	3.412	9	3.569	9.5
29	2.067	47.5	1.882	49	1.804	48
30	3.200	27	3.235	14	2.843	30.5
31	2.800	38.5	2.941	23.5	2.510	40
32	2.000	49.5	2.676	36.5	2.529	39
33	3.267	23	3.182	15	3.220	19
34	2.667	42.5	2.471	39	2.471	41
35	3.800	8	3.176	16	3.471	13
36	3.333	20	2.941	23.5	3.451	14
37	2.933	36	2.813	28	3.000	26
38	3.667	11	2.735	33	2.647	35
39	3.400	18.5	2.765	31.5	2.745	33
40	3.867	4.5	3.147	18	3.569	9.5
41	3.133	30	3.824	27	3.314	18
42	3.500	14	3.529	6	3.686	7.5
43	3.600	12	3.152	17	3.360	16
44	3.133	30	2.853	26	2.627	36
45	3.267	23	2.647	38	2.843	30.5
46	3.267	23	2.234	42	2.431	42
47	3.400	18.5	2.765	31.5	2.569	37.5
48	2.733	40.5	1.941	47	1.765	49
49	2.333	45	1.912	48	2.000	47
50	2.267	46	1.667	50	1.735	50

algebra.

For Group 2, 38 of the objectives had mean ratings in the important range but only 18% of these were perceived to be very important. Furthermore, of these 38 objectives placed in the important range, there was an equal distribution between algebra and geometry. However, only one geometry objective was rated very important.

For teachers who have completed 8 or more courses in mathematics (Group 3) a study of Table 2 shows that 41 of the objectives had a mean rating of 2.5 or greater (important range) and that 34% of these were perceived as very important. With 53% of the objectives in the important range being associated with algebra, the distribution between algebra and geometry was approximately equal.

Using the classification described earlier, it can be observed from Table 2 that only a small percentage of the objectives were rated as non-important by any group. In the group of teachers who completed two or fewer than two courses in mathematics, only six objectives were considered non-important. For Group 2, twelve objectives were placed in the last two categories of the rating scale. Teachers who have completed eight or more mathematics courses, rated nine objectives as non-important. The frequency distribution for the rating of the objectives by these three groups of teachers is included in Appendix G.

The degree of agreement among the three groups can be illustrated by comparing the items ranked at both ends of the ranking scale. Table 3 contains the items occupying the upper ten ranks for each of the three groups concerned.

From examining Table 3 it can be readily observed that in the upper extreme range, ranks 1 to 5, there are several objectives in common for the three groups. Specifically, objective 15 (to simplify an algebraic expression), objective 11 (adding, subtracting, multiplying, and dividing polynomials), and objective 5 (to solve and validate first degree algebraic equations) are perceived by the three groups to be among the five highest-ranked objectives. If the first ten ranks are considered, three more objectives - objective 1 (to define and illustrate terms associated with algebra), objective 28 (to give a justification for two particular triangles being congruent), and objective 10 (to evaluate expressions by substituting for the variable) can be included in the list of objectives considered important by all three groups. Therefore, there was very strong agreement among the three groups on the highest-ranked objectives.

Considering the common objectives for any two of the groups, Groups 2 and 3 are also in agreement on objective 42 (to graph ordered pairs of numbers on the coordinate plane), and objective 26 (to define basic geometric terms) being included in the ten highest-ranked objectives. In relation to these two objectives, Group 1 ranked objective 42 as number 14, and objective 26 as number 16. Groups 1 and 2 ranked objective 7 (to write an equation for and solve word problems) within the ten highest ranks. Objective 7 was ranked

Table 3

Ten Highest Ranked Objectives for

Teachers Relative to Mathematics Background

Rank	Group 1	Group 2	Group 3
1	15	11	11
2	11	8	15
3	5	15	1
4	1	5	5
5	7	10	8
6	40	42	10
7	27	19	26
8	28	1	42
9	35	28	28
10	10	12*	40
		7*	
		26*	

* indicates tied ranks

twelfth by Group 3.

Table 4 contains the ten objectives ranked by teachers as the lowest-ranked objectives. From Table 4 it can be observed that there were only two common objectives in the bottom 5 ranks. To be specific, objective 29 (to complete the basic constructions of Euclidean Geometry using a Mira) and objective 50 (to use coordinate geometry to prove the properties of a given transformation) were included in the last five ranks by all groups. However, if the last ten ranks are considered there is strong agreement among the three groups with six objectives in common. An examination of Table 4 shows that in addition to objectives 29 and 50, objective 16 (to solve simple equations involving exponents), objective 22 (to use scientific notation to find the product or quotient of very large or very small numbers), objective 48 (to apply concepts of midpoint, slope, and/or distance to prove properties of a triangle), and objective 49 (to find the image of a figure under a given transformation) are ranked in the ten lowest ranks by all groups.

Again as with the highest ranked objectives, there is strong agreement between Groups 2 and 3 with these groups agreeing on nine of the lowest-ranked objectives. In addition to the objectives already mentioned, these groups agreed on objective 3 (to apply the properties of the real number system in developing simple algebraic proofs), objective 14 (to judge the appropriateness of particular values in an algebraic expression), and objective 46 (to apply the

Table 4

Ten Lowest - Ranked

Objectives for Groups of

Teachers Relative to Mathematics Background

Rank	Group 1	Group 2	Group 3
	20*		
41	48*	3	34
42	34	46	46
43	16	16	14
44	13	21	3
45	49	22	22
46	50	14	16
47	21	48	49
48	29	49	29
49	22	29	48
50	32	50	50

* indicates tied ranks

concept of slope to determine if two or more lines are parallel, perpendicular, or neither) were included in the ten lowest ranks. Group 1 ranked these objectives in rank positions 34, 37, and 23 respectively.

Strong agreement was also apparent between Groups 1 and 2. From Table 4 it can be observed that these two groups are in agreement on seven of the ten lowest - ranked objectives. In addition to the six objectives common to the three groups, these groups also rank objective 21 (to write a given number in scientific notation) among the ten lowest - ranked objectives. Group 3 ranked this objective in rank position 37.

An examination of Tables 3 and 4 also revealed that the highest ranked objectives are those pertaining to algebra. In the upper ten ranks the majority of the objectives were the algebra objectives. Groups 1 and 3 included six algebra objectives in the upper ten ranks while Group 2 had a slightly higher number. In addition, the highest rank given to any geometry objective by any group was rank six. In considering the lower ranks, 60% of the objectives were geometry for Groups 1 and 3 while for Group 2 there was no distinction between algebra and geometry.

Thus it can be seen that the three groups showed substantial agreement concerning the objectives ranked in the upper and lower ranks.

The data gathered were analyzed with a view to determine the relationship that existed between the number of mathematics courses that teachers had completed and their ranking of the objectives. The following hypothesis was, therefore, proposed:

Hypothesis: There is no agreement among the groups of teachers regarding the ranking of objectives.

The hypothesis was tested using Kendall's Cofficient of Concordance (W) which when calculated was transformed to Chi square. A W-value of 0.94 was obtained and the corresponding Chi square was 138.75 ($p < 0.05$). Consequently, the null hypothesis was rejected and it was concluded that there was agreement among the three groups relative to the ranking of the objectives.

Even though there was agreement relative to the ranking of the objectives by the three groups of teachers, a more detailed analysis was carried out to determine if the groups differed on the mean rating that had been given to each objective. To test this, the following hypothesis was proposed:

Hypothesis: There is no significant difference in the mean rating for specific objectives relative to the three groups.

This was tested using a one-way analysis of variance. Where differences in the mean scores were significant, the Newman-Keul's procedure was carried out to determine for what groups significant differences existed. Only objectives that yielded statistically significant results are reported on here.

When a one-way analysis of variance was applied to the data for objective 14 (to judge the apprupriateness of particular values for a variable in an algebraic expression) as shown in Table 5, it was found that a significant difference ($p < 0.05$) existed among the three sets of means.

Table 5

Summary of ANOVA for Objective 14

Relative to Teachers' Mathematics Background

Source	DF	SS	MS	F	P
Between Groups	2	6.9775	3.4887	4.4661	0.0140*
Within Groups	97	75.7725	0.7812		
Total	99	82.7500			

* reject at 0.05 level of significance

Further analysis, using the Newman-Keul's Procedure, determined that there was a significant difference in the mean rating of objective 14 for Group 1 and Group 2 with the mean rating for Group 1, 2.87, being significantly higher than the mean rating for Group 2, 2.06.

The results of the one-way analysis of variance for objective 27 (to list the postulates used to prove two triangles congruent), are shown in Table 6. Inspection of this table shows that a significant difference ($p < 0.05$) existed between the three sets of means.

Further analysis, using the Newman-Keul's Procedure, found that there was a significant difference in the mean rating of objective 27 for Groups 3 and 1 in comparison to Group 2. The mean ratings for Group 3 and 1, respectively 3.51 and 3.80 were significantly higher than mean rating for Group 2 which was 3.03.

Table 6

ANOVA Summary for Objective 27

Relative to Teachers' Mathematics Background

Source	DF	SS	MS	F	P
Between Groups	2	7.6743	3.8372	5.6296	0.0049*
Within Groups	97	66.1157	.6816		
Total	99	73.7900			

* reject at 0.05 level of significance

For objective 35 (to apply the Pythagorean Theorem in the solution of word problems), the results of the one way analysis of variance are shown in Table 7. The results shown in this table indicate that there is a significant difference in the mean rating of objective 35 for the three groups of teachers. The Newman-Keul's procedure showed that significant differences existed between Group 1 and Group 2 with the mean for Group 1, 3.80, being significantly higher than the mean for Group 2, 3.03.

The results of the one-way analysis of variance for objective 38 (to supply a complete two column proof for congruent triangles) are shown in Table 8. Inspection of Table 8 shows that significant

Table 7

ANOVA Summary for

Objective 35 - Relative to Teachers' Mathematics Background

Source	DF	SS	MS	F	P
Between Groups	2	4.3129	2.1565	4.0190	.0210*
Within Groups	97	52.0471	.5366		
Total	99	56.3600			

* reject at the 0.05 level of significance

Table 8

ANOVA Summary for

Objective 38 - Relative to Teachers' Mathematics Background

Source	DF	SS	MS	F	P
Between Groups	2	12.5120	6.2560	5.2495	.0068*
Within Groups	97	115.5980	1.1917		
Total	99	128.1100			

* reject at 0.05 level of significance

differences existed in the means for this objective among the three groups.

The Newman-Keul's procedure indicated that this significant difference occurred between Group 1 and Groups 2 and 3 with the mean for Group 1, 3.67, being significantly higher than the mean for either Groups 2 or 3, respectively 2.74 and 2.65.

The results of the one way analysis of variance for objective 40 (to apply the rules related to various geometric concepts to find missing measures) are shown in Table 9.

The results of ANOVA indicated that there was a significant difference in the means for the three groups. Further analysis, using the Newman-Keul's Procedure showed that the means for Groups 1 and 3, respectively 3.87 and 3.57, were significantly higher than the mean of 3.15 for Group 2.

Table 9

ANOVA Summary for

Objective 40 - Relative to Teachers' Mathematics Background

Source	DF	SS	MS	F	P
Between Groups	2	6.4022	3.2011	5.4949	0.0055*
Within Groups	97	56.578	.5826		
Total	99	62.9100			

* reject at 0.05 level of significance

The results of the analysis of variance for objective 46 (to apply concept of slope to determine if two or more lines are parallel, perpendicular, or neither) are shown in Table 10. From these results, it was concluded that a significant difference in the means did exist. Furthermore, an examination of the results of the Newman-Keul's procedure, indicated that this significant difference occurred for Group 1 in relation to the other two groups. It was concluded that the mean for Group 1, 3.27, was significantly higher than the mean for either Group 2 or Group 3 having means of 2.32 and 2.43 respectively.

Table 10

ANOVA Summary for

Objective 46 - Relative to Teachers' Mathematics Background

Source	DF	SS	MS	F	P
Between Groups	2	10.757	5.0378	5.0439	.0082*
Within Groups	97	96.8843	.9988		
Total	99	106.9600			

* reject at 0.05 level of significance

The results of the one-way analysis of variance for objective 47 (to graph pairs of linear equations on same graph and determine the point of intersection) are shown in Table 11. From these results it was concluded that a significant difference did exist in the means

Table 11

ANOVA Summary for

Objective 47 - Relative to Teachers' Mathematics Background

Source	DF	SS	MS	F	P
Between Groups	2	8.0125	4.0063	3.7285	0.0275*
Within Groups	97	104.2275	1.745		
Total	99	112.2400			

* reject at 0.05 level of significance

Table 12

ANOVA Summary for

Objective 48 - Relative to Teachers' Mathematics Background

Source	DF	SS	MS	F	P
Between Groups	2	10.9178	5.4589	6.1577	0.0030*
Within Groups	97	85.9922	0.8865		
Total 99	96.9100				

* reject at 0.05 level of significance

for the three groups. An examination of the results of the Newman-Keul's Procedure, indicated that this difference occurred with respect to Groups 1 and 3 with Group 1 giving the objective the higher rating.

As indicated by Table 12, objective 48 (to apply concepts of midpoint, slope, and/or distance to prove properties of a triangle) also yielded means which were significantly different. Further analysis, using the Newman-Keul's procedure, indicated that the mean rating of Group 1, 2.73, was significantly higher than the mean rating for either Group 2 having a mean rating of 1.94 or Group 3 having a mean rating of 1.76.

From the analysis of this data, therefore, the null hypothesis of there being no significant difference on specific objectives was rejected for objectives 14, 27, 35, 38, 40, 46, 47 and 48. For the remainder of the objectives the null hypothesis was accepted.

An examination of the objectives for which the null hypothesis was rejected showed that all but one of the objectives were associated with geometry. Furthermore, an examination of the results of using the Newman-Keul's Procedure for these objectives indicated that Group 1, which consisted of teachers with 2 or fewer than 2 courses in mathematics, assigned a higher mean rating to the objective that did the other groups. Therefore, it would seem that for these particular geometry objectives Group 1 had a significantly different perception.

However, based on the analysis of the data it was concluded that for the overall ranking of the objectives no relationship existed between teachers' ranking of the objectives used in this study and the number of mathematics courses completed. Teachers with varying numbers of mathematics courses did not perceive the objectives significantly different from one another. It was only with respect to eight specific objectives that any significant differences occurred and it is recognized that some of these differences could have occurred through random chance.

__Results Relating to Question 2__

Question 2: Is there a relationship between teachers' ranking of objectives and the number of mathematics education courses completed?

Respondents were divided into the following three groups depending on the number of mathematics education courses completed:

Group 1 . . . . . . 0 courses

Group 2 . . . . . . 1 or 2 courses

Group 3 . . . . . . more than 2 courses

Table 13 contains the mean ratings and the rank of each objective for each of the three groups being considered. This table can be used to determine which objectives are in the important or non-important ranges based on the following classification:

Mean Rating 3.5 - 4.0 . . . . . . Very Important

Mean Rating 2.5 - 3.5 . . . . . . Trend towards important

Mean Rating 1.5 - 2.5 . . . . . . Trend towards non-importance

Mean Rating 1.0 - 1.5 . . . . . . Non-important

From an examination of Table 13 it can be see that for Group 1, 42 objectives were perceived as being important and that approximately 21% of these were rated as very important. For the objectives placed in the important range, the distribution between algebra and geometry was approximately equal with 22 of the objectives being algebraic. However, for the objectives rated as very important approximately 78% were related to algebra with only two geometry objectives being perceived as very important.

For Group 2, 86% of the objectives had mean ratings in the important range and 30% of these were considered very important. For the objectives placed in the important range, the distribution between algebra and geometry was also approximately equal with 51% of the objectives in these first two categories of the rating scale being associated with algebra. This trend was also seen for the objectives rated as very important. From Table 13 it can be observed that seven algebra objectives and six geometry objectives were rated very important.

For teachers who have completed more than two courses in mathematics education, a study of Table 13 shows that 38 of the objectives had a mean rating of 2.5 or greater (important range) but only nine of these had a mean rating of 3.5 or greater (very important). As with Groups 1 and 2, there were approximately an equal number of algebra and geometry objectives classified as important. However, only 33% of the objectives classified as very important were related to geometry.

Using the classification described earlier, it can be observed from Table 13 that only a small percentage of the objectives were rated in the non-important range by either group. Teachers in Group 1 rated eight objectives - three algebra and five geometry - as non-important. For teachers in Group 2, three algebra and four geometry objectives were rated as non-important. A total of twelve objectives - five algebra and seven geometry - had mean ratings less than 2.5 for Group 3 teachers. Frequency distributions for the rating of the objectives by these three groups of teachers are included in Appendix H. To gain some insight into the extent to which agreement existed among the three groups the objectives ranked at both ends of the ranking scale were compared. In Table 14 the list of ten highest-ranked objectives for each of the three groups under discussion is provided. By examining Table 14 it can be determined that in the upper extreme ranks, ranks 1 to 5, there are three objectives in common for the three groups. To be specific, objective 11 (to add, subtract, multiply, and divide polynomials) which received a rank of 1 by the three groups, and objective 15 (to simplify an algebraic expression), and objective 5 (to solve and validate first degree algebraic equations in one variable) are common within the five highest ranks for the three groups. If the first ten ranks are considered three additional objectives - objectives 1, 8, and 10 are common to the three groups. Therefore, there was basic agreement among the three groups on the highest-ranked objectives.

Considering the common objectives for any two of the groups,

Table 13

Mean Rating and Ranking of Objectives by Teachers with Varying Numbers of Mathematics Education Courses Completed

Objective	Group 1		Group 2		Group 3	
	Mean Rating	Rank	Mean Rating	Rank	Mean Rating	Rank
1	3.548	6.5	3.765	5	3.833	2
2	3.097	19	3.098	22.5	3.278	18
3	2.839	30	2.353	44	2.056	47
4	2.710	33.5	2.980	28	3.167	23.5
5	3.710	3	3.824	3.5	3.667	5.5
6	3.000	21.5	3.059	25	2.944	26
7	3.452	9	3.608	9	3.278	18
8	3.548	6.5	3.863	2	3.667	5.5
9	3.290	15	3.098	22.5	2.833	29
10	3.645	4	3.760	6	3.722	4
11	3.839	1	3.902	1	4.000	1
12	3.355	13.5	3.275	18	3.278	18
13	2.645	39	2.588	39	2.667	32.5
14	2.161	45.5	2.451	43	2.389	40
15	3.806	2	3.824	3.5	3.778	3
16	2.467	42	2.260	45	1.722	49
17	2.900	26	3.314	16.5	3.444	12
18	3.000	21.5	3.000	27	2.722	31
19	3.448	10	3.412	15	3.167	23.5
20	2.667	36.5	2.961	29.5	3.333	14.5
21	2.333	44	2.471	41.5	2.278	43.5
22	2.379	43	2.163	46	2.118	45
23	2.667	36.5	3.782	4	3.333	14.5
24	2.935	24	2.784	37	2.556	35.5
25	2.645	39	2.961	29.5	3.278	18
26	3.226	18	3.706	8	3.611	7
27	3.419	11	3.451	13	3.167	23.5
28	3.581	5	3.569	10	3.444	12
29	2.032	48	1.765	49	1.889	48
30	2.903	25	3.157	21	2.889	27
31	2.677	35	2.804	36	2.444	39
32	2.129	47	2.706	38	2.556	35.5
33	3.258	16.5	3.180	20	3.235	21
34	2.484	41	2.471	41.5	2.611	34
35	3.355	13.5	3.431	14	3.500	9
36	3.032	20	3.314	16.5	3.500	9
37	2.767	32	3.039	26	2.882	28
38	2.968	23	2.922	31	2.333	41.5
39	2.871	27.5	2.863	34	2.778	30
40	3.387	12	3.510	11	3.500	9
41	2.839	30	3.235	19	3.278	18
42	3.500	8	3.725	7	3.444	12
43	3.258	16.5	3.480	12	3.000	25
44	2.839	30	2.843	35	2.500	37.5
45	2.871	27.5	2.882	32.5	2.667	32.5
46	2.645	39	2.510	40	2.333	41.5
47	2.710	33.5	2.882	32.5	2.500	37.5
48	2.161	45.5	1.961	48	1.667	50
49	1.819	49	2.039	47	2.278	43.5
50	1.806	50	1.694	50	2.059	46

Groups 1 and 2 are also in agreement on objective 28 (to give a justification for two particular triangles being congruent), objective 42 (to graph ordered pairs to numbers on the coordinate plane) and objective 7 (to solve word problems) being included in the ten highest ranks. In relation to these three objectives, Group 3 ranked them in rank positions 12, 12, and 18 respectively. Groups 2 and 3 ranked objective 26 in the upper ten ranks whereas Group 1 ranked it in position 18.

An examination of Table 14 also reveals that more algebra objectives as compared to geometry were included in the list of the ten highest ranked objectives. Group 1 listed eight algebra objectives, Group 2 listed seven algebra objectives, and Group 3 listed six algebra objectives. Furthermore, for all groups the highest ranked objectives were algebra. Group 1 listed a geometry objective at five, but the highest rank for a geometry objective by the other groups was rank position seven.

Table 15 contains the objectives ranked in the lower ten ranks for each of the groups concerned. From Table 15 it can be observed that in the bottom five ranks there was strong agreement, with three objectives (29, 48, and 50) being placed there by the three groups. If the bottom ten ranks are considered there is stronger agreement with seven objectives (16, 22, 21, 48, 29, 49, and 50) being common to the three groups. Furthermore, an additional two objectives were common to two groups. Specifically, objective 34 was ranked in the lower ten by Groups 1 and 2, and objective 3 was placed there by

Table 14

Ten Highest - Ranked Objectives for Groups of Teachers with Different Backgrounds in Mathematics Education

Rank	Group 1	Group 2	Group 3
1	11	11	11
2	15	8	1
3	5	5*	15
4	10	15*	10
5	28	1	5*
6	1*	10	8*
7	8*	42	26
8	42*	26	35*
9	7	7	36*
10	19	28	40*

* indicates tied ranks

Table 15

Ten Lowest - Ranked Objectives for

Groups of Teachers with Different

Backgrounds in Mathematics Education

Rank	Group 1	Group 2	Group 3
41	34	21*	38*
42	16	34*	46*
43	22	14	21*
44	21	3	49*
45	14	16	22
46	48	22	50
47	32	49	3
48	29	48	29
49	49	29	16
50	50	50	48

* indicates tied ranks

Groups 2 and 3. Objective 34 was ranked 34 by Group 3 and objective 3 was ranked 30 by Group 1.

An examination of this table also shows that teachers in Group 3 placed the same number of algebra and geometry objectives in these lower ranks and that the other two groups placed one more algebra objective in these lower ranks as compared to geometry. Thus it can be seen that the three groups showed substantial agreement on listing objectives in both the upper and lower ranks. The data gathered were analyzed with a view to determine the relationship that existed between the number of mathematics education courses that teachers had completed and their ranking of the objectives. The following hypothesis was, therefore, proposed:

Hypothesis: There is no agreement among the groups of teachers regarding the ranking of objectives.

The hypothesis was tested using Kendall's Coefficient of Concordance (W) which when calculated was transformed to Chi-square. A Kendall's Coefficient of Concordance of 0.92 with a corresponding Chi-square of 135.62 ($p < 0.05$) was obtained. Consequently, the null hypothesis was rejected and it was concluded that there was a consensus among these three groups of teachers regarding the ranking of objectives. Therefore, the ranking of these objectives was not dependent upon the number of courses in mathematics education that the teachers had completed.

Even though there was agreement relative to the overall ranking of the objectives by the three groups of teachers, a more detailed analysis was carried out to determine if the groups differed on the mean rating that had been given to each objective. To test this, the following hypothesis was proposed:

Hypothesis: There is no significant difference in the mean rating on specific items for the three groups.

This hypothesis was tested using a one-way analysis of variance. When a significant F-ratio was obtained, the Newman-Keul's procedure was used to determine what groups were significantly different. Only objectives that yielded statistically significant results are reported here.

The results of the analysis of variance with respect to Objective 3 (to apply the properties of the real number system in developing simple algebraic proofs) are shown in Table 16.

These results indicated that there was a significant difference ($p < 0.05$) among the three sets of means. The results of the Newman-Keul's procedure which was carried out relative to this objective indicated that significant differences existed between Groups 3 and 2 with respect to Group 1, with the mean rating obtained for this objective by Group 1, 2.84 being significantly higher than the mean rating for either Groups 2 or 3 having means of 2.35 and 3.06 respectively.

The results of the analysis of variance for objective 8 (to translate English statements into algebraic statements) are shown in Table 17. This result shows that a significant difference ($p < 0.05$) existed among the three sets of means. Further analysis

Table 16

ANOVA Summary for

Objective 3 - Relative to Courses in Mathematics Education

Source	DF	SS	MS	F	P
Between Groups	2	7.9649	3.9825	3.5510	0.0325*
Within Groups	97	108.7851	1.1215		
Total	99	116.7500			

* reject at 0.05 level of significance

Table 17

ANOVA Summary for

Objective 8 - Relative to Courses in Mathematics Education

Source	DF	SS	MS	F	P
Between Groups	2	1.9934	.9967	3.2533	.0429*
Within Groups	97	29.7166	.3064		
Total	99	31.7100			

* reject at 0.05 level of significance

using the Newman-Keul's procedure indicated that this significant difference existed between Groups 2 and 1 with Group 2 having the higher mean rating.

Table 18 shows the results of the analysis of variance for objective 17 (to graph sets of real numbers on a number line). These results indicated that there was a significant difference in the means for objective 17 among these three groups. The results of the Newman-Keul's procedure indicated that there was a significant difference in the mean rating between Groups 2 and 1 with Group 2 having a significantly higher mean.

Table 18

ANOVA Summary for

Objective 17 - Relative to Courses in Mathematics Education

Source	DF	SS	MS	F	P
Between Groups	2	4.4206	2.2103	3.6506	.0296*
Within Groups	96	58.1248	.6055		
Total	98	62.5455			

* reject at 0.05 level of significance

For objective 26 (to define basic geometric terms), the results of the one way analysis of variance are shown in Table 19. Inspection of this table shows that for objective 26, significant differences existed among the three sets of means. Comparisons of these means, using the Newman-Keul's procedure showed that a significant difference existed for Group 2 and Group 1 with the mean rating for Group 2, 3.71, being significantly higher than the mean rating for Group 1, 3.23.

Table 19

ANOVA Summary for

Objective 26 - Relative to Courses in Mathematics Education

Source	DF	SS	MS	F	P
Between Groups	2	4.5546	2.2773	3.7900	0.0260*
Within Groups	97	58.2854	.6009		
Total	99	62.8400			

* reject at 0.05 level of significance

Based on these results of the analysis of variance, the null hypothesis of there being no significant difference between the mean ratings of the objectives for the three groups was rejected in only four cases - objectives 3, 8, 17, and 26. For all other objectives it was concluded that no significant difference in the mean rating of specific objectives existed among the three groups.

An examination of these four objectives shows that for three of them - 8, 17, and 26, Group 2 had a significantly higher mean than Group 1. Furthermore, these three objectives represented low level cognitive behaviour. It is recognized, however, that the differences found for objectives 3, 8, 17, and 26 could be attributed to chance and not actual differences among the groups.

Based on the analysis of the data relative to the number of courses teachers had completed in mathematics education it was concluded that for the overall ranking of the objectives no relationship existed between teachers' ranking of objectives used in the study and the number of mathematics education courses completed. Teachers with varying levels of mathematics education courses did not have different perceptions pertaining to the ranking or rating of the objectives for Grade 9 algebra and geometry.

<u>Results Relating to Question 3</u>

Question 3: Is there a relationship between teaching experience and the ranking of objectives?

Respondents were assigned to one of the following three groups depending on their years of experience:

Group 1 . . . . . 1 - 10 years

Group 2 . . . . . 11 - 20 years

Group 3 . . . . . more than 20 years

Table 20 contains the mean ratings and rank of each objective for each of these three groups. From this table a list of the objectives classified in the important range (mean rating 2.5 - 4.0) and in the non-important range (mean rating less than 2.5) can be determined.

An examination of Table 20 shows that for Group 1, 41 objectives were classified as important and that 22% of these were rated very important (mean ratings of 3.5 - 4.0). There was

Table 20

Mean Ratings and Ranking of Objectives by Teachers with Varying Years of Teaching Experience

Objective	Group 1		Group 2		Group 3	
	Mean Rating	Rank	Mean Rating	Rank	Mean Rating	Rank
1	3.350	13.5	3.765	5	3.862	3.5
2	2.90	29	3.157	21	3.241	20
3	2.550	39.5	2.529	40	2.241	44
4	2.600	37.5	2.961	26.5	3.103	23.5
5	3.65	2.5	3.784	4	3.793	5
6	3.000	26	2.922	32	3.272	2
7	3.450	10.5	3.628	8	3.310	18
8	3.50	7.5	3.745	6	3.386	3.5
9	3.000	26	2.941	28	3.483	11.5
10	3.600	5	3.820	3	3.621	7
11	3.750	1	3.960	1	3.897	1.5
12	3.150	17	3.294	15	3.414	14
13	2.75	33.5	2.726	36	2.345	42
14	2.450	42	2.353	44	2.276	43
15	3.650	2.5	3.824	2	3.897	1.5
16	2.400	43	2.320	45	1.929	48
17	3.05	21	3.220	19	3.310	13
18	3.100	18	3.041	23	2.690	34.5
19	3.632	4	3.280	16	3.379	15
20	3.050	21	2.940	30	2.862	31.5
21	2.250	44.5	2.400	43	2.483	39.5
22	1.947	46	2.149	46	2.517	38
23	2.750	33.5	3.060	22	3.069	26
24	2.550	39.5	2.940	30	2.690	34.5
25	2.600	37.5	2.940	30	3.103	23.5
26	3.350	13.5	3.501	10	3.724	6
27	3.400	12	3.412	12	3.345	16
28	3.550	6	3.550	9	3.552	9
29	1.800	48	1.843	49	1.966	47
30	2.800	31.5	2.961	26.5	3.310	18
31	2.500	41	2.666	37.5	2.862	31.5
32	2.250	44.5	2.569	39	2.552	37
33	3.300	15.5	3.260	17	3.712	5
34	2.800	31.5	2.431	42	2.414	41
35	3.50	7.5	3.373	14	3.448	13
36	3.050	21	3.216	20	3.483	11.5
37	2.700	35	3.020	24	2.929	30
38	3.000	26	2.686	37.5	2.966	27.5
39	2.850	30	2.784	34.5	2.966	27.5
40	3.450	10.5	3.432	11	3.552	9
41	3.050	21	3.245	18	3.214	29
42	3.474	9	3.686	7	2.586	9
43	3.300	15.5	3.400	13	2.483	21
44	3.050	21	2.784	34.5	2.586	36
45	3.000	26	2.980	25	2.483	39.5
46	3.000	26	2.510	41	2.270	45
47	2.650	36	2.824	33	2.724	33
48	1.850	47	2.059	48	1.897	49
49	1.700	49.5	2.137	47	2.034	44
50	1.700	49.5	1.816	50	1.821	50

approximately the same number of algebra and geometry objectives in the important range. However, 67% of the objectives which were rated very important were algebra objectives.

For Group 2, 82% of the objectives had mean ratings greater than 2.5 (important range) and 24% of these were rated very important. As with Group 1, there was approximately an equal number of algebra and geometry objectives in the important range and a concentration of algebra objectives (70%) rated as very important.

Teachers in Group 3 rated 40 objectives - 21 algebra and 19 geometry - in the important range. For objectives with mean ratings greater than 3.5, there were six algebra and four geometry objectives.

An examination of Table 20 also reveals that for Groups 1 and 2, only 9 objectives - five geometry and four algebra- were placed in the non-important range. For Group 3, there were also nine objectives with mean ratings less than 2.5. However, for this group only three of these were algebra. Frequency Distributions for the rating of the objectives by these three groups of teachers are included in Appendix I.

The degree of agreement among the three groups can be illustrated by comparing the objectives ranked at both ends of the ranks. In Table 21 the ten highest - rated objectives for each of these three groups under discussion are listed. By examining Table 21 it can be readily observed that in the upper extreme range ranks 1 to 5, there was strong agreement with three objectives -

Table 21

Ten Highest - Ranked Objectives for

Groups of Teachers Based on Years of Teaching Experience

Rank	Group 1	Group 2	Group 3
1	11	11	11*
2	15*	15	15*
3	5*	10	1*
4	19	5	8*
5	10	1	5
6	28	8	26
7	35*	42	10
8	8*	7	40*
9	42	28	28*
10	40*	26	42*
	7*		

* indicates tied ranks

objectives 11, 15, and 5 being placed there by the three groups. If the first ten ranks are considered, then there is agreement on seven of the objectives with objectives 10, 28, 8, and 42 being added to the list of objectives common to the three groups.

When any two groups are considered, Groups 2 and 3 also agree on objectives 1 and 26 being included in the ten highest-ranked objectives. These two objectives were tied at rank 13 by Group 1. Group 1 and 2 placed objective 7 which was ranked 18 by Group 3 in the ten highest ranks.

A listing of the ten lowest - ranked objectives for these three groups of teachers is shown in Table 22. From Table 22 it can be observed that in the lower 5 ranks, there was very strong agreement with 4 objectives (50, 49, 29 and 48) being placed there by the three groups. An examination of the table also shows that for Groups 1 and 2 there was agreement on the five lowest-ranked objectives and that the only exception for Group 3 was objective 22 which was ranked 38 by the teachers in that group. If the lower ten ranks are considered, then there were an additional two objectives- objectives 14 and 16 - common to the three groups.

If any two groups are considered, then from Table 22 it can be observed that Groups 2 and 3 are in agreement on eight of the objectives. In addition to the objectives common to the three groups, these two groups also rank objectives 34 and 46 in the lower ten ranks. These objectives were ranked in rank positions 31 and 26 by Group 1. Furthermore, objective 22 which was ranked 38 by Group

Table 22

Ten Lowest - Ranked Objectives for

Groups of Teachers Based on Years of Teaching Experience

Rank	Group 1	Group 2	Group 3
41	31	46	34
42	14	34	13
43	16	21	14
44	21	14	3
45	32	16	46
46	22	22	49
47	48	49	29
48	29	48	16
49	49	29	48
50	50	50	50

3 was included in the last ten ranks by both Groups 1 and 2.

Examining both of these tables it can be observed that for the three groups the majority of the objectives were algebra. Specifically, Groups 1 and 2 included seven algebra objectives in the upper ten ranks while Group 3 included six algebra objectives. But,

the highest rank given to any geometry objective was a rank of 6. In the lower ten ranks the three groups listed four algebra objectives and six geometry objectives.

Thus it can be seen that there was substantial agreement among the three groups in selecting the objectives in the upper and lower ten ranks.

The data gathered were analyzed with a view to determining if the differences which existed in the rankings of the objectives were statistically significant. The following hypothesis was proposed:

Hypothesis: There is no agreement among the groups regarding the ranking of the objectives.

The hypothesis was tested using Kendall's coefficient of Concordance (W) for which a value of 0.80 was obtained. To test for significance this W - value was changed to Chi - square yielding a value of 117.69 ($p < 0.05$).

Consequently, the null hypothesis was rejected and it was concluded that there was strong agreement among these three groups of teachers regarding the ranking of the objectives.

A more detailed analysis was also carried out to determine whether the groups differed on the mean rating that had been calculated for each objective. The following hypothesis was proposed:

Hypothesis: There is no significant difference in the mean rating on specific items for the three groups.

A one-way analysis of variance procedure was performed using the mean rating obtained for each objective for the three groups. Objectives that showed significant differences were analyzed further using the Newman-Keul's Procedure. The results of these procedures indicated that significant differences existed for only two objectives - 1 and 46. With significant results being obtained for this extremely small number of objectives, it was decided that these differences might be the result of chance and consequently, the results have not been reported. Based on the data analysis pertaining to the ranking and mean rating of the objectives relative to teaching experience, it was concluded that teachers with differing numbers of years of teaching experience do not differ in their perceptions of the importance and non-importance of the objectives for Grade 9 algebra and geometry. Therefore, no relationship exists between ranking of objectives and years of experience. It is realized that if different intervals for teaching experience had been used, different results might have been obtained. However, for this study the number of respondents did not make the use of other intervals feasible.

Results Relating to Question 4

Question 4 :Is there a relationship between teachers' ranking of objectives and the grade(s) in which these teachers taught mathematics during the school year 1988-1989?

Respondents to the study were assigned to one of the following groups depending on the grades in which they taught mathematics during 1988-1989:

Group 1 . . . . . Grade 9 only

Group 2 . . . . . Grade 9 and any other(s) at junior high level

Group 3 . . . . . Junior and Senior High

Table 23 contains the mean ratings and rank of each objective for each of these three groups. From this table the list of objectives in the important (mean rating 2.5 - 4.0) and non-important (mean rating less than 2.5) ranges can be determined. This table shows that for Group 1, 42 objectives had mean ratings in the important range and that 10 of these were rated very important. For the objectives in the important range, there was approximately an equal number of algebra and geometry objectives. However, there was a concentration of algebra objectives rated very important with seven algebra objectives in comparison to only three geometry objectives being placed in the first category of the rating scale.

For Group 2, 80% of the objectives had mean ratings in the important range and 30% of these were rated as very important. There were an equal number of algebra and geometry objectives with

Table 23

Mean Rating and Ranking of Objectives by Teachers who teach Mathematics at Different Grade Levels

Objective	Group 1		Group 2		Group 3	
	Mean Rating	Rank	Mean Rating	Rank	Mean Rating	Rank
1	3.852	2	3.524	11	3.712	4
2	3.259	20	3.095	22	3.772	2
3	2.704	38	2.286	44.5	2.385	42
4	2.963	31.5	2.857	33	2.942	26.5
5	3.741	5	3.857	4.5	3.731	3
6	2.852	34.5	2.952	3	3.135	20.5
7	3.444	11.5	3.714	7	3.442	11
8	3.667	7	3.905	2.5	3.692	5
9	3.185	22.5	2.952	30	3.135	20.5
10	3.778	4	3.950	1	3.596	6.5
11	3.889	1	3.905	2.5	3.902	1
12	3.444	11.5	3.238	17.5	3.250	17
13	2.519	41.5	2.762	37.5	2.615	36
14	2.519	41.5	2.286	44.5	2.288	44
15	3.815	3	3.857	4.5	3.788	2
16	2.333	44.5	2.226	46	2.157	46
17	3.296	18	3.328	17.5	3.157	19
18	3.037	27.5	3.200	19	2.804	30
19	3.556	9	3.350	15	3.294	14
20	2.852	34.5	2.952	30	2.980	25
21	2.444	43	2.381	41.5	2.373	43
22	2.269	46	2.238	47.5	2.118	45
23	3.742	5.5	2.810	35	3.039	24
24	3.111	24	2.762	37.5	2.635	34.5
25	2.963	31.5	2.810	35	2.942	26.5
26	3.481	10	3.476	12	3.596	6.5
27	3.471	3.5	3.571	10	3.308	13
28	3.667	7	3.619	9	3.462	10
29	1.963	48	2.095	49	1.731	50
30	3.185	22.5	3.286	16	2.846	29
31	2.741	36.5	2.952	30	2.577	37.5
32	2.333	44.5	2.524	40	2.577	37.5
33	3.333	17	3.850	24	3.216	18
34	2.741	36.5	2.238	47.5	2.481	39.5
35	3.471	3.5	3.429	13.5	3.423	12
36	3.370	15.5	3.048	25.5	3.228	15
37	3.037	27.5	2.810	35	2.920	28
38	2.963	31.5	3.143	20	2.635	34.5
39	3.000	29	3.095	22	2.673	33
40	3.259	20	3.667	8	3.500	9
41	3.259	20	3.095	22	3.058	23
42	3.667	7	3.750	6	3.519	8
43	3.370	15.5	3.429	13.5	3.260	16
44	2.667	39.5	2.952	30	2.769	31
45	2.963	31.5	3.000	27	2.712	32
46	2.667	39.5	2.571	39	2.423	41
47	3.742	5.5	3.048	25.5	2.481	39.5
48	2.000	47	2.381	41.5	1.788	49
49	1.852	49	2.333	43	1.981	47
50	1.593	50	1.900	50	1.860	48

mean ratings in the important range. However, for the objectives rated as very important 58% were algebra based.

A study of Table 23 shows that teachers assigned to Group 3 also rated 80% of the objectives, equally distributed between algebra and geometry, in the important range. This trend was also seen for the objectives rated as very important. From Table 23 it can be observed that six algebra objectives and six geometry objectives were rated very important.

Using the classification described earlier, it can be observed that for Groups 2 and 3 an equal number of algebra and geometry objectives had mean ratings less than 2.5 (non-important range). For Group 1, however, three algebra objectives and five geometry objectives were rated non-important. For the three groups of teachers being considered, the majority of the objectives were rated as important or very important. Frequency distributions for the rating of the objectives by these three groups of teachers are included in Appendix J.

To gain some insight into the extent of agreement among the three groups, objectives ranked at both ends of the rankings were compared. In Table 24 the ten highest-rated objectives for each of the three groups being considered are given. By examining Table 24 it can be determined that in the upper extreme ranks, for example ranks 1 to 5, there are three objectives in common for the three groups. Specifically, objective 11 (to add, subtract, multiply and divide polynomials), objective 15 (to simplify an algebraic

Table 24

Ten Highest-Ranked Objectives for Teachers

Based on Grade(s) in Which they are Teaching Mathematics

Rank	Group 1	Group 2	Group 3
1	11	10	11
2	1	8*	15
3	15	11*	5
4	10	15*	1
5	5	5*	8
6	8*	42	26*
7	28*	7	10*
8	42*	40	42
9	19	28	40
10	26	27	8

* indicates tied ranks

expression), and objective 5 (to solve and validate first degree equations) are included in the upper five ranks by the three groups. If the first ten ranks are considered, four additional objectives- 10, 8, 28, and 42 are common to the three groups.

Considering any two groups, then Groups 2 and 3 are also in agreement on objectives 1 and 26 being included in these upper ranks. Group 2 ranked these objectives at 11 and 12 respectively. Groups 2 and 3 ranked objective 40 in the ten highest ranked objectives but Group 1 ranked this objective at a much lower rank at position 20.

In Table 25 the objectives placed in the lower ten ranks for each of the three groupings of teachers are presented. From Table 25

it can be observed that in the bottom five ranks there were just two objectives (29 and 50) placed there by three groups. However, in the bottom 10 ranks there is very strong agreement with 8 objectives (14, 16, 21, 22, 29, 48, 49,and 50) being placed there by the three groups.

Examining Tables 24 and 25 it can be observed that in the upper ten ranks all objectives were low level cognitive items with a small majority of these objectives being related to algebra. For the lower ten ranks there was an even number of low level cognitive and high level objectives being ranked in these positions with equal emphasis given to algebra and geometry objectives.

Table 25

Ten Lowest - Ranked Objectives for Teachers

Based on Grades in Which they are Teaching Mathematics

_Rank	Group 1	Group 2	Group 3
41	13*	48	46
42	14*	21	3
43	21	49	21
44	16*	3*	14
45	32*	14*	22
46	22	16	16
47	48	22*	49
48	29	34*	50
49	49	29	48
50	50	50	29

* indicates tied ranks

Therefore, there was significant agreement among the three groups on the objectives included in the upper and lower ranks.

The data gathered were analyzed with a view to determine if the ranking of the objectives by these three groups of teachers were significantly different. The following hypothesis was proposed:

Hypothesis: There is no agreement among these groups of teachers regarding the ranking of the objectives.

The hypothesis was tested using Kendall's Coefficient of Concordance (W) which when calculated was transformed to Chi-square. A Kendall's Coefficient (W) of 0.94 was obtained from which a corresponding Chi-square value of 137.93 ($p < 0.05$) was obtained. Consquently, the null hypothesis was rejected and it was concluded that there was agreement among the three groups of teachers regarding the ranking of the objectives. In other words, these three groupings of teachers relative to the grade(s) in which they teach mathematics did not differ in their perceptions of the importance or non-importance of the objectives.

Even though there was agreement on the ranking of the objectives by the three groups of teachers, a more detailed analysis was carried out to determine if the groups differed on the mean rating that had been given to each objective. To test this, the following hypothesis was proposed.

Hypothesis: There is no significant difference in the mean rating on specific items for the three groups.

This hypothesis was tested using a one-way analysis of variance.

Only objectives that yielded statistically significant results were further examined and reported on. The results of a one-way analysis of variance showed that significant differences existed in the mean rating of two objectives - 20 and 47. Due to the low number of objectives having significant results, it was accepted that these differences might be the result of chance and consequently the results are not reported.

In answering the question posed at the beginning of this section it was concluded that there is no relationship between the ranking of objectives and the grade(s) in which these teachers were teaching mathematics during 1988-1989. In other words, teachers who were teaching mathematics classes at different grade levels do not have different perceptions of the relative importance of the objectives.

Results Relating to Question 5

Question 5: Is there a relationship between the classification of the communities as rural, urban or semi-urban, and the ranking of objectives by the teachers ?

Respondents to this study were divided into the following three groups depending on the classification of the community in which their schools were located:

Group 1 . . . . . . rural

Group 2 . . . . . . semi-urban

Group 3 . . . . . . urban

This classification system was used in a 1988 study by Bulcock and Pereira-Mendoza (1988).

The mean ratings and ranks of the objectives for each of these groups are included in Table 26.

From this table it can be seen that for teachers in Group 1, a mean rating of 2.5 or greater (important range) was obtained for 40 of the objectives and that 11 of these were perceived to be very important (mean rating 3.5 - 4.0). In the important range there were 19 geometry objectives but only three of the geometry objectives were perceived to be very important.

Teachers in Group 2 rated 21 algebra and 19 geometry objectives in the important range. Of these, 12 objectives equally distributed between algebra and geometry were considered very important.

A study of Table 26 would also reveal that 88% of the objectives received mean ratings of 2.5 or greater with one more algebra objective as compared to geometry being placed in the important range. Of the objectives placed in the important range, only nine objectives - six algebra and three geometry - were rated very important.

From Table 26 it can also be observed that for the three groups none of the objectives were perceived as being non-important (mean rating 1.0 - 1.5) by either group of teachers. The trend towards non-important range (mean rating of 1.5 - 2.5) contained only 10 objectives for Group 1, nine for Group 2, and six for Group 3. However, for all groups there were slightly more geometry objectives

Table 26

Mean Rating and Ranking of Objectives by Teachers Relative To Classification of Community

Objective	Group 1		Group 2		Group 3	
	Mean Rating	Rank	Mean Rating	Rank	Mean Rating	Rank
1	3.740	3	3.478	12.7	3.852	3
2	3.080	20	3.087	23	3.259	19
3	2.580	38.5	2.130	44.5	2.481	42.5
4	2.800	33.5	2.913	28.5	3.185	21.5
5	3.680	6	3.870	2	3.815	4.5
6	3.020	23	2.565	38	3.471	3.5
7	3.420	12	3.739	3.5	3.444	12
8	3.700	5	3.739	3.5	3.778	6
9	3.200	16.5	2.565	38	3.471	3.5
10	3.714	4	3.609	7	3.815	4.5
11	3.878	1	3.957	1	3.889	2
12	3.200	16.5	3.435	14.5	3.370	15.5
13	2.480	40	3.000	26	2.556	39
14	2.320	43	2.435	42	2.333	46
15	3.800	2	3.696	5	3.926	1
16	2.240	46	1.909	48	2.642	44
17	3.180	18	3.801	22	3.370	15.5
18	2.918	29	2.955	27	3.000	28
19	3.469	11	3.273	19	3.296	18
20	2.880	30.5	3.409	16	2.667	36.5
21	2.320	43	2.455	41	2.481	42.5
22	2.271	45	1.857	49	2.423	45
23	2.940	26.5	3.045	24	3.742	6
24	2.760	35	2.913	28.5	2.741	33
25	2.960	24.5	2.652	35	3.742	6
26	3.400	13	3.652	6	3.704	7.5
27	3.380	14	3.261	20	3.519	10.5
28	3.520	8.5	3.435	14.5	3.704	7.5
29	1.840	50	2.043	46	1.778	50
30	2.920	28	3.174	21	3.118	24
31	2.680	37	2.870	30.5	2.593	38
32	2.320	43	2.565	38	2.778	32
33	3.102	19	3.545	10	3.148	23
34	2.400	41	2.496	33.5	2.519	40.5
35	3.480	10	3.565	8.5	3.185	21.5
36	3.040	21.5	3.348	17.5	3.593	9
37	2.878	32	3.043	25	2.923	31
38	2.880	30.5	2.609	36	2.926	30
39	2.940	26.5	2.522	40	2.963	29
40	3.520	8.5	3.522	11	3.333	17
41	3.040	21.5	3.348	17.5	3.742	6
42	3.673	7	3.565	8.5	3.519	10.5
43	3.313	15	3.478	12.5	3.222	20
44	2.860	33.5	2.696	33.5	2.704	34.5
45	2.960	24.5	2.783	32	2.667	36.5
46	2.580	38.5	2.391	43	2.519	40.5
47	2.740	36	2.870	30.5	2.704	34.5
48	1.940	48	2.000	47	2.000	48
49	1.960	47	2.130	44.5	2.037	47
50	1.878	49	1.591	50	1.808	49

rated in this range. Frequency distributions for the rating of these objectives by the three groups of teachers are included in Appendix K.

The degree of agreement among these three groups can be illustrated by comparing the objectives placed in the upper and lower rank positions. In Table 27 the objectives occupying the upper ten ranks for each of the groups concerned are listed. From this table it can be observed that in the upper extreme range, ranks 1 to 5, there is only agreement on two objectives - Objective 11 (to add, subtract, multiply, and divide polynomials) and Objective 15 (to simplify an algebraic expression) in common. In the first ten ranks the agreement is slightly stronger with six objectives - 11, 15,10, 8, 5, and 42 - having been ranked in the upper 10 ranks by the three groups.

Considering any two groups, then it can be seen from Table 27 that for Groups 1 and 3 there is agreement on eight objectives with objectives 1 and 28 also being placed in the upper ten ranks by both groups. Group 2 ranked these objectives 12 and 14 respectively. Between Groups 2 and 3 there is agreement on objective 26 which was ranked 13 by Group 1 being included in the upper 10 ranks. Objective
35 which was placed in the upper ten ranks by both Groups 1 and 2 was ranked much lower by Group 3 at 21.

At the other end of the scale there is stronger agreement. Table 28 shows the objectives occupying the ten lowest ranks for

Table 27

Ten Highest - Ranked Objectives for Groups of

Teachers Relative to Classification of Community

Rank	Group 1	Group 2	Group 3
1	11	11	15
2	15	5	11
3	1	7	1
4	10	8	5*
5	8	15	10*
6	5	26	8
7	42	10	26*
8	40*	35*	28*
9	28*	42*	36
10	35	33	42*
			27*

* indicates tied ranks

each of the three groups concerned. In the lower extreme range, ranks 46 to 50, there are three objectives - objectives 29, 50, and 48 placed there by the three groups. If the lower ten ranks are considered, then from the table it can be observed that there are eight objectives - objectives 14, 21, 22, 16, 48, 49, 50,and 29 - in common.

If agreement between any two groups is examined, then it can be seen from Table 28 that Groups 2 and 3 place the same objectives in the lower ten ranks. In relation to Group 1 there is agreement on 9 of the objectives with respect to Groups 2 and 3.

From Tables 27 and 28 it is evident that there is agreement on the type of objectives included in these upper and lower ranks. For the three groups the highest ranked objectives are low level algebra. Only four geometry objectives are included in the upper ten ranks and the highest rank of any geometry objective by any group is rank position six. In the lower ranks there is an even distribution between the low cognitive and high cognitive level objectives.

Therefore, it can be seen that while there was substantial agreement among the three groups on selecting the objectives ranked at the lower end of the scale, agreement on the objectives ranked at the upper end was not as strong.

The data gathered were analyzed with a view to determine if teachers from different communities that is, rural, urban, and semi-urban, ranked the objectives differently. The following

Table 28

Ten Lowest - Ranked Objectives for Groups of

Teachers Relative to Classification of Community

Rank	Group 1	Group 2	Group 3
			46*
41	3	21	34*
42	32*	14	3
43	14*	46	21
44	21*	3	16
45	22	49	22
46	16	29	14
47	49	48	22
48	48	16	48
49	50	22	50
50	29	50	29

* indicates tied ranks

hypothesis was proposed:

Hypothesis: There is no agreement among these three groups regarding the ranking of objectives.

The hypothesis was tested by using Kendall's Coefficient of Concordance (W) which was transformed to Chi-square to test for significance. A Kendall's Coefficient of concordance (W) value was 0.94 from which a Chi-square of 138.75 was obtained. This result indicates that the null hypothesis be rejected ($p < 0.05$) and it was concluded that there was a consensus among these three groups regarding the ranking of the objectives. Even though there were differences in the rankings of the objectives across the three groups, these differences were not statistically significant.

A more detailed analysis was carried out to determine if there were significant differences in the mean ratings given to each objective by the three groups. The following hypothesis was proposed:

Hypothesis: There is no significant difference in the mean rating on specific objectives for the three groups.

This hypothesis was tested using a one-way analysis of variance. When a significant F-ratio was obtained, the Newman-Keul's procedure was used to determine what groups were significantly different. The results of these procedures indicated that significant differences existed for only three objectives-objectives 9, 20, and 36. With significant results being obtained for such a small number of objectives, it was decided that these differences might be the result of chance and consequently, the results have not been reported.

Based on the data analysis pertaining to the ranking and mean rating of the objectives relative to the classification of the community, it was concluded that teachers whose schools were classified as being located in urban, semi-urban, or rural communities did not differ in their perceptions of the importance and non-importance of the objectives. In summary then the analysis of this data indicates that there is no relationship between the ranking o the objectives and the classification of the community.

Results Relating to Question 6

Question 6: Is there a relationship between teachers' ranking of objectives and the number of years teaching the Grade 9 mathematics program?

Respondents were divided into the following groups depending on the number of years they had been teaching Grade 9 mathematics:

Group 1 . . . . 1 - 10 years teaching Grade 9 mathematics

Group 2 . . . . . . 11 - 20 years teaching Grade 9 mathematics

Group 3 . . . . . . more than 20 years teaching Grade 9 mathematics

From Table 29 the mean ratings and ranking of the objectives by each of these three groups of teachers can be obtained. From this table it can be seen that for Group 1, 41 objectives have mean ratings greater than 2.5 (important range) and that approximately 27% of these were rated very important (mean rating 3.5 - 4.0). For

Table 29

Mean Rating and Ranking of Objectives by Teachers with Varying Years Experience Teaching Grade Nine Mathematics

Objective	Group 1		Group 2		Group 3	
	Mean Rating	Rank	Mean Rating	Rank	Mean Rating	Rank
1	3.623	5	3.806	5	3.818	5.5
2	3.170	19	3.083	23.5	3.091	25
3	2.660	39	2.222	44	2.182	43.5
4	2.755	36.5	3.193	20	3.091	25
5	3.755	2.5	3.694	6.5	4.000	1.5
6	2.925	28	3.083	23.5	3.273	20.5
7	3.566	8	3.444	12	3.364	16
8	3.604	6	3.834	4	4.000	1.5
9	3.226	18	2.833	30	3.455	13.5
10	3.642	4	3.856	3	3.636	8
11	3.865	1	3.944	1	3.999	3.5
12	3.302	15.5	3.306	17	3.273	20.5
13	2.547	40.5	2.667	36	2.818	32.5
14	2.340	44	2.333	43	2.455	38
15	3.755	2.5	3.861	2	3.909	3.5
16	2.453	42	1.941	49	2.000	45
17	3.113	20	3.343	16	3.273	20.5
18	3.094	22	2.794	32	2.727	34.5
19	3.464	10	3.257	18	3.364	16
20	2.783	34	3.114	21	3.091	25
21	2.321	45	2.486	40	2.455	38
22	2.200	46	2.206	45	2.364	40.5
23	2.981	26	3.029	25	3.000	27
24	2.811	32.5	2.861	29	2.455	38
25	2.811	32.5	2.944	27.5	3.364	16
26	3.377	13	3.694	6.5	3.818	5.5
27	3.302	15.5	3.444	12	3.636	8
28	3.585	7	3.500	9.5	3.545	11
29	1.830	49	2.000	47	1.636	49.5
30	3.000	25	2.944	27.5	2.455	13.5
31	2.755	36.5	2.611	38	2.727	34.5
32	2.359	43	2.583	39	2.909	28.5
33	3.289	17	3.086	22	3.273	20.5
34	2.547	40.5	2.472	41	2.364	40.5
35	3.452	11	3.444	12	3.182	23
36	3.094	22	3.417	14.5	3.545	11
37	2.827	31	2.972	26	3.300	18
38	2.943	27	2.639	37	2.909	28.5
39	2.887	30	2.806	38	2.819	31
40	3.434	12	3.500	9.5	3.545	11
41	3.094	22	3.250	19	2.818	32.5
42	3.558	9	3.667	8	3.636	8
43	3.346	14	3.417	14.5	2.900	30
44	2.906	29	2.750	34.5	2.273	42
45	3.038	24	2.750	34.5	2.182	43.5
46	2.736	38	2.389	42	1.909	46.5
47	2.774	35	2.778	33.5	2.636	36
48	2.019	47	1.944	48	1.818	48
49	1.943	48	2.167	46	1.909	46.5
50	1.808	50	1.824	50	1.636	49.5

the objectives rated important there were approximately an equal number of algebra and geometry objectives but only 3 geometry objectives were rated very important.

For Group 2, 41 objectives were also placed in the first two categories of the rating scale with approximately equal distribution between algebra and geometry. Of the 41 objectives in the important range, approximately 24% were rated very important with 60% of these being algebra objectives.

Teachers with more than 20 years experience with the Grade 9 program rated 19 algebra objectives and 17 geometry objectives in the important range. Of these 36 objectives in the important range, 33% were rated very important with equal emphasis being given to algebra and geometry.

From Table 29 it can also be observed that teachers in Groups 1 and 2 rated nine objectives - four algebra and five geometry - in the non-important range (mean rating less than 2.5). Of the 14 objectives rated non-important by Group 3, approximately 57% were geometry objectives. Frequency distributions for the rating of the objectives by the three groups of teachers are included in Appendix L.

The extent of agreement that existed among these three groups was determined by comparing the objectives that were ranked in the upper and lower ranks. Table 30 includes the ten highest-ranked objectives for each of the three groups under discussion.

By examining Table 30, it can be determined that in the upper

Table 30

Ten Highest - Ranked Objectives for Groups of

Teachers in Relation to Years Teaching Grade 9 Mathematics

Rank	Group 1	Group 2	Group 3
1	11	11	5*
2	5	15	8*
3	15	10	15*
4	10	8	11*
5	1	1	1*
6	8	5	26*
7	28	26	10
8	7	42	42
9	42	28*	27
10	19	40*	28*
			36*
			40*

* indicates tied ranks

extreme ranks, ranks 1 to 5, there is strong agreement with three objectives (objective 11, 15, and 1) being placed there by the three groups. If the upper ten ranks are considered, this agreement is stronger, with eight objectives (objectives 11, 5, 15, 10, 1, 8, 28, and 42) common to the three groups. Therefore, there is very strong agreement among these three groups on the objectives in the ten highest ranks.

Considering any two groups, then from Table 30 it can be seen that for Groups 2 and 3 there is agreement on the ten objectives. It is noted that because of tied ranks Group 3 has 12 objectives in its ten highest ranks and this would influence to a certain extent the strength of the agreement. However, even without the two extra objectives these two Groups would agree on nine of the ten objectives.

From Table 30 it is also seen that for each of the three groups, more algebraic objectives as compared to geometry were included in the list of the ten highest-ranked objectives. However, Groups 2 and 3 included a greater percentage of geometry objectives than did Group 1.

The list of the ten lowest ranked objectives for the three groups of teachers is presented in Table 31. From Table 31 it can be determined that in the bottom 5 ranks there was very strong agreement with 4 objectives (objectives 50, 49, 48, and 29) being placed there by the three groups.

Comparing the bottom ten ranks, it can be observed from Table 31

Table 31

Ten Lowest - Ranked Objectives by Groups of

Teachers in Relation to Years of Teaching Grade 9 Mathematics

Rank	Group 1	Group 2	Group 3
	34*		22*
41	13*	34	34*
42	16	46	44
43	32	14	3*
44	14	3	45*
45	21	32	16
46	22	49	49*
47	48	29	46*
48	49	48	48
49	29	16	29
50	50	50	50

* indicates tied ranks

that there is agreement on seven objectives (objectives 34, 16, 22, 29, 48,49, and 50) among the three groups. Furthermore, objective 14 which was ranked 32 by Group 3 was ranked in the lower ten ranks by both Groups 1 and 2. Groups 2 and 3 included objectives 46 and 3 in the lower ten ranks while these objectives were ranked 38 and 39 respectively by Group 1.

It can be seen then that the three groups were in agreement on the objectives listed in the upper and lower ranks of this set of objectives even though rankings of the objectives by the groups differed.

The data were analyzed with a view to determine if there was a significant difference between the rankings by the three groups. The following hypothesis was,therefore, proposed:

Hypothesis: There is no agreement among these groups of teachers regarding the ranking of objectives .

The hypothesis was tested by using Kendall's Coefficient of Concordance (W) which was transformed to Chi-square to test for significance. For these three groups of teachers, Kendall's Coefficient of Concordance (w) was 0.897 from which a Chi-square value of 128.30 ($p < 0.05$) was obtained. This result indicated that the null hypothesis be rejected ($p < 0.05$) and it was concluded that these three groups were in agreement regarding the ranking of the objectives. Even though there were differences in the rankings of the objectives across the three groups, these differences were not statistically significant.

A more detailed analysis was also carried out to determine if the groups differed on the mean rating that had been given to each objective. To test this, the following hypothesis was proposed:

Hypothesis: There is no significant differences in the mean rating on specific items for three groups.

This hypothesis was tested using a one-way analysis of variance. Only objectives which showed significant differences were further examined and reported on here. The results of the analysis of variance indicated that significant differences occurred for just two objectives - objectives 45 and 46. Since significant differences were obtained for such a small number of objectives, it was accepted that these differences occurred through chance and consequently the results were not reported.

In answering the questions posed at the beginning of this section, it was concluded that there is no relationship between teachers ranking of the objectives and the number of years that have been teaching Grade 9 mathematics. Teachers with differing numbers of years of experience with the Grade 9 mathematics program do not differ in their perception of the ranking of the objectives for algebra and geometry.

It is recognized that different intervals could have been used for teaching experience. However, if different intervals had been used in this study the number of respondents in certain intervals would have been too few for comparisons to be made.

Results Relating to Question 7

Question 7: What objectives were listed by teachers as being the 5 most important objectives and 5 least important objectives for Grade 9 algebra and geometry?

As part of the study, teachers were also asked to list the five objectives they considered most important and the five objectives they considered least important for the Grade 9 mathematics program.

In Table 32 the number of teachers in the sample who classified each objective as most important is given. From an examination of this table it can be seen that the perceptions of teachers regarding this classification of objectives varied greatly with 42 of the objectives being classified as most important by varying numbers of the sample. It is recognized, however, that many of these objectives were classified most important by only a small number of the teachers sampled. Specifically, objective 3, 16, 22, 34, 41, and 45 were perceived most important by one teacher and only two teachers perceived objectives 14, and 46 as most important. As can be seen from Table 32, twenty-eight of the objectives were classified as most important by 10% or less of the sample.

An examination of this table also shows that only one objective (objective 5) was classified most important by more than 50% of the sample and only five objectives (5, 11, 7, 15, and 1) were considered most important by 25% or more of the teachers. Therefore, the 5 objectives selected most frequently as being most important did not represent a consensus of opinion among the teachers.

Table 32

Classification of Objectives as Most Important *

Objective	Number	Objective	Number
1	27	25	4
2	12	26	19
3	1	27	9
4	4	28	5
5	56	30	11
6	5	31	5
7	32	33	5
8	24	34	1
9	11	35	6
10	23	36	4
11	44	37	9
12	4	38	8
13	6	39	3
14	2	40	12
15	28	41	1
16	1	42	5
17	4	43	13
18	3	44	10
19	9	45	1
20	16	46	2
22	1	47	4

* obj not listed indicates they were not classified as most important

The list of objectives classified most important by at least 25% of the teachers in the various sub-groups of the sample is given in Table 33. A comparison of the two tables shows that the objectives selected by 25% of the sample - (5, 11, 7, 15 and 1) are also selected by 25% of the various sub-groups. It can also be seen that there is basic agreement among the sub-groups regarding the objective perceived most important.

In examining the objectives as they were classified by the sub-groups a few trends became apparent. With the exception of just one objective - objective 26 - all the objectives classified most important were related to algebra. In addition these objectives stressed basic algebraic skills involving only the recall of previously learned material and as such occupy a low taxonomic level.

The same difference in perception is evident in the classification of the objectives as least important. In Table 34 the number of teachers who classified each objective as least important is given. As can be seen from this table, 45 of the objectives were classified least important by varying numbers in the sample. It is recognized, however, that many of these objectives were classified least important by only a small percentage of the teachers sampled. Specifically, 31 of these objectives were classified least important by only 10% or less of the sample. Of the remaining 14 objectives, only four (50, 49, 48, and 29,) were selected as least important by 25% or more of the sample and none of the objectives were classified by 50% or more of the sample.

Table 33

Objectives Perceived Most Important by

Sub-groups of Sample

Variable	Sub-group	Objective Perceived as Most Important
Number of Courses in Math	2 of Fewer Than 2 Courses	11, 5, 1, 10, 7, 15
	3-7 Courses	5, 11, 8, 7
	8 or More Courses	5, 11, 15, 7, 1
Number of Courses in Math Education	0 Courses	5, 11, 15, 7
	1 or 2 Courses	5, 11, 7, 1, 8, 15, 26
	More than 2 Courses	5, 11, 1
Total Teaching Experience	1 - 10 Years	5, 15, 7, 11, 19, 20
	11 - 20 Years	5, 11, 7, 8, 10

(Table Continues)

Variable	Sub-group	Objective Perceived as Most Important
	More than 20 Years	5, 11, 1, 7
Experience in Grade 1X	1 - 10 Years	5, 1, 7, 10
	11 - 20 Years	5, 11, 7, 8, 15, 26
	More than 20 Years	5, 11, 1, 7, 26
Grade Presently Teaching	Gr. 9 Only	5, 11, 15, 8, 7, 1
	Jr. High	5, 15, 7, 1
	Jr. & Sr. High	11, 5, 7, 1
Classification of Community	Rural	5, 11, 1, 7, 15
	Semi-urban	5, 11, 7, 8
	Urban	5, 11, 7, 1, 10

Table 34

Classification of Objectives as

Least Important *

Objective	Number	Objective	Number	Objective	Number
2	5	24	10	46	12
3	15	25	6	47	9
4	4	26	4	48	35
5	1	27	2	49	36
6	9	29	39	50	44
7	3	30	9		
9	5	31	9		
10	1	32	13		
12	2	33	1		
13	12	34	12		
14	12	36	4		
15	2	37	4		
16	24	38	11		
17	2	39	7		
18	6	40	2		
19	3	41	1		
20	4	42	1		
21	17	43	2		
22	24	44	4		
23	7	45	8		

* Obj not listed indicates they were not classified least important

Table 35

Objectives Perceived Least Important by

Sub-groups of Sample

Variable	Sub-Group	Objectives Perceived Least Important
Number of Courses in Mathematics	2 or Fewer Than 2 Courses	29, 49, 50, 32
	3 - 7 Courses	50, 48, 49, 29
	8 or More Courses	50, 48, 29, 49
Number of Courses in Math Ed	0 Courses	49, 50, 29
	1 or 2 Courses	50, 29, 48, 14, 16
	More Than 2 Courses	48, 38, 16, 3, 29
Total Teaching Experience	1 - 10 Years	50, 49, 29, 22, 21
	11 - 20 Years	50, 48, 49, 29, 22
	More than 20 Years	50, 29, 49, 48, 16

Variable	Sub-Group	Objectives Perceived Least Important
Teaching Experience in Grade 9	1 - 10 Years	50, 49, 48
	11 - 20 Years	50, 49, 29, 48, 22
	More than 20 Years	29, 50, 49, 48, 16
Grade Presently Teaching	Grade 9 Only	50, 48, 49, 29
	Jr. High	50, 29, 49, 34
	Jr. & Sr. High	29, 50, 49, 48, 22
Classification of Community	Rural	50, 29, 49, 48
	Semi-urban	50, 48, 49, 29
	Urban	50, 49, 48, 29

Therefore, with just four objectives being selected by 25% or more of the sample it can be seen that there was not a consensus of opinion regarding the least important objectives.

The list of objectives classified least important by at least 25% of the teachers in the various sub-groups of the sample is given in Table 35. A comparison of these two tables shows that the objectives selected by 25% of the sample are also selected by 25% of the various sub-groups .

In examining Tables 34 and 35 it is apparent that the objectives selected as least important were mainly related to either low-level transformational geometry (objectives 29 and 4) or high level co-ordinate geometry (objective 48 and 50). Implications arising from this will be discussed in the next chapter.

<u>Results Relating to Question 8</u>

Question 8: Is there a different emphasis given to algebra and geometry objectives?

Hypothesis: There is no significant difference in the amount of emphasis given to algebra and geometry objectives.

This hypothesis was tested using a t-test for dependent samples. The results for entire sample of teachers are summarized in Table 36. This result indicates that there is a significant difference in the amount of emphasis given to algebra and geometry objectives, and that significantly more emphasis is given to algebra objectives.

This difference for the entire sample was investigated further by examining the difference in algebra and geometry relative to the

Table 36

Results of a t-test on Difference in

Emphasis between Algebra and

Geometry Objectives for Entire Sample

Obj.	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Alg.	100	3.0858	0.328	0.427	5.03	0.000*
Geom.	100	2.8711	0.408			

* reject at 0.05 level of significance

variable being investigated - total teaching experience, number of mathematics courses completed, and grade(s) presently teaching. Tables 37, 38, and 39 summarize the results obtained for the variable of teaching experience in relation to emphasis given to algebra and geometry.

An examination of these tables (Tables 37, 38, 39) indicates that for teachers with 1-10 years of experience there is no significant difference ($p > 0.05$) in the emphasis given to algebra and geometry. However, for teachers who have more than 10 years of experience there is a significant difference ($p < 0.05$) in the emphasis given to algebra and geometry, and that significantly more emphasis is given to algebra.

Tables 40, 41, and 42 summarize the results obtained for the

Table 37

Results of a t-test on Differences in
Emphasis between Algebra and Geometry for
Teachers with 1- 10 Years of Experience

Obj.	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Alg.	20	2.9876	0.321	0.508	1.28	0.217*
Geom.	20	2.8424	0.428			

* accept at 0.05 level of significance

Table 38

Results of a t-test on Differences in
Emphasis between Algebra and Geometry for
Teachers with 11-20 Years of Experience

Obj.	N.	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Alg.	51	3.1134	0.337	0.379	4.26	0.000*
Geom.	51	2.8873	0.395			

* reject at 0.05 level of significance

Table 39

Results of a t-test on Differences in

Emphasis between Algebra and Geometry for

Teachers with More Than 20 Years Experience

Obj.	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Alg.	29	3.1051	0.315	0.456	2.86	0.008*
Geom.	29	2.8625	0.430			

* reject at 0.05 level of significance

Table 40

Results of t-test on Difference in Emphasis between

Algebra and Geometry for Teachers with 2 or Fewer

Than Two Courses in Mathematics

Obj.	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Alg.	15	3.1822	.290	.418	.32	.750
Geom.	15	3.1472	.460			

* accept at 0.05 level of significance

Table 41

Results of a t-test on Difference in
Emphasis between Algebra and Geometry for
Teachers with 3 - 7 courses in Mathematics

Obj.	N	Grand Mean	S.D.	S.D. in Diff.	t-Value	P
Alg.	34	2.9937	0.347	0.436	2.94	0.006*
Geom.	34	2.7743	0.416			

* reject at 0.05 level of significance

Table 42

Results of t-test on Difference in
Emphasis between Algebra and Geometry for
Teachers With 8 or More Courses in Mathematics

Obj.	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Alg.	51	3.1189	0.317	0.418	4.52	.000*
Geom.	51	2.8545	0.357			

* reject at 0.05 level of significance

difference in emphasis between algebra and geometry in relation to the number of university courses completed in mathematics. An examination of these tables indicated that for teachers with 2 or fewer than 2 courses in mathematics there is no significant difference in the emphasis between algebra and geometry. However, for the other two groups of teachers there is a significant difference in emphasis between algebra and geometry, and that significantly more emphasis is given to algebra.

The results of t-tests for differences in emphasis between algebra and geometry in relation to the grade(s) in which the teachers teach mathematics are presented in Tables 43, 44, and 45.

Table 43

Results of a t-test on Difference in Emphasis between Algebra and Geometry for Teachers who Teach at only the Grade 9 Level

Obj.	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Alg.	27	3.1442	0.295		3.04	.005*
Geom.	27	2.9200	0.417			

* reject at 0.05 level of significance

Table 44

Results of a t-test on Difference in

Emphasis between Algebra and Geometry for

Teachers who Teach at the Junior High Level

Obj.	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Alg.	21	3.0853	.332	.1064	1.36	1.90*
Geom.	21	2.9789	.381			

* accept ($p > 0.05$)

Table 45

Results of t-test on Difference in

Emphasis between Algebra and Geometry for

Teachers who Teach at the Junior and Senior High Level

Obj.	N	Grand Mean	S.D.	S.D. of diff.	t-Value	P
Alg.	52	3.0557	0.344	0.472	3.088	0.000*
Geom.	52	2.8022	0.408			

* reject at 0.05 level of significance

Based on these results it was concluded that for teachers who teach mathematics at only the Grade 9 level and for those who teach at both junior and senior high a significant difference existed ($p < 0.05$) between algebra and geometry and that significantly more emphasis was given to algebra. However, for teachers who teach mathematics classes at different levels of junior high school there is no significant difference in emphasis between algebra and geometry.

In summing up this section, then, there was a significant difference ($p < 0.05$) in relative importance attached to algebra and geometry by the sample of teachers involved in the study. In addition, significant differences favoring algebra were found in many of the subgroups relative to teaching experience, number of mathematics courses completed, and grade(s) in which mathematics is taught. Implications arising from these findings will be discussed in the next chapter.

Results Relating to Question 9

Question 9: Is there any difference in emphasis given to objectives of low cognitive behaviour and those of high cognitive behaviour?

Each objective in the study was designated as representing either a low cognitive level behaviour or a high cognitive level behaviour. Appendix B gives the classification of each of the objectives. The following hypothesis was proposed to see if there was a difference between the grand mean ratings for high cognitive level objectives and the grand mean ratings for low cognitive level objectives.

Hypothesis: There is no significant difference in the amount of emphasis given to high and low cognitive objectives.

This hypothesis was tested using a t-test for dependent samples. The results for the sample involved in this study are summarized in Table 46.

Table 46

Results of a t-test for Entire Sample on Difference in Emphasis between High and Low Cognitive Level Objectives

Item	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Low	100	3.1289	0.321	0.323	13.72	0.000*
High	100	2.6864	0.037			

* reject at 0.05 level of significance

These results indicated that there is a significant difference in the amount of emphasis given to high and low cognitive level objectives and that significantly more emphasis was given to the low level items.

This difference was investigated further to determine if significant difference existed for various subgroupings of teachers based on teaching experience, number of courses in mathematics,and grade(s) in which presently teaching mathematics.

The results of the t-tests for various subgroups of teachers relative to teaching experience are summarized in Tables 47 - 49. It was concluded that for the subgroupings of teachers relative to teaching experience significant differences did exist between the emphasis on high level and low level objectives, and that significantly more emphasis was given to the low level items.

In relation to the number of courses completed in mathematics, the results of the t-tests for differences in emphasis between high level and low level objectives are summarized in Tables 50 - 52.

Table 47

Results of a t-test on Differences in Emphasis Between High and Low Cognitive Level Objectives for Teachers with 1 - 10 Years Experience

Item	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Low	20	3.0596	0.332	0.380	4.99	0.000*
High	20	2.6353	0.335			

* reject at 0.05 level of significance

Table 48

Results of a t-test on Differences in

Emphasis Between High and Low Cognitive Level

Objectives for Teacher with 11 - 20 Years Experience

Item	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Low	51	3.1479	0.311	0.294	10.57	0.000*
High	51	2.7132	0.399			

* reject at 0.05 level of significance

Table 49

Results of a t-test on Difference in

Emphasis Between High and Low Cognitive Level

Objectives for Teachers with More Than 20 Years Experience

Item	N	Grand	S.D.	S.D.	t-Value	P
Low	29	3.1433	0.333	0.339	7.45	0.000*
High	29	2.6755	0.352			

* reject at 0.05 level of significance

Table 50

Results of t-test on Difference in Emphasis

Between High and Low Level Cognitive Objectives for

Teachers with 2 or Fewer than 2 Courses in Mathematics

Item	N	Grand Mean	S.D.	S.D. in Diff.	t-Value	P
Low	15	3.3038	0.335	0.247	6.43	0.000*
High	15	2.8941	0.358			

* reject at 0.05 level of significance

Table 51

Results of t-test on Difference in Emphasis

Between High and Low Level Cognitive Objectives for

Teachers with 3 - 7 Courses in Mathematics

Item	N	Grand Mean	S.D.	S.D. in Diff.	t-Value	P
Low	34	3.0244	0.342	0.368	6.59	0.000*
High	34	2.6093	0.390			

* reject at 0.05 level of significance

Table 52

Results of t-test on Difference in Emphasis
Between Low Level and High Level Objectives for
Teachers with 8 or More Courses in Mathematics

Item	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Low	51	3.1472	0.279	0.313	10.73	0.000*
High	51	2.6762	0.346			

* reject at 0.05 level of significance

From an examination of these tables it was concluded that for all subgroupings of the sample based on number of courses in mathematics that significant differences existed between emphasis given to low and high cognitive level objectives, and that significantly more emphasis was given to low level objectives.

The results of the t-test for the subgroupings of teachers relative to the grades in which they are presently teaching mathematics are presented in Tables 53 - 55.

It was concluded that for all subgroupings of the sample based on the grade(s) in which the groups of teachers taught mathematics that significant differences existed between emphasis given to low and high cognitive level objectives, and that significantly higher emphasis was placed on low level objectives.

Table 53

Results of t-test on Difference in Emphasis
Between High and Low Level Objectives for
Group Teaching at Only Grade 9

Item	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Low	27	3.1722	0.297	0.310	6091	0.000*
High	27	2.7603	0.411			

* reject at 0.05 level of significance

Table 54

Results of t-test on Difference in Emphasis
Between High and Low Level Objectives for
Group Teaching at Junior High

Item	N	Grand Mean	S.D.	S.D. in Diff.	t-Value	P
Low	21	3.1972	0.328	0.384	5.82	0.000*
High	21	0.7092	0.411			

* reject at 0.05 level of significance

Table 55

Results of a t-test on Difference in

Emphasis between High and Low Level Objective for

Group Teaching at Junior and Senior High

Item	N	Grand Mean	S.D.	S.D. of Diff.	t-Value	P
Low	29	3.1433	0.333	0.339	7.45	0.000*
High	29	2.6744	0.352			

* reject at 0.05 level of significance

In summing up this section, then, it was determined that there was a significant difference ($p < 0.05$) in emphasis between low and high cognitive level objectives by the sample of teachers involved in the study. Furthermore, significant differences favouring low cognitive level objectives were found for all subgroupings relative to teaching experience, number of mathematics courses completed, and grade(s) in which mathematics is taught. Implications arising from these findings will be discussed in the next chapter.

Chapter V

Summary, Conclusions, Implications, and Recommendations

In this chapter a summary of the study, including an outline of the problem investigated, the instrument used in the collection of the data, the sample of teachers involved, and the analysis applied to the data, is given. Conclusions reached from the results of the study are given, and some implications of these results are presented along with some suggestions for further research.

SUMMARY OF THE INVESTIGATION

Purpose of the Study This study was designed to examine the perceptions of teachers of grade nine mathematics relative to a set of behavioral objectives for grade nine algebra and geometry. Attempts were made to determine differences in the perceptions of the relative importance of the objectives which existed among various groupings of teachers relative to experience, academic background, professional training, grade(s) in which teachers in the sample are presently teaching mathematics, and classification of the community in which the school is located.

Questions analyzed The questions, previously listed in Chapter 1, which this study sought to answer, were the following:

1. Is there a relationship between teachers' rankings of objectives and the number of mathematics courses completed?
2. Is there a relationship between teachers' rankings of objectives and the number of mathematics education courses completed?

3. Is there a relationship between teaching experience and the ranking of objectives?
4. Is there a relationship between the rankings of the objectives by the teachers and the grade(s) in which they teach mathematics?
5. Is there a relationship between classification of the community as rural, urban, or semi-urban and the ranking of objectives by the teachers?
6. Is there a relationship between teachers' ranking of the objectives and the number of years teaching the Grade 9 mathematics program?
7. What objectives were listed by teachers as being the 5 most important objectives and the 5 least important objectives for Grade 9 algebra and geometry?
8. Is there any difference in emphasis given to algebra and geometry objectives?
9. Is there any difference in emphasis given to objectives of low cognitive behaviour and those of high cognitive behaviour?

The instrument In order to gather the necessary data an appropriate instrument was constructed. After piloting, an instrument consisting of 50 objectives, each reproduced with the corresponding example on a 7.6 cm X 12.7 cm card was utilized. Also included as part of the instrument were appropriate instructions and a recording sheet.

Population and Sample This study involved Grade 9 teachers who were teaching mathematics in the province of Newfoundland and Labrador during the academic year 1988-1989. Letters of permission to include the schools within their jurisdiction in this study were received from thirty-one school district in Newfoundland and Labrador. From the list of schools which offered Grade 9 mathematics a random sample of 138 schools was selected.

Administration of the Instrument Packages containing the objective cards, the instructions, recording sheet, and questionnaire together with an explanatory letter were sent to 180 Grade 9 mathematics teachers in the schools sampled during November, 1988. Teachers were asked to rate each objective according to a four point scale of importance with 1 being the most important and 4 being the least important. Respondents were also asked to list the five objectives they considered to be most important the five objectives they considered least important.

Follow-up letters were sent the various schools during December, 1988 and January, 1989. After allowing for some delay, collection of data was completed on February 3, 1989. Complete sets of data were returned by 100 teachers and used in the analysis.

Analysis Mean ratings were computed for each item as perceived by various groupings of teachers based on the following variables- total teaching experience, experience teaching Grade 9 mathematics, academic background, professional training, grade(s) in which presently teaching mathematics, and classification of community as to rural, urban or semi-urban. These were used to rank the objectives in order of importance for each group. Comparisons were made between groups to determine whether or not agreement existed on the important or non-important items. Statistical procedures of appropriate correlational analyses, analysis of variance, and comparison measures were used to evaluate the data in response to the questions under investigation.

CONCLUSIONS

In questions 1 - 6, it was asked if there was a relationship between teachers' ranking of objectives and the variables - number of courses in mathematics, number of courses in mathematics education, total teaching experience, grade(s) in which the teacher taught mathematics during the 1988-1989 school year,classification of the communities as rural, semi-urban, or urban, and years of experience teaching grade nine mathematics. In all cases, comparisons of the rankings of the objectives by the various subgroupings of the teachers indicated that strong agreement existed among the groupings obtained for each variable as to the relative importance of the objectives.

The null hypothesis of no agreement among the groups relative to the ranking of objectives was rejected for each of these variables being considered. Furthermore, an analysis of variance indicated that for the majority of the objectives no significant differences existed in the mean ratings given by the groups of teachers obtained for each variable. In the case of number of mathematics courses completed, significant differences existed for eight objectives - 14 (to judge the appropriateness of particular values for a variable in an algebraic expression), 27 (to list the postulates used to prove two triangles congruent), 35 (to apply the Pythagorean Theorem in the solution of word problems), 38 (to supply a complete two column proof for congruent triangles), 40 (to apply an appropriate sketch for a given theorem or problem), 46 (to apply concept of slope of, midpoint of, or distance between two points on the x-y plane), 47 (to graph pairs of linear equations on same graph and determine the point of intersection), and 48 (to apply concepts of midpoint, slope, and/or distance to prove properties of a triangle). For all other variables significant differences existed for a fewer number of objectives.

When all sub-groupings of teachers were compared on the items ranked very important, differences of opinion existed among the various groups. In the upper 10 ranks, only four objectives (5 (to solve and validate first degree algebraic equations in one variable), 11 (to perform the basic operations (addition, subtraction, multiplication, and division), 10 (to evaluate expressions by substituting for the variable), 15 (to write an algebraic expression in simplest form) were common to all groups. Objective 1 (to define and illustrate terms associated with algebra) was ranked in the upper 10 ranks by all groups relative to mathematics courses completed, mathematics education courses completed, number of years teaching Grade 9 mathematics but was not placed there by the following sub-groups: teachers with less than ten years experience, those who teach mathematics at more than one level in junior high school, and those whose schools were located in a semi-urban community. Differences in opinion also existed for objective 28 (to give a justification for two particular triangles being congruent) which was not ranked in the upper ten ranks by teachers with one or two courses in mathematics education, and those whose school was located in a community classified semi-urban. Objective 42 (to graph ordered pairs of numbers on the co-ordinate plane) was not ranked in the upper 10 ranks by either group relative to mathematics courses and mathematics education courses completed. However, the greatest difference of opinion was seen for objective 8 (to translate English statements into algebraic statements) which was placed in the upper ten ranks by all subgroupings except those teachers with two or less than two courses completed in mathematics.

When all sub-groupings wer compared on the objectives ranked in the lower ten ranks, differences in opinion also existed with just four objectives being placed there by all sub-groupings of teachers. Objectives 3, (to apply the properties of the real number system in developing simple algebraic proofs), 14 (to judge the appropriateness of particular values for a variable in an algebraic expression), 16, (to solve simple equations involving exponents), 21 (to write a given number in scientific notation and vice versa), 22 (to use scientific notation to find the product or quotient of very large or very small number) and 49 (to find the image of a figure under a translation, rotation, reflection, glide or dilatation) were assigned to the lower ten ranks by only certain sub-groups. For example, objective 21 (to write a given number in scientific notation and vice versa) was not ranked in the lower ten ranks by teachers with eight or more courses in mathematics, more than twenty years experience, and those with more than ten years experience with Grade 9 mathematics.

Therefore, the results of these six questions seemed to indicate that none of the variables considered had a significant effect on teachers' perceptions of the relative importance of algebra and geometry objectives for grade nine. It might have been expected that the opinions of these different subgroups would have differed, but the results of this study indicated the opposite. However, it should be remembered that teachers' perceptions would likely be influenced by a composite of these variables rather than a single variable.

With respect to the five most important and five least important objectives, it was discovered that teachers did not agree on the listing of these objectives, with 42 of the objectives being classified as most important by varying numbers of the sample. Furthermore, only five objectives - 5 (to solve and validate first degree algebraic equations in one variable), 11 (to perform the basic operations (addition, subtration, multiplication, and division) with polynominals), 7 (to write an equation for and solve word problems of the following types: number problems, coin problems, age problems, consecutive integar problems and geometric problems), 15 (to write an algebraic expression in simplest form) and 1 (to define and illustrate terms associated with algebra) - were considered most important by 25% or more of the sample. The same difference in perception was seen in the classification of the objectives as least important with 45 objectives classified as least important by varying number of teachers and only four objectives - 50 (to verify, using coordinate geometry, the properties of a given transformation), 49 (to find the image of a figure under a translation, rotatioin, reflection, glide or dilatation) 48 (to apply concepts of midpoint, slope, and/or distance to prove properties of a triangle), and 29 (to complete the basic constructions of Eculidean Geometry using a mira) - were perceived least important by 25% or more of the sample. One possible explanation for this lack of consensus among the teachers is that from such a comprehensive list of objectives it was difficult to select just 5 objectives which could be classified either most or least important. It should also be kept in mind that "most important" and "least important" could have different interpretations for different people.

Also investigated was the emphasis given to algebra and geometry objectives. It was determined that for several of the subgroups, significantly higher emphasis was given to algebra objectives as compared to geometry objectives. Specifically, teachers who have more than 10 years of experience, teachers with more than two courses in mathematics, teachers who teach at only the Grade 9 level, and teachers who teach at both junior and senior high school level ranked algebra objectives significantly higher than geometry objectives.

Since the Newfoundland and Labrador Department of Education in its curriculum guide recommended approximately equal time for algebra and geometry, different results might have been expected. One possible explanation is that teachers feel that the geometry component of mathematics should be reserved for high school and that only the basics of geometry be taught at junior high school. It should also be remembered that transformational geometry is relatively new in mathematics and this might affect teachers' perceptions of the objectives.

In relation to emphasis given to algebra and geometry, it was concluded that teachers with more than ten years experience gave significantly higher emphasis to algebra but for techers with less than ten years experience there was no significant difference. These results seem to indicate that teachers recently completing university have a different perspective on the importance of both algebra and geometry. Through their professional training, these teachers with less than ten years experience believe that geometry is an important branch of mathematics and that the geometric concepts should be developed throughout the mathematics program and not reserved for high school as evident in mathematics courses of the past.

With respect to high and low cognitive items a significantly higher degree of emphasis was given to low cognitive items by all subgroups of the sample. Based on the rankings it appeared that the teachers attached more importance to the objectives dealing with the recall and "straight-forward" applications of previously learned material. Relatively little importance was attached to those objectives dealing with structure in mathematics or solving non-routine problems. It would be very difficult to determine why this was the case, but a possible explanation is that junior high school teachers feel a need to teach facts and skills in order to help students pass the course and prepare them for senior high mathematics courses. They, therefore, feel little time can be allotted to higher level objectives. Perhaps this situation has an influence on their perception of the importance of the objectives of the grade nine program. One must also bear in mind that teachers were dealing with a wide range of student capability.

TEACHING IMPLICATIONS

The results of the study would seem to imply that there is a discrepancy between the intended curriculum as outlined by the National Council of Teachers of Mathematics or the curriculum guide of the Department of Education of Newfoundland and Labrador and the implemented curriculum as evidenced in the perceptions of teachers regarding objectives used in this study. It has been recommended that problem solving both routine and non-routine be the focus of mathematics programs yet objectives related to a non-routine application of skills, facts, or principles received relatively low rankings. In addition, it has been recommended that geometry in junior high be intuitively based and that student awareness of geometric relationships be developed in an informal manner but objectives dealing with these aspects of geometry also received low rankings. The very nature of the learning process itself requires that attention be given to both inductive and deductive reasoning but attention appeared to be focused on showing and telling rather than seeking and enquiring. This would suggest that efforts be made at the provincial and district levels to ensure that curriculum guides or locally produced materials be clear about the need for addressing these objectives in any mathematics programs. At the local level efforts need to be taken by school boards to not only in-service teachers about implementing the curriculum but also to provide adequate materials so that the intended objectives can be attained.

The findings of the study indicate agreement among the subgroups of teachers concerning the relative importance of the objectives for grade 9 algebra and geometry. However, the high rankings attached to low-level objectives implies that teachers perceive that basic skills and manipulation of algorithms are more important than objectives that accent higher categories of intellectual attainment. Certainly, fundamental concepts and skills are important but it is also desirable and necessary that students be provided the opportunity for the development of problem-solving skills which will be useful for them throughout life. It was evident from the results of the study that most classroom instruction is associated with the low categories of the cognitive domain. It appeared that many teachers accented content items that are fed to students for regurgitation on examinations. One of the implications of this is that guidelines should be provided to classroom teachers so that the more important goals of mathematics teaching - critical thinking, creativity, skill in attacking original problems and solving them are emphasized in instruction and evaluation procedures. The low ranking of many geometry objectives would imply that geometry, particularly transformational geometry, may not be considered important in grade nine. This would suggest that school boards ensure that teachers have an adequate understanding of both the concepts of the different branches of geometry and the purposes for the inclusion of these topics in the Grade 9 mathematics program.

One factor that causes concern is the lack of consensus regarding the selection of most important and least important objectives. If different aspects of the programs are being emphasized by different teachers, then this could affect the development of concepts needed in future courses. Since the Grade 9 mathematics course lays a foundation for senior high school courses, efforts must be made by the various school boards to ensure that all teachers be aware of the important concepts, skills, and principles of introductory algebra and geometry.

RECOMMENDATIONS FOR FURTHER RESEARCH

Results of this study would imply that in one particular area of mathematics agreement existed as to the objectives perceived important by various sub-groupings of teachers. However, such agreement may not exist within and between other groups in society. This suggests a possibility for further investigation on a more extensive level, involving more groups and a wider range of individuals. Consideration could be given to including such groups as junior high school students, parents of junior high school students; provincial curriculum planning committees;and mathematics co-ordinators.

Since geometry objectives were perceived as less important than algebra objectives, there is a need for investigating the effects of various factors on how teachers perceive the geometry objectives of a grade nine mathematics program. It could be determined if the study of Euclidean geometry courses at university, and teachers' attitude towards the importance of geometry affect their perception of the importance of geometry objectives.

This study also points to the need for investigating the combined effects of various external factors on how mathematics teachers perceive the objectives of Grade 9 mathematics.

BIBLIOGRAPHY

Allen, G.F. (1923). Objectives of mathematics in secondary schools. Mathematics Teacher, 16, 65-77.

Allendoerfer, C.B. (1965). The second revolution of mathematics. Mathematics Teacher, 58, 690-695

Allendoerfer, C.B. (1971). The utility of behavioral objectives: Pros - a valuable teaching aid. Mathematics Teacher, 64, 686, 738-741

Barber, H.C. (1927). Re-organized mathematics in the junior high school. In second yearbook of National Council of Teachers of Mathematics, Curriculum problems in teaching mathematics (pp 125-142)

Bassler, O.C., & Kolb, J.R. (1971). Learning to teach secondary school mathematics. Scranton: International Textbook Company.

Bidwell, J.K., & Clason, R.G. (Eds.) (1970) Readings in the history of mathematics education. Washington, D.C.: National Council of Teachers of Mathematics.

Brooks, E. (1883). Mental science and methods of mental culture. In J.K. Bidwell & R.G. Clason (Eds), (1970), Readings in the history of mathematics education. (pp 76-90). Washington, D.C.: National Council of Teachers of Mathematics.

Bulcock, J.; Pereira-Mendoza, L. (1988) The academic standing of 1987 graduating students. A report deone for the Review Committee of Faculty of Education. Memorial University of Newfoundland.

Butler, C.H. ; Wren, F.L.; Banks, J.H. (1970) The teaching of secondary mathematics (5th. edition) New York: McGraw -Hill Book Company.

Carpenter, T.P.; Coburn, T.G.; Reys, R.E.; Wilson, J. W. (1975) Results and implications of the NAEP mathematics assessment: Secondary school. Mathematics Teacher, 68, 453-470

Carpenter, T.P.; Corbitt, M.K.; Kepner, H.S.; Lindquist, M.M.; & Reys, R.E. (1980). National assessment: A perspective of students' mastery of basic skills. In Lindquist, M.M. (Ed.) Selected issues in mathematics education. (pp 215-257) Berkeley, California: McCutcheon Publishing Corporation.

Chambers, D.L. (1986). A guide to curriculum planning in mathematics (Eric Document Reproduction Service No. ED 271 328)

Chipman, J.C. (1976). An analysis of content objectives of junior high school mathematics based on perceptions of a selected number of seventh and eight grade teachers. Unpublished master's thesis, Memorial University of Newfoundland, St.John's, Newfoundland

Cole, E.W. (1979). The content for a non-university prepatory mathematics program for grades 9, 10, and 11 as perceived by mathematics teachers in the high schools and trade schools of Newfoundland. Unpublished masters thesis, Memorial University of Newfoundland, St. John's, Newfoundland

Commission on Mathematics (1959). Program for college preparatory mathematics. In James K. Bidwell, & Robert G. Clason (Eds), (1970) Readings in the history of mathematics education. (pp 664-706) Washington, D.C.: National Council of Teachers of Mathematics

Commission on Post-War Plans (1945) The second report of the Commission on Post-War Plans. Mathematics Teacher, 38, 195-221

Conference Board of the Mathematical Sciences (1975). Overview and analysis of school mathematics: Grades K-12 (Eric Document Reproduction Service No ED 115 512)

Coxford, A. (1985). School algebra: What is still fundamental and what is not? In Christian R. Hirsh and Marilyn J. Zeweng (Eds) The secondary school mathematics curriculum (pp 53-64) 1985 yearbook of National Council of Teachers of Mathematics

Connectecuit State Department of Education (1981) A guide to curriculum development in mathematics. Hartford: Bureau of Elementary and Secondary Education (Eric Document Reproduction Service No. ED 214 800)

Davis, R.B. (1965). Mathematics. In G.G. Unruh (Ed.) New curriculum development: A report of ASCD's Committee on Current Curriculum Development. Washington,D.C.: Association for Supervisors and Curriculum Developers

Department of Education - Government of Newfoundland and Labrador (1984) Intermediate mathematics curriculum guide

Devault, M.V. (1981). Doing mathematics is problem solving. Arithmetic Teacher, 28, 40-43

Edling, J.V. (1971). Educational Objectives. In Dwight W. Allen & Eli Seifman (Eds.) The teacher's handbook (pp 207-214). Glenview, Illionis: Scott, Foresman and Company.

Edwards, E.L. & Nichols, E.D. (1972) Mathematical competencies and skills essential for enlightened citizens. Mathematics Teacher, 67, 671-677

Gearhart, G. (1975). What do teachers think about the high school geometry controversy. Mathematics Teacher, 68, 486-493

Greenberg, H.J. (1974). The objectives of mathematics education. Mathematics Teacher, 67, 639-643

Gronlund, N.E. (1985). Measurment and evaluation in teaching (5th. edition) New York: MacMillan Publishing Co.

Grossnickle, F.E.; Reckzeh, J.; Perry, L.M.; & Ganoe, N.S. (1973). Discovering meaning in elementary school mathematics. Holt, Rhinehart,& Winston.

Hassler, J.O.; & Smith, R.R. (1937). The teaching of secondary mathematics New York: The MacMillan Company

Hill, S. (1976). Issues from the NACOME report. Mathematics Teacher, 69, 440-446

Howson, A.G. (1979). A criticial analysis of curriculum development in mathematics education. In New trends in mathematics teaching, 4, 134-161. Paris: UNESCO

Howson, A.G.; Geitel, C.; & Kilpatrick, J. (1981). Curriculum development in mathematics. Cambridge: Cambridge University Press

Hunkins, F.P.(1980) Curriculum development: Program improvement. Columbus, Ohio: Charles E.Merrill Publishing Company

Illionis State Board of Education (1986). Mathematics grades 3,6,8,10,12: State goals for learning and sample learning objectives (Eric Document Reproduction Service No. ED 275 530)

Joint Commission of the Mathematical Association of America and National Council of Teachers of Mathematics (1940). The place of mathematics in secondary education. Fifteenth Yearbook of National Council of Teachers of Mathematics

Jones, P.S.; & Coxford, A.F. Jr. (1970). Mathematics in the evolving schools. In thirty-second yearbook of National Council of Teachers of Mathematics. (pp 11-86). A history of mathematics education in the United States and Canada. Washington, D.C.: National Council of Teachers of Mathematics.

Kemeny, J.G. (1963). Report to the International Congress of Mathematics. Mathematics Teacher, 56, 66-78

Kinsella, J.J. (1965) Secondary school mathematics. New York: The Centre for Applied Research in Education, Inc.

Kline, M. (1958). The ancients versus the moderns, a new battle of the books. Mathematics Teacher, 51, 418-433

Kline, M. (1966). A proposal for the high school mathematics curriculum Mathematics teacher, 59, 322-330

Krathwohl, D.R. (1965) Stating objectives appropriately for program, for curriculum, and for instructional materials development. Journal of Teacher Education, 16, 83-92

Krulik, S.; & Weise, J.B. (1975). Teaching secondary school mathematics. Philadelphia: W.B. Saunders Company

Lindquist, M.M. (1984). The elementary school mathematics curriculum: Issues for today. Elementary School Journal, 84, 595-608

Mager, R.F. (1984). Preparing instructional objectives. Pala Alto, California: Fearon Publishers, Inc.

Mathematical Association of America (1962). On the mathematics curriculum of the high school. The American Mathematical Monthly, 69, 189-192

Mercer, R. (1975). The mathematical needs of high school students as perceived by mathematics instructors in post-secondary institutions in Newfoundland. Unpublished master's thesis, Memorial University of Newfoundland, St. John's, Newfoundland.

Michigan Council of Teachers of Mathematics (1981). A curriculum guide in geometry for grades K-9: Guidelines for quality teaching (Eric Document Reproduction Service No. ED 228 051)

Mueller, F.J. (1967). The revolution at Sputnik - plus ten. Mathematics Teacher, 60, 696-706

National Advisory Committe on Mathematical Education (1975). Overview and analysis of school mathematics. Washington, D.C. : Conference Board of Mathematical Sciences

National Committee on Mathematical Requirements (1923). The reorganization of mathematics in secondary education. In J.K. Bidwell & R.G. Clason (Eds), (1970), Readings in the history of mathematics education. (pp 382-459). Washington, D.C.: National Council of Teachers of Mathematics

National Council of Supervisors of Mathematics (1978). Position paper on basic mathematics skills. Mathematics Teacher 71, 147-152

National Council of Teachers of Mathematics (1968) The continuing revolution in mathematics. Reston, Va: National Council of Teachers of Mathematics

National Council of Teachers of Mathematics (1978) Position paper on basic mathematics skills. Mathematics Teacher, 71, 147

National Council of Teachers of Mathematics (1981). An agenda for action: Recommendations for school math of the 1980s. Reston, Va: National Council of Teachers of Mathematics

National Council of Teachers of Mathematics (1984) School mathematics: Options for the 1990's. (Eric Document Reproduction Service No. ED 250 195)

National Institute of Education (1975). NIE conference on basic math skills and learnings. (U.S. Government Document Micro-Card 77-11014)

Ohio State Department of Education (1985). Mathematics 7-8: Minimum standards of leadership series. (Eric Document Reproduction Service No. ED 272 367)

Olson, A.T.; & Freeman, E. (1976). The objectives for teaching mathematics in the junior high school as perceived by parents, students, teachers, and professional educators. Alberta Journal of Educational Research, 22, 52-58

Organisation for Economic Cooperation and Development (1975). Handbook on curriculum development. Paris: Centre for Educational Research and Innovation.

Osbourne, A.R.; & Crosswhite, F.J. (1970). Forces and issues related to curriculum and instruction, 7-12. In 32nd Yearbook of National Council of Teachers of Mathematics. A history of mathematics education in the United States and Canada. (pp 155-300) Washington, D.C. : National Council of Teachers of Mathematics

Petronia, Sister M. (1971). A second look at modern mathematics. In J.A. McIntosh (Ed) Perspectives on secondary mathematics (pp 25 - 36). New Jersey: Prentice - Hall, Inc.

Progressive Education Association (1938). Mathematics in general education In J. K. Bidwell, & R.G. Clason. (Eds) (1970). Readings in the history of mathematics education (pp 534 - 567) Washington, D.C. : National Council of Teachers of Mathematics

Reeve, W.D. (1925) Objectives in the teaching of mathematics. Mathematics Teacher, 18, 385 - 402

Report of the Cambridge Conference on School Mathematics (1963). Goals for school mathematics Boston: Houghton Mifflin Company

Regional Orientation Conference in Mathematics (1961). The revolution in school mathematics. Washington, D.C.: National Council of Teachers of Mathematics.

Robbins, M. (1973). The objectives of deductive geometry in Newfoundland secondary schools as perceived by concerned groups. Unpublished master's thesis, Memorial University of Newfoundland, St. John's, Newfoundland

Robitaille, D.; & Dirks, M. (1982). Models for the mathematics curriculum. For the Learning of Mathematics, 2, pp 3-21

Robitaille, D.F.; & Sherrill, J.M. (1980). The teaching of mathematics in British Columbia. Canadian Journal of Education, 5, 14-27

Rose, R.H. (1982). The objectives of the matriculation mathematics program in Newfoundland and Labrador as perceived by secondary and post-secondary mathematics educators Unpublished master's thesis, Memorial University of Newfoundland, St. John's, Newfoundland

Smith, D.E. (1904). The teaching of elementary mathematics. In J.K. Bidwell & R.G. Clason (Eds) (1970) Readings in the history of mathematics education (pp 211-219) Washington, D.C.: National Council of Teachers of Mathematics

Smith, D.E.; & Reeve, W.D. (1927). Objectives in the teaching of junior high school mathematics. Second yearbook of National Council of Teachers of Mathematics. Curriculum problems in teaching mathematics

Suydam, M.N. (1979). The case for a comprehensive mathematics curriculum. Arithmetic Teacher, 26 , 10-11

Taba, H. (1962). Curriculum development: Theory and practice. New York: Harcourt, Brace, & World Inc.

Taylor, R. (1977) What to do about basic skills in math. Today's Education, 66, 32-33

Texas Education Agency (1985) Mathematics objectives and measurement specifications Texas Education Agency (Eric Document Reproduction Service No. ED 265 068)

Trafton, P.R. (1980) Assessing the mathematics curriculum today. In M.M. Lindquist (Ed) Selected Issues in mathematics education (pp 9-26) Berkeley, California: McCutcheon Publishing Corporation

Tyler, R. (1949) Basic principles of curriculum and instruction Chicago: The University of Chicago Press

Tyler, R.W. (1975) Specific approaches to curriculum development. In Jon Schaffarzick & David H. Hampson (Eds) Strategies for curriculum development. Berkeley, California: McCuthcheon Publishing Corporation

Usiskin, Z. (1985) We need another revolution in secondary school mathematics. In Christian A. Hirsh, and Marilyn J. Zweng (Eds.) The Secondary School Mathematics Curriculum 1985 Yearbook of National Council of Teachers of Mathematics

Wilson, J.W. (1971). Evaluation of learning in secondary mathematics. In B.S. Bloom ; J.T. Hastings ; G.F. Madaus. Handbook on formative and summative evaluation of student learning. (pp 643-696) New York McGraw-Hill Book Co.

Wood, R. (1967) Objectives in the teaching of mathematics Educational Research, 83-98

Appendix A

Final List of Objectives

Accompanying Instructions and Recording Sheet

FINAL LIST OF OBJECTIVES

1. To define and illustrate terms associated with algebra.

Eg. Define and give examples of like and unlike terms.

2. To know the basic properties of the real number system.

Eg. Identify the properties which are illustrated by the following:

$a + b = b + a$

$a \cdot (b+c) = a.b + a.c$

$a \cdot 1 = a$

3. To apply the properties of the real number system in developing simple algebraic proofs.

Eg. Prove that $(a + b) + -b = a$

4. To distinguish between rational and irrational numbers.

Eg. Identify the following as rational or irrational:

5/2, 7, -3, 25, 2

5. To solve and validate first degree algebraic equations in one variable .

Eg. Solve the following equation:

$3(x+2) - 5x = 7 - 2 (3x-6)$

6. To solve inequalities in one unknown.

Eg. $3x + 16 < 5x-4$

7. Write an equation for and solve word problems of the following types: number problems, coin problems, age problems, consecutive integer problems, and geometric problems.

Eg. Gerry is 3 times as old as James. In 5 years he will be twice as old as James. Find their present ages.

8. To translate English statements into algebraic statements.

Eg. Write an equation to represent the following:

Three times a number increased by four is equal to two.

9. To factor polynomials by finding the greatest common factor.

Eg. Factor the following polynomial:

$25x^3y^2 + 15x^2y - 5xy^2$

10. To evaluate expressions by substituting for the variable.

Eg. Find the value of $3x^2 - 2x + 3$ if $x = -2$.

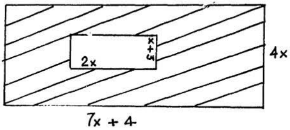
11. To perform the basic operations (addition, subtraction, multiplication, and division) with polynomials:

Eg. Simplify:

$2x + 5y - 7x + 3y$

12. To use polynomials in problems involving measurement.

Eg. Find the area of the shaded region



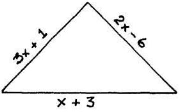
13. To identify irrelevant information in word problems.

Eg. Identify the extraneous information in the following:

The sum of 3 consecutive integers is 84. The numbers are less than 35 but greater than 19. Find the numbers.

14. To judge the appropriateness of particular values for a variable in an algebraic expression.

Eg. What is the smallest possible value of x ?



15. To write an algebraic expression in simplest form.

Eg. Simplify:

$3x(2x-5) - 2x(x+1) + x(x-2)$

16. To solve simple equations involving exponents.

Eg. Solve:

$6^{4y-3} = 6^{y-12}$

17. To graph sets of real numbers on a number line.

Eg. Sketch graph of:

$\{ x / -5 < x < 3,\ x \in R \}$

18. To apply the appropriate properties of powers in simplification.

Eg. (1) Simplify: $(2x^{-2}y^3)^2$

(2) $\frac{2-1 - 3-1}{3}$

19. To substitute into formulas and solve for the variable.

Eg. If $P = 2w + t$, find w if $P = 40$ and $t = 6$.

20. To use strategies such as (a) looking for a pattern, (b) making a list, (c) making a table, (d) guess and check, and/or (e) solving a simpler related problem to solve non-routine problems.

Eg. In a round robin tournament, each team plays another team once. How many games would be played by 10 teams in a round robin tournament?

21. To write a given number in scientific notation and vice versa.

Eg. Express 66000 in scientific notation

Express 2.31×10^{-4} as a decimal numeral.

22. To use scientific notation to find the product or quotient of very large or very small numbers.

Eg. $\frac{230,000 \times .000005}{.00612}$

23. To show an understanding of meaning of opposite when applied to real numbers or variables.

Eg. -(a) can represent either a positive or negative number. Explain

24. To discover patterns in determining a rule for a relationship given data in tabular form.

Eg. Give the equation that describe the relationship rule shown in the following table of values.

x	y
-3	11
-1	5
-4	14

25. To demonstrate the relationships between various number systems that make up the real number systems.

Eg. By means of a diagram show the relationship between whole numbers, integers, etc. within the real number system.

26. To define basic geometric terms.

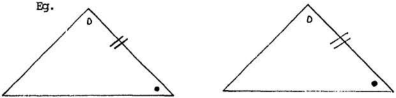
Eg. An acute angle is

27. To list the postulates used to prove two triangles congruent.

Eg. Give the four postulates that can be used to prove congruency between triangles.

28. To give a justification for two particular triangles being congruent.

Eg.



What postulate allows us to conclude that these two triangles are congruent?

29. To complete the basic constructions of Eculidean Geometry using a mira.

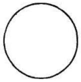
Eg. Use a mira to bisect the angle given below.

30. To accurately perform the basic constructions using a straightedge and compass.

Eg. Construct the perpendicular bisector of a segment.

31. To apply the knowledge of geometric principles in solving non-routine geometric problems.

Eg. Through construction determine the centre of the following circle:



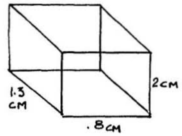
32. To tell if a given example represents inductive or deductive thinking?

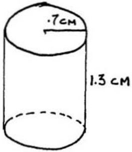
Eg. Is the thinking illustrated below inductive or deductive? Explain your answer.

A child examines eight acorns and concludes that all acorns are hard.

33. To apply the perimeter, area, or volume formulas in a comparison of geometric figures.

Eg. Determine which container has the greater volume.





34. To determine the effects of changing one dimension of a figure on its areas and/or volume.

Eg. How is the volume of a cone affected when its height it doubled?

35. To apply the Pythagorean Theorem in the solution of word problems.

Eg. The diagonal of a rectangle is 21 cm. Find the width of the rectangle if the length if 11.7 cm.

36. To use standard geometrical notation.

Eg. What is represented by each of the following symbols:

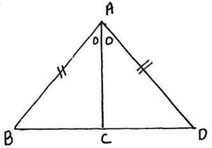
AB, AB, AB, AB

37. To discover geometric relationships by investigating a variety of examples.

Eg. Consider various triangles. Measure the lengths of the sides. What relationship appears to exist between any two sides of a triangle and the third side?

38. To supply a complete two column proof for congruent triangles.

Eg. Prove that $\triangle ABC \cong \triangle ADC$ giving both statements and reasons.



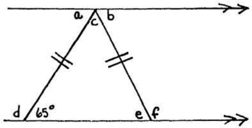
39. To make an appropriate sketch for a given theorem or problem.

Eg. Draw a diagram to represent the following. Indicate the given information on the diagram.

In $\triangle ABC$, $\overline{AB} \cong \overline{AC}$. AD bisects $\angle BAC$ meeting BC at D. Prove D is midpoint of BC.

40. To apply the rules related to the following concepts to find missing measures (a) parallelism (b) perpendecularity (c) congruency (d) similarity (e) relationships in a circle (f) relationships in a triangle

Eg.



41. To identify in a diagram and correctly describe terms such as ordinate, abscissa, origin, quadrant, slope, and linear relation.

Eg. Define slope of a line.

42. To graph ordered pairs of numbers on the co-ordinate plane.

Eg. Plot the following points.

A (2,3) B(-5,4) C(-3,2) D(1,-7)

43. To graph a linear equation by using a table of values.

Eg. Set up a table of values and graph $2x + 3y = 9$.

44. To graph a linear equation in two variables by using slope and y-intercept method.

Eg. Sketch graph of $y = -2/3x + 5$ by slope and y-intercept method.

45. To find the slope of, midpoint of, or distance between two points on the x-y plane.

Eg. Find slope of line joining (3,-2) and (4,-3)

46. To apply concept of slope to determine if two or more lines are parallel, perpendicular, or neither.

Eg. Given A (-3,4), B (6,-2) C (-5,6) D (3,-4) determine if AB and CD are parallel, perpendicular, or neither. Do not graph.

47. To graph pairs of linear equations on same graph and determine the point of intersection

Eg. Graph the following on the same axes and give the coordinates of the point of intersection.

{ $y = 2x-1$

{ $y = 1/2x$

48. To apply concepts of midpoint, slope, and/or distance to prove properties of a triangle.

Eg. The vertices of ABC are A (8,7) B (-6,-7), C (10,1) Let D be the midpoint of AB and E the midpoint of BC. Prove AC = 2DE.

49. To find the image of a figure under a translation, rotation, reflection, glide or dilatation.

Eg. Given ABC with A (-3,5) , B (2,-1) , C(-3-5), find the image of A B C under the transformation described:

(x,y) = (x-3, y+4)

50. To verify, using coordinate geometry, the properties of a given transformation

Eg. XYZ, such that X (-2,3) Y (-4,1) and Z (3,-2)

Verify the properties of a reflection if the triangle is reflected in the x-axis.

INSTRUCTIONS FOR SORTING OBJECTIVE CARDS

Each of the enclosed cards contains one possible objective with a corresponding example for the algebra and geometry content areas of Grade 1X Mathematics. You are kindly asked to sort the cards into 4 groups, ranging from Group 1, which contains what you feel are the very important objectives of algebra and geometry, to Group 4 which you feel are unimportant objectives. Objectives in Groups 2 and 3 will contain those which are perceived in decreasing order of importance. In short:

Group 1 . . . . Very Important

Group 2 . . . . Tending towards Importance

Group 3 . . . . Tending towards Non-Importance

Group 4 . . . . Non-Important

There is no limit on the number of objectives you may place in any group, so please feel free to place as many objectives as you wish in any one group or if you wish leave any group empty.

The objectives were placed on cards to give you greater flexibility in reclassifying objectives reflecting changes in your initial rating as you proceed through the list.

When you have sorted the cards to your satisfaction, please record the number shown on each card in the appropriate column on the Recording Sheet.

Would you also list in order of importance the five objectives you consider to be most important for Grade 1X algebra and geometry as well as the five objctives you consider to be least important?

Please return the recording sheet in the enclosed envelope. **It is not necessary to return the cards.**

Thank you for your cooperation.

RECORDING SHEET FOR RATING OF OBJECTIVES

After you have sorted the cards into the four groups place the number on each card in the appropriate column below. For example, if you place objectives numbered 3, 5, 7, 12, 25, 42 in group 2, then these numbers should be recorded in column 2 below. Also, record the numbers of the five objectives you consider most important and numbers of the five objectives you consider least important.

1	2	3	4

Most Important Objectives   Least Important Objectives

Appendix B

Classification of the Objectives

Objective	Level of Behaviour		
1	Computation	-	Low
2	Computation	-	Low
3	Analysis	-	High
4	Analysis	-	High
5	Application	-	Low
6	Application	-	Low
7	Application	-	Low
8	Comprehension	-	Low
9	Computation	-	Low
10	Computation	-	Low
11	Computation	-	Low
12	Analysis	-	High
13	Analysis	-	High
14	Analysis	-	High
15	Application	-	Low
16	Computation	-	Low
17	Comprehension	-	Low
18	Computation	-	Low
19	Application	-	Low
20	Analysis	-	High
21	Comprehension	-	Low
22	Computation	-	Low
23	Analysis	-	High

24	Analysis	–	High
25	Comprehension	–	Low
26	Computation	–	Low
27	Comprehension	–	Low
28	Comprehension	–	Low
29	Computation	–	Low
30	Computation	–	Low
31	Analysis	–	High
32	Analysis	–	High
33	Analysis	–	High
34	Analysis	–	High
35	Application	–	Low
36	Computation	–	Low
37	Analysis	–	High
38	Analysis	–	High
39	Analysis	–	High
40	Comprehension	–	Low
41	Computation	–	Low
42	Computation	–	Low
43	Computation	–	Low
44	Comprehension	–	Low
45	Computation	–	Low
46	Application	–	Low
47	Application	–	Low
48	Analysis	–	High

49	Computation	-	Low
50	Analysis	-	High

Appendix C

Letter to Superintendents

64 Mortimore Drive
Mt. Pearl, Newfoundland
A1N 3C4

ATTENTION: SUPERINTENDENT

Dear

I am presently completing my program of studies for a Masters of Education degree in Curriculum & Instruction specializing in mathematics education. As partial fulfillment of the requirements for this degree, I am planning to conduct a study among a randomly selected group of Grade 9 teachers. This study will pertain to their perceptions of the importance of the objectives for Grade 9 algebra and geometry. The study will attempt to determine if differences exist in teachers' perceptions relative to educational, experiential and environmental factors. Enclosed please find the list of objectives that will be used in my study.

Please accept this as my letter of request for permission to include the schools within your board's jurisdiction for my survey.

Thank you for you anticipated cooperation.

Yours sincerely,

Brenda Hickey

Enclosures

Appendix D

Letter of Intent and Questionnaire

Sent to Respondents

64 Mortimore Drive
Mt. Pearl, Newfoundland
A1N 3C4

November 5, 1988

Dear Teacher:

I am a graduate student in the Department of Curriculum and Instruction at Memorial University specializing in Mathematics Education.As partial fulfillment of the requirements for this degree program, I am presently conducting a study among a randomly selected group fo Grade 1X Mathematics teachers. The purpose of this study is to determine what various teachers see as the important content objectives for Algebra and Geometry in Grade 1X.

To obtain the opinions of teachers I have drawn up a list of 50 objectives which can be rated in terms of importance or non-importance. The objectives are not based on any specific textbook series, but represent a broad spectrum of the algebra and geometry as presently covered in the current Grade 1X program.

I realize that participation in this study will be an extra burden in your already busy schedule. However, if you can possibly spare the few minutes required to sort the cards as outlined in the accompanying instructions, it would be greatly appreciated. Please note that there is no right or wrong ways to sort the cards, rather the object is to see to what extent our Grade 1X Mathematics teachers agree with each other.

It is not necessary for you to identify yourself in any way. The code included on the envelope in which you will return both the questionnaire and data sheet will be used to identify the school districts from which responses are received.

Anticipating your cooperation, I sincerely appreciate your assistance in this study. At your request, I will forward you the results and recommendations of this study upon its completion.

Yours sincerely,

Brenda Hickey

Enclosures

Please answer the following questions and include this questionnaire in the package that is to be mailed back.

1. Number of years teaching mathematics in Grade 1X. (Include this current year) ________

2. Total number of years teaching experience. (Include this current year)________

3. In what grade(s) are you now teaching mathematics?________

4. Number of university courses completed in mathematics. (A course being equivalent to a university's semester course)________

5. In your undergraduate degree did you major in mathematics?________

6. Number of University courses completed in mathematics education.________

7. If given the opportunity, would you prefer to teach mathematics over other subject areas?________

Appendix E

Letter from Mr. Wilbert Boone

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF EDUCATION

P. O. BOX 4750
ST. JOHN'S, NFLD
A1C 5T7

Re: A Study on the Perception of Grade Nine Teachers on Content Objectives for Algebra and Geometry

Conducted by

Brenda Hickey, Graduate Student, M.U.N.

As the Education Consultant responsible for Mathematics, I support the research by Ms. Brenda Hickey related to teachers' perceptions of the mathematics content in the ninth grade. I encourage you to complete the instrument being forwarded to you by Ms. Hickey.

The information collected can be of benefit to improving the curriculum in grade nine mathematics.

Wilbert Boone
Education Consultant - Mathematics

Appendix F

Follow up Letters

64 Mortimore Drive
Mt. Pearl, Newfoundland
A1N 3C4

December 9, 1988

Dear Grade Nine Teachers:

Approximately three weeks ago I sent you a set of objective cards for Grade 1X Algebra and Geometry and a questionnaire relating to a study that I am doing for my Master of Education degree. If you have already completed and returned the questionnaire I now thank you.

If you have not, I would greatly appreciate your taking the necessary time to complete the questionnaire and return it to me within two weeks. Without your assistance, my study cannot be a success.

Once again, your cooperation in this matter will be very much appreciated.

Yours sincerely,

Brenda Hickey

64 Mortimore Drive
Mt. Pearl, Newfoundland
A1N 3C4

January 4, 1989

Dear Grade Nine Teachers:

During the month of November I forwarded packages requesting your cooperation in the completion of a study I had undertaken as part of my Master Program. I am now in the final stages of preparing to analyze the data received.

If you have not replied to this questionnaire, could you please take the time that is required to complete this survey and return it to the undersigned at the above address by January 27, 1989.

Your cooperation is very much appreciated.

Yours sincerely,

Brenda Hickey

Appendix G
Frequency Distribution of
The Rating of Objectives
By Teachers With
Varying Number of
Mathematics Courses Completed

Table G-1
Frequency Distribution
of The Rating of
Objectives By Teachers
With 0- 2 Math Courses

OBJECTIVE	1	2	3	4
1	13	2		
2	6	5	4	
3	5	6	3	1
4	6	4	5	
5	12	2		
6	6	8	1	
7	13	2		
8	10	2	3	
9	10	3	2	
10	13	2		
11	14	1		
12	7	8		
13	3	4	6	2
14	3	7	5	
15	14	1		
16	4	6	1	4
17	6		3	
18	8	3	3	1
19	7	5	3	
20	4	5	4	2
21		5	6	4
22	4	5	5	1
23	4	7	4	
24	6	5	2	2
25	6	5	2	2
26	10	3	1	1
27	12	3		
28	12	3		
29	2	2	6	5
30	9	1	4	1
31	5	5	2	3
32		5	5	5
33	8	4	2	1
34	1	9	4	1
35	12	3		
36	6	8	1	

Table G-1 (Cont'd)

Objective	1	2	3	4
37	6	5	1	3
38	12	1	2	
39	7	7	1	
40	14		1	
41	6	6	2	1
42	10	2	1	1
43	12	1	1	1
44	7	5	1	2
45	7	6	1	1
46	7	6	1	1
47	10	2	2	1
48	4	5	4	2
49	2	5	4	4
50	3	4	2	6

Table G-2

Frequency distribution for

Rating of Objectives by

Teachers with 3 - 7 Math Courses

OBJECTIVE	1	1	2	4
1	21	8	4	2
2	15	11	2	6
3	6	11	7	10
4	7	14	8	5
5	26	5	2	1
6	13	12	6	3
7	18	10	6	
8	27	6	1	
9	17	10	6	1
10	22	11	1	
11	28	3	2	
12	14	18	2	
13	8	6	12	8
14	2	8	14	10
15	27	3	3	
16	3	12	9	9
17	8	17	7	1
18	13	7	11	2
19	19	11	3	
20	8	12	8	5
21	5	7	13	8
22	4	8	12	8
23	11	10	6	6
24	7	16	8	3
25	9	9	13	3
26	19	9	5	1
27	11	15	6	2
28	18	12	4	
29	1	7	13	13
30	19	6	7	2
31	10	15	6	3
32	9	11	8	6
33	13	15	3	2
34		12	11	6
35	17	7	9	1
36	13	11	5	5
37	9	9	13	1
38	9	12	8	5
39	10	11	8	5
40	12	17	3	2
41	8	16	6	4

Table G-2 (Cont'd)

Objective	1	2	3	4
42	22	9	2	1
43	15	11	4	3
44	12	10	7	5
45	7	13	9	5
46	5	10	10	9
47	9	13	7	5
48	2	7	12	13
49	3	5	12	14
50	1	5	9	18

Table G-3

Frequency Distribution for

Rating of Objectives by

Teachers with 8 or more Math Courses

Objective	1	2	3	4
1	44	6	1	
2	24	16	8	3
3	10	11	16	14
4	21	16	10	4
5	44	5	1	1
6	14	20	12	4
7	33	13	2	3
8	42	7	2	
9	19	16	7	9
10	42	5	3	
11	49	2		
12	21	21	8	1
13	17	14	12	1
14	6	17	19	9
15	45	5	1	
16	4	13	15	18
17	27	18	4	2
18	15	18	13	4
19	29	12	6	3
20	21	18	11	1
21	10	16	18	7
22	6	12	20	11
23	24	16	8	3
24	11	22	11	7
25	17	22	9	3
26	40	8	1	2
27	35	11	1	4
28	35	12	2	2
29	3	8	16	24
30	16	19	8	8
31	7	19	18	7
32	11	14	17	9
33	21	19	10	
34	7	15	24	5
35	28	19	4	
36	33	11	4	3
37	20	16	10	5
38	18	10	10	13

(Table Continues)

Table G-3 (Cont'd)

Objective	1	2	3	4
39	18	12	11	10
40	36	10	3	2
41	28	14	6	3
42	39	9	2	1
43	29	13	5	3
44	13	14	16	8
45	20	10	14	7
46	9	14	18	10
47	10	21	8	12
48	3	8	14	26
49	5	7	22	17
50	1	6	21	21

Appendix H

Frequency Distribution For

Rating of Objectives By

Teachers With Various

Numbers of Mathematics

Education Courses Completed

Table H-1

Frequency Distribution for

Rating of Objectives by

Teachers with 0 Math Education Courses

Objective	1	2	3	4
1	20	8	3	
2	13	11	4	3
3	10	12	3	6
4	9	9	8	5
5	24	5	2	
6	11	12	5	3
7	18	9	4	
8	22	4	5	
9	17	8	4	2
10	23	5	3	
11	27	3	1	
12	14	14	3	
13	8	9	9	5
14	1	11	11	8
15	27	2	2	
16	5	9	11	5
17	10	10	7	3
18	13	6	9	2
19	18	6	5	
20	8	9	8	5
21	4	9	10	7
22	3	12	7	7
23	6	12	8	4
24	8	15	6	2
25	7	10	10	4
26	15	9	6	1
27	18	9	3	1
28	20	9	2	
29	1	9	11	10
30	13	6	8	4
31	8	12	4	7
32	3	7	12	9
33	16	10	2	3
34	4	11	12	4
35	19	5	6	1
36	13	10	4	4
37	8	11	7	4
38	14	6	7	4
39	10	11	6	4

(Table Continues)

Table H-1 (Cont'd)

Objective	1	2	3	4
40	19	5	5	1
41	9	12	6	4
42	21	5	2	2
43	16	10	2	3
44	11	10	4	6
45	11	10	5	5
46	8	10	7	6
47	9	10	6	6
48	3	10	7	11
49	2	6	8	15
50	3	5	6	17

Table H-2

Frequency Distribution for

Rating of Objectives by

Teachers with 1 or 2 Math Education Courses

Objective	1	2	3	4
1	42	7	1	1
2	23	15	8	5
3	8	13	19	11
4	17	19	12	3
5	45	4	1	1
6	19	20	8	4
7	36	11	3	1
8	44	7		
9	23	15	8	5
10	1	41	6	3
11	47	3	1	
12	20	25	6	
13	15	10	16	10
14	9	13	21	8
15	44	5	2	
16	5	19	10	16
17	22	23	6	
18	18	16	14	2
19	29	25	6	1
20	16	19	14	2
21	8	14	23	6
22	5	8	26	10
23	22	15	10	4
24	10	23	15	4
25	14	24	10	3
26	40	9	2	
27	30	16	3	2
28	33	15	2	1
29	4	5	17	25
30	25	14	7	5
31	13	19	15	4
32	14	15	15	7
33	19	21	10	
34	5	19	22	5
35	28	17	6	
36	27	16	5	3
37	19	17	13	2
38	20	13	12	6

(Table Continues)

Table H-2 (Cont'd)

Objectives	1	2	3	4
39	19	13	12	7
40	30	18	2	1
41	23	19	7	2
42	38	12	1	
43	33	10	5	2
44	18	13	14	6
45	18	15	12	6
46	10	16	15	10
47	15	22	7	7
48	5	8	18	20
49	5	7	24	15
50	1	7	17	24

Table H-3

Frequency Distribution for

Rating of Objectives by

Teachers with more 2 Math Education Courses

Objective	1	2	3	4
1	16	1	1	
2	9	6	2	1
3	3	3	4	8
4	8	6	3	1
5	14	3	1	
6	3	8	5	1
7	10	5	1	2
8	13	4	1	
9	6	6	3	3
10	13	5		
11	17			
12	8	8	1	1
13	5	5	5	3
14	1	8	6	3
15	15	2	1	
16	1	3	4	10
17	9	8	1	
18	5	6	4	3
19	8	7	1	2
20	9	7	1	1
21	3	5	4	6
22	2	5	3	7
23	11	4	1	2
24	4	7	2	5
25	11	2	1	1
26	14	2	1	1
27	10	4	1	3
28	12	3	2	1
29	1	3	7	7
30	6	6	4	2
31	1	8	7	2
32	3	8	3	4
33	1	7	7	3
34	4	6	5	3
35	10	7	1	
36	12	14	1	1
37	8	2	4	3
38	5	4	1	8

(Table Continues)

Table H-3 (Cont'd)

Objective	1	2	3	4
39	6	5	2	4
40	13	3	2	
41	10	5	1	2
42	12	3	2	1
43	7	5	3	2
44	3	6	6	3
45	5	4	7	2
46	3	4	7	4
47	5	3	4	5
48	1	2	5	10
49	3	4	6	5
50	1	3	9	4

Appendix I

Frequency Distribution of

Rating of Objectives in

Relation to Years of Experience

Table I-1

Frequency Distribution for

Rating of Objectives by Teachers

With 1-10 Years of Experience

Objectives	1	2	3	4
1	10	7	3	
2	7	6	5	2
3	5	6	4	5
4	4	6	8	2
5	15	3	2	
6	11	8	1	
7	6	8	5	1
8	13	4	3	
9	7	8	3	2
10	14	4	2	
11	16	3	1	
12	7	9	4	
13	4	8	7	1
14	3	6	8	3
15	15	3	2	
16	3	6	7	2
17	8	6	5	1
18	7	8	5	
19	14	3	2	
20	8	7	3	2
21	3	3	10	4
22		4	10	5
23	5	6	8	1
24	3	8	6	3
25	5	5	7	3
26	11	6	2	1
27	12	5	2	
28	14	3	3	
29		5	6	3
30	7	5	5	1
31	3	8	5	1
32	2	5	9	2
33	10	7	2	
34	5	6	9	
35	12	6	2	
36	7	9	2	2
37	5	5	9	1
38	10	3	4	3

(Table Continues)

Table I-1 (Cont'd)

Objectives	1	2	3	4
39	5	9	4	2
40	13	4	2	1
41	7	9	2	2
42	13	4	1	1
43	11	6	1	2
44	9	6	2	3
45	8	7	2	3
46	8	7	2	3
47	4	9	3	4
48	1	4	6	9
49	1	3	5	11
50	1	3	5	11

Table I-2

Frequency Distribution for

Rating of Objectives by

Teachers with 11-20 Years of Experience

Objectives	1	2	3	4
1	42	7	1	1
2	23	18	5	5
3	13	13	13	12
4	17	20	9	5
5	41	9	1	
6	12	23	11	4
7	39	7	3	2
8	40	9	2	
9	20	16	7	8
10	43	5	2	
11	31	19		
12	22	23	5	1
13	20	9	10	12
14	6	18	15	12
15	43	5	2	
16	8	15	12	8
17	21	21	6	2
18	19	16	11	2
19	25	16	7	3
20	15	20	12	9
21	7	15	19	9
22	5	11	17	14
23	20	18	7	5
24	12	27	9	3
25	15	22	10	4
26	35	9	5	2
27	31	13	4	3
28	33	14	3	1
29	2	8	21	20
30	20	16	8	7
31	10	23	10	8
32	12	15	14	10
33	24	16	9	1
34	6	18	19	
35	28	15	7	1
36	28	11	7	5
37	19	17	10	4
38	16	14	10	11

(Table Continues)

Table I-2 (Cont'd)

Objectives	1	2	3	4
39	20	9	13	9
40	32	12	4	3
41	26	15	7	3
42	38	10	3	
43	31	11	5	3
44	18	11	15	7
45	22	12	11	6
46	11	13	18	9
47	18	16	7	10
48	7	10	13	21
49	6	10	20	15
50	2	8	18	21

Table I-3

Frequency Distribtuion for

Rating of Objectives by

Teachers with more than 20 Years Experience

Objectives	1	2	3	4
1	26	2	1	
2	15	8	4	2
3	3	9	9	8
4	13	8	6	2
5	27			2
6	15	8	3	3
7	15	9	4	1
8	26	2	1	
9	19	5	5	
10	20	7	2	
11	27	1	1	
12	13	15	1	
13	4	7	13	5
14	2	8	15	4
15	27	1	1	
16		10	6	12
17	12	14	3	
18	10	4	11	4
19	16	9	3	1
20	10	8	8	3
21	5	10	8	6
22	5	10	9	5
23	14	7	4	4
24	7	10	8	4
25	12	9	7	1
26	23	5		1
27	15	11	1	2
28	18	10		1
29	4	4	8	13
30	17	5	6	1
31	9	18	11	1
32	6	10	7	6
33	8	15	4	1
34	2	12	11	4
35	17	8	4	
36	17	10	1	1
37	11	8	5	4
38	13	6	6	4

(Table Continues)

Table I-3 (Cont'd)

Objectives	1	2	3	4
39	10	12	3	4
40	17	11	1	
41	9	12	5	3
42	20	6	2	1
43	14	08	4	2
44	5	12	7	5
45	4	10	11	4
46	2	10	9	8
47	7	11	7	4
48	1	6	11	11
49	3	4	13	9
50	2	4	9	13

Appendix J

Frequency Distribution for

Teachers who teach

Mathematics at Different Grade Levels

Table J-1

Frequency Distribution for

Rating of Objectives by

Teachers who Teach only Grade 9

Objective	1	2	3	4
1	24	2	1	
2	14	7	5	1
3	7	11	3	6
4	11	7	6	3
5	23	2	1	
6	8	11	4	4
7	17	5	5	
8	21	3	3	
9	15	5	4	3
10	22	4	1	
11	25	1	1	
12	14	11	2	
13	6	8	7	6
14	4	10	9	4
15	24	1	2	
16	5	7	7	8
17	14	8	4	1
18	12	5	9	1
19	18	6	3	
20	10	7	6	4
21	4	9	9	5
22	2	9	9	6
23	11	10	3	3
24	9	12	6	
25	11	6	8	2
26	18	5	3	1
27	16	7	3	1
28	20	5	2	
29	1	5	13	8
30	15	5	4	3
31	8	9	5	5
32	3	10	7	7
33	15	7	4	1
34	4	13	9	1
35	16	6	5	
36	15	9	1	2

(Table Continues)

Table J-1 (Cont'd)

Objectives	1	2	3	4
37	9	12	4	2
38	13	4	6	4
39	12	7	4	4
40	15	6	4	2
41	12	10	5	
42	20	6	1	
43	16	6	4	1
44	7	9	6	5
45	10	8	7	2
46	8	6	9	4
47	13	7	3	4
48	3	4	10	10
49		8	7	12
50		6	4	17

Table J-2

Frequency Distribution for

Rating of Objectives by Teachers who Teach

More Than One Grade at the Junior High Level

Objective	1	2	3	4
1	14	5	1	1
2	12	2	4	3
3	3	6	6	6
4	7	6	6	2
5	18	3		
6	6	10	3	2
7	17	3		1
8	19	2		
9	7	7	6	1
10	19	1		
11	19	2		
12	7	12	2	
13	7	4	8	2
14	3	6	6	6
15	18	3		
16	3	5	6	6
17	8	11	1	1
18	11	3	5	1
19	11	6	2	1
20	6	9	5	1
21	3	6	8	4
22	2	7	6	6
23	7	6	5	3
24	7	5	6	3
25	5	9	5	2
26	15	3	1	2
27	15	4	1	1
28	14	6	1	
29	1	7	6	7
30	11	6	3	1
31	5	0	6	
32	6	3	8	4
33	6	9	5	
34	1	6	11	3
35	11	9		1
36	11	4	2	4
37	8	4	6	3

(Table Continues)

Table J-2 (con't)

Objective	1	2	3	4
38	11	4	4	2
39	9	7	3	2
40	15	5	1	
41	9	7	3	2
42	16	3	1	
43	13	6	2	
44	7	8	4	2
45	8	7	4	2
46	3	9	6	3
47	7	9	4	1
48	3	6	8	4
49	4	3	10	4
50	2	2	8	8

Table J-3

Frequency Distribution for

Rating of Objectives by Teachers who

Teach at the Junior and Senior High Level

Objective	1	2	3	4
1	40	9	3	
2	19	23	5	5
3	11	11	17	13
4	16	21	11	4
5	42	7	2	1
6	19	19	11	2
7	30	17	3	2
8	39	10	3	
9	24	17	5	6
10	36	11	5	
11	47	3	1	
12	21	24	6	1
13	15	12	15	10
14	4	16	23	9
15	44	5	3	
16	3	19	12	17
17	19	22	9	1
18	13	20	13	5
19	26	16	7	2
20	17	19	12	3
21	8	13	20	10
22	6	9	21	12
23	21	15	11	4
24	6	28	11	7
25	16	21	11	4
26	36	12	3	1
27	27	18	3	4
28	31	16	3	2
29	4	5	16	27
30	18	15	12	07
31	9	20	15	8
32	11	17	15	9
33	21	22	6	2
34	8	17	19	8
35	30	14	8	
36	26	17	7	2
37	18	14	14	4
38	15	15	10	12

(Table Continues)

Table J-3 (Cont'd)

Objectives	1	2	3	4
39	14	16	13	9
40	32	16	2	2
41	21	19	6	6
42	35	11	4	2
43	27	13	6	4
44	18	12	14	8
45	16	14	13	9
46	10	15	14	13
47	9	20	10	13
48	3	10	12	27
49	6	6	21	19
50	3	7	20	20

Appendix K

Rating of Objectives

Relative to Classification of Community

Table K-1

Rating of Objectives by

Teachers in a Rural Community

Objective	1	2	3	4
1	40	7	3	
2	20	18	8	4
3	12	17	9	12
4	15	16	13	6
5	38	9	2	1
6	15	21	9	4
7	30	13	5	2
8	39	7	4	
9	25	14	7	4
10	39	6	4	
11	44	4	1	
12	20	21	8	1
13	9	16	15	10
14	7	14	17	12
15	43	4	3	
16	5	18	11	16
17	21	19	8	2
18	18	14	12	5
19	30	13	5	1
20	12	24	10	4
21	12	18	12	
22	7	12	16	13
23	19	15	10	6
24	11	22	11	6
25	16	20	10	4
26	32	9	6	3
27	31	11	4	4
28	31	15	3	1
29	3	8	17	22
30	20	13	10	7
31	10	22	10	8
32	7	15	15	13
33	20	17	9	3
34	3	19	23	5
35	32	11	6	1
36	23	13	7	7
37	19	12	11	7

(Table Continucs)

Table K-1 (Cont'd)

Objective	1	2	3	4
38	20	13	8	9
39	17	18	10	5
40	31	16	1	2
41	21	15	9	5
42	38	7	3	1
43	28	11	5	4
44	18	14	11	7
45	20	14	10	6
46	11	16	14	9
47	13	17	14	6
48	3	10	18	19
49	7	4	19	20
50	5	5	18	21

Table K-2

Rating of Objectives by

Teachers in a Semi-urban Community

Objective	1	2	3	4
1	14	7	1	1
2	10	8	2	3
3	2	5	10	6
4	6	10	6	1
5	21	1	1	
6	4	8	8	3
7	17	6		
8	17	6		
9	6	7	4	6
10	16	5	2	
11	22	1		
12	11	11	1	
13	12	4	2	5
14	2	8	11	2
15	17	5	1	
16	3	4	3	12
17	1	6	12	4
18	8	5	9	
19	12	5	4	1
20	13	6	2	1
21	3	7	9	3
22		4	10	7
23	8	9	3	2
24	5	12	5	1
25	5	9	5	4
26	15	8		
27	11	8	3	1
28	14	6	2	1
29	2	5	8	8
30	10	8	4	1
31	7	8	6	2
32	5	8	5	5
33	13	8	1	
34	6	7	7	3
35	14	8	1	
36	11	9	3	
37	8	8	7	

(Table Continues)

Table K-2 (Cont'd)

Objective	1	2	3	4
38	10	7		6
39	7	4	6	6
40	15	6	1	1
41	12	8	2	1
42	16	5	1	1
43	16	3	3	1
44	7	5	8	3
45	8	5	7	3
46	6	2	10	5
47	9	7	2	5
48	3	5	4	11
49	1	6	11	5
50	1	4	5	13

Table K-3

Rating of Objectives by

Teachers in an Urban Community

Objective	1	2	3	4
1	24	2	1	
2	15	6	4	2
3	7	6	7	7
4	13	8	4	2
5	24	2	1	
6	14	11	1	1
7	17	6	3	1
8	23	2	2	
9	15	8	4	
10	22	5		
11	25	1	1	
12	11	15	1	
13	7	4	13	3
14	2	10	10	5
15	26		1	
16	3	9	11	3
17	14	10	2	1
18	10	9	6	2
19	13	10	3	1
20	8	5	11	3
21	4	9	10	4
22	3	9	10	4
23	12	7	6	2
24	6	11	7	3
25	11	7	9	
26	22	3	1	1
27	16	10	1	
28	20	6	1	
29	1	4	10	12
30	14	5	5	3
31	5	9	10	3
32	8	7	10	2
33	9	13	5	
34	4	10	9	4
35	11	10	6	
36	18	8		1
37	8	10	6	5

(Table Continues)

Table K-3 (Cont'd)

Objective	1	2	3	4
38	9	10	5	3
39	11	8	4	4
40	16	5	5	1
41	9	13	3	2
42	17	8	1	1
43	12	11	2	2
44	7	10	5	5
45	6	10	7	4
46	14	12	5	6
47	7	12	1	7
48	3	5	8	11
49	2	7	10	8
50	1	6	9	11

Appendix L

Frequency Distribtion of Rating of Objectives

In Relation to Number of Years Teaching

Grade Nine Mathematics

Table L-1

Frequency Distribution for Rating of

Objectives by Teachers with 1-10 Years Experience

Teaching Grade Nine Math

Objectives	1	2	3	4
1	39	9	4	
2	25	16	8	4
3	15	17	9	12
4	14	19	13	7
5	43	7	3	
6	15	24	9	5
7	34	15	4	
8	37	11	5	
9	26	17	6	4
10	39	9	5	
11	46	5	1	
12	15	13	5	
13	12	15	6	10
14	6	17	19	11
15	44	5	4	
16	9	18	14	12
17	21	20	9	3
18	23	15	12	3
19	14	24	13	2
20	14	20	13	6
21	6	15	22	10
22	4	14	20	12
23	20	17	14	6
24	12	23	14	4
25	16	17	14	6
26	31	13	7	2
27	30	13	6	4
28	39	9	5	1
29		12	20	21
30	22	15	10	6
31	12	24	9	8
32	7	16	19	11
33	28	14		3
34	9	17	21	6
35	33	12	7	1
36	23	18	6	6
37	15	17	16	4

(Table Continues)

Table L-1 (Cont'd)

Objectives	1	2	3	4
38	23	12	10	8
39	18	17	12	6
40	36	8	5	4
41	22	19	7	5
42	36	11	3	2
43	32	11	4	5
44	21	14	10	8
45	23	16	7	7
46	16	16	12	9
47	28	16	8	11
48	5	12	15	21
49	3	11	19	20
50	2	10	16	24

Table L-2

Frequency Distribution for Rating of

Objectives by Teachers with 11-20 Years Experience

Teaching Grade Nine Math

Objectives	1	2	3	4
1	29	7		
2	15	13	4	4
3	5	8	13	10
4	15	12	8	1
5	29	5		2
6	13	12	7	3
7	24	7	2	3
8	31	4	1	
9	13	10	7	6
10	14	18	3	
11	35		1	1
12	15	18	2	1
13	12	7	10	6
14	3	12	15	
15	32	3	1	15
16	2	9	8	
17	16	15	4	3
18	9	12	10	2
19	17	12	4	1
20	14	12	8	6
21	6	11	12	9
22	4	8	13	3
23	13	13	6	3
24	8	18	7	2
25	10	16	8	
26	29	5	1	2
27	21	12	1	1
28	21	13	13	14
29	5	4	6	5
30	14	11	12	5
31	8	11	11	7
32	10	8	7	
33	10	18	14	4
34	3	15	4	
35	19	14	3	
36	22	9	3	2
37	16	8	7	5
38	11	9	8	8

(Table Continues)

Table L-2 (Cont'd)

Objectives	1	2	3	4
39	13	9	8	6
40	20	14	2	
41	16	14	5	1
42	27	7	1	1
43	22	8	5	1
44	10	11	11	4
45	11	9	9	4
46	5	11	13	7
47	9	16	5	6
48	4	7	8	17
49	6	4	16	10
50	3	3	13	15

Table L-3

Frequency Distribtuion for Rating of

Objectives by Teachers with More Than 20 Years

Experience Teaching Grade Nine Math

Objectives	1	2	3	4
1	10		1	
2	5	3	2	1
3	1	3	4	3
4	5	3	2	1
5	11			
6	5	4	2	
7	6	3	2	
8	11			
9	7	2	2	
10	7	4		
11	10	1		
12	4	6	1	
13	4	2	4	1
14	2	3	4	2
15	10	1		
16		4	3	4
17	4	6	1	
18	4	1	5	1
19	7	2	1	1
20	5	3	2	1
21	3	2	3	3
22	2	3	3	3
23	6	1	2	2
24	2	4	2	3
25	6	3	2	
26	9	2		
27	7	4		
28	6	5		
29	1	1	2	7
30	8		3	
31	2	4	5	
32	3	6		2
33	4	6	1	
34	1	4	4	2
35	5	3	3	
36	7	3	1	
37	4	5	1	

(Table Continues)

Table L-3 (Cont'd)

Objective	1	2	3	4
38	5	2	2	2
39	4	4	3	
40	6	5		
41	4	3	2	2
42	8	2	1	
43	2	6	1	1
44	1	4	3	3
45	4	5	2	
46		3	4	4
47	2	4	4	1
48		1	7	3
49	1	2	3	5
50		2	3	6