PARENTS, STUDENTS, AND TEACHERS AS DATA SOURCES FOR THE SELECTION OF MINIMUM-COMPETENCY OBJECTIVES FOR GRADES SEVEN AND EIGHT MATHEMATICS

ROBERT DOMINO WILKINS

PARENTS, STUDENTS, AND TEACHERS AS DATA SOURCES FOR THE SELECTION OF MINIMUM - COMPETENCY OBJECTIVES FOR GRADES SEVEN AND EIGHT MATHEMATICS

by

© Robert Domino Wilkins, B.A., B.Ed.

A Thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Education

Department of Curriculum and Instruction
Memorial University of Newfoundland
March 1976

St. John's Newfoundland

ACKNOWLEDGMENTS

Several people have helped in conducting this study and in the preparation of this thesis, and some deserve special recognition.

To my supervisor, Dr. Glyn Wooldridge, sincere thanks for the work put into this thesis. His advice and encouragement have been a continued source of strength throughout this endeavour. His zeal as a mathematics educator has been an inspiration.

To Dr. Alec Brace, mathematics educator of the Faculty of Education at Memorial University of Newfoundland, and to Mr. Philip Warren, Principal, Ralph Laite Pentecostal Collegiate, Lewisporte, thanks for the help and understanding given me during the preparation of this thesis.

A very helpful colleague during the past year has been Ralph Andrews.

Sincere thanks to my wife, Carol, for typing the manuscript, and for supporting and encouraging me in many ways.

Thank you.

ABSTRACT

This study attempted to test the feasibility of the approach of involving parents, students, and teachers in responding to a set of objectives which define what might be considered minimal mathematical competencies expected of an enlightened citizen in contemporary society. Samples rated, on a Likert-type scale from 1 -- not important to 5 -- very important, forty-eight objectives which defined ten mathematical skills or competencies -- Numbers and Numerals, Operations and Properties, Mathematical Sentences, Geometry, Measurement, Relations and Functions, Probability and Statistics, Graphing, Mathematical Reasoning, Business and Consumer Mathematics. Results were used to identify objectives which these three groups perceive as important and feel should be a major proportion of the objectives of the grades seven and eight mathematics program.

Parents', students', and teachers' responses were analyzed using Kendall's Coefficient of Concordance, W. The χ^2 test and the F-test at the 0.01 level of significance were used as a basis for rejection of the null hypothesis. The null hypothesis tested was: There is no significant agreement of the perceived importance of the objectives, as revealed on an appropriate instrument, among parents, students, and teachers. The observed value of W, 0.787, led to a rejection of the null hypothesis. This high value of W was interpreted to mean that the particular ordering

obtained established an importance-priority of objectives which reflect the needs of the local clientele.

In addition to making statistical comparisons for hypothesis testing, the researcher endeavoured to identify any educational needs which may exist in grades seven and eight mathematics. A descriptive analysis of mean ratings of the objectives revealed that seven of the ten skills investigated were considered of average or of above average importance by parents, students, and teachers for grades seven and eight mathematics. A comparison of these skills with the present grades seven and eight mathematics program skills revealed a substantial agreement. However, Business and Consumer mathematics was considered most important, Relations and Functions of average importance by parents, students, and teachers, but these skills were not being taught in grades seven and eight mathematics. Their relatively high rating suggested they were needs requiring educational amelioration.

This study illustrated the utility of involving local clientele in determining priorities among educational objectives. Input in determining educational preferences among educational objectives by students, parents, and teachers may result in a more defensible set of preferences.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Statement of the Problem

In March 1970 the National Council of Teachers of Mathematics (NCTM) established a committee to write a set of objectives to define what might be considered the minimal mathematical competencies that are expected of the enlightened citizenship in contemporary society. The report, completed in 1972, suggested that competencies in mathematics can be divided into three categories (Edwards, Nichols, Sharpe, 1972). A brief description of each category follows.

Category I: Mathematics as a tool for effective citizenship and personal living. This category covers the utilitarian aspect of mathematics and is important for all citizens.

Category II: Mathematics as a tool for the functioning of the technological world. This category is essential for the scientist and the engineer -- generally to those who make their living through professions that use mathematics as a tool.

Category III: Mathematics as a system in its own right. This category is of concern to the professional mathematician, who sees in it a fascination and beauty that usually escapes the untrained mind.

The present study endeavored to test the feasibility of the approach of involving teachers, parents, and students in responding to the NCTM set of Category I objectives in order to determine the importance of these objectives. Results were used to identify objectives which these three groups perceive as important and feel should be a major proportion of the objectives of the grades seven and eight mathematics program. These objectives were compared to the Category I objectives of the present grades seven and eight mathematics program. Any discrepancy between the objectives identified as important by the teachers, parents, and students and the present program objectives was considered a need requiring educational amelioration.

Briefly, the problem was to:

(i) identify in Category I, objectives perceived as important for grades seven and eight mathematics by teachers, parents, and students.

(ii) compare the perceived importance of the objectives among the three groups -- teachers, parents, and students.

(iii) identify needs by comparing the objectives perceived important by teachers, parents, and students with the present grades seven and eight mathematics program Category I objectives.

Hypotheses & Questions

The determination of the importance of objectives as perceived by parents, students, and teachers does not involve hypothesis testing. Specific hypothesis testing becomes necessary when comparisons are made among the various groups of students, parents, and teachers involved.

The hypothesis tested in this study was:

1. There is no significant agreement of the perceived importance of the objectives, as revealed on an appropriate instrument, among parents, students, and teachers.

Subsequent to testing the above hypothesis, this study attempted to determine any educational needs which may exist in grades seven and eight mathematics. This required the answering of the following questions:

1. Which of the skills or competencies being investigated are perceived as being most important, which as being of average importance, and which of least importance by the parents, students and teachers?

2. What skills or competencies are considered important for grades seven and eight mathematics by the Newfoundland Department of Education and outlined in the Mathematics Curriculum Bulletin, 1975?

3. What discrepancies are observed between the skills perceived as important by the parents, students, and

teachers and the skills outlined as important by the Department of Education?

Delimitations and Limitations

The delimitations of this study were:

1. Because this study attempted to interpret the NCTM Category I objectives in light of a local situation, it was limited to a single school system, the Ralph Laite Pentecostal Collegiate School System, located at Lewisporte, Notre Dame Bay, Newfoundland. This school system includes students from Lewisporte and eight surrounding rural communities -- Embree, Little Burnt Bay, Stanhope, Brown's Arm, Laurenceton, Norris Arm North, Campbellton, and Michael's Harbour.

2. The samples used in this study were limited to grades seven and eight students enrolled in the mathematics program at Ralph Laite Pentecostal Collegiate, the parents of these students, and mathematics teachers of this school system. There were two reasons for choosing grades seven and eight students. First, the present mathematics program treats grades seven and eight mathematics as a single block of mathematical skills. Secondly, grades seven and eight are, in general, the final two years of formal schooling in which the utilitarian aspect of mathematics is emphasized. In grades seven and eight mathematics, Category I -- mathematics as a tool for effective citizenship and personal living -- is emphasized.

In grades nine, ten, and eleven, students study different branches of mathematics, Algebra, Geometry, and Trigonometry. In these courses, objectives of Category II -- mathematics as a tool for the functioning of the technological world, and Category III -- mathematics as a system in its own right -- receive greater emphasis.

The limitations of this study were:

1. This study was limited to the identification of objectives to define minimum competencies in mathematics in Category I only. There was no attempt to define minimum competence in Category II or Category III.

2. This study was limited to what Bloom (1956) calls the "cognitive domain". There was no consideration of the affective or psychomotor domains.

Need For and Significance of the Study

The basic mathematical competencies and skills essential for enlightened citizens of a society are determined by the needs of that society at a given time. Educators charged with maintaining a contemporary basic mathematics program must be aware of these needs and give them consideration in their efforts to design effective programs. The writer has been unable to find a single study which attempted to determine the mathematical needs of the citizens of Newfoundland. Therefore, there seemed to be a genuine need for this type of study.

Since a logical way to determine the mathematical competencies and skills essential for the citizens of a given society is to involve the citizens of that society, parents and students had major inputs into this study. Since it is also desirable to have professional input into the determination of mathematical competencies and skills, mathematics teachers were involved.

While it is desirable to emphasize local needs and local problems, the writer acknowledges the necessity of a broader base for our mathematics programs. The needs of society are interpreted by various social agents (newspaper writers, academicians, government officials, leaders of industry, etc.) into broad educational objectives. These broad-category objectives are translated into various subject programs, including mathematics, by curriculum developers and publishers. It then becomes the responsibility of governmental Departments of Education and school boards to select the mathematics programs which best meet the mathematical needs of the citizens they serve. To determine these needs, however, it seems logical to consult those clientele which the selected programs will serve.

The information gained from comparisons of the competencies and skills essential for enlightened citizens as perceived by parents, students, and teachers can provide a basis for modification of the present grades seven and eight mathematics program. This type of evaluation may be considered significant as a basis for curriculum development emphasizing local needs.

CHAPTER II

REVIEW OF THE LITERATURE

A review of the literature reveals an abundance of materials and studies on the form of statement of educational objectives and on the range of purposes that objectives serve. These studies were helpful in providing criteria for choosing the instrument used in this study. Some of the published reports describe studies that utilize objectives in determining educational needs. Such studies appear to be very similar to the present study.

The literature reviewed here can be considered under two general categories. The first category deals with the range of purposes of objectives and the controversy that has arisen over the form of their statement. The second category contains studies on the use of objectives in assessing educational needs.

The Controversy Over the Proper Form of Statement of Objectives and the Multi-purposes of Objectives

Several writers, Cronbach (1963), Smith & Tyler (1962), Taba (1962), Dressel and Mayhew (1954), have discussed the purposes that the statement of educational objectives serves in curriculum design, implementation, and evaluation. Some of the suggested purposes are: to direct ongoing classroom instruction, to guide in the selection of content, to aid in the evaluation of student progress, to direct course evaluation activities, and to aid in the development of new courses. In view of the range of purposes that objectives are called upon to serve, it is not surprising that a good deal of controversy had begun to arise over the form of their statement. On the one side, Mager (1962) has given voice to the demand that the only proper way to state objectives is in terms of explicitly observable behaviors. Taking a less dogmatic view, Atkin (1963) warned that such insistence can lead to the curtailment of teacher creativity, and at the extreme pole Eisner (1966) suggested that it is not possible to even state some objectives in behavioral terms.

Atkin (1968), and Nichols (1972) criticize educational goals stated in terms of behavioral objectives for describing rather trivial behavior. Several writers, Walbesser (1970, 1972) Walbesser, Kurtz, Goss, and Robl (1970), however, have taken exception to this view and have suggested that behavioral objectives can also be constructed to describe complex behaviors. Popham and Baker (1970) make the case that instructional objectives behaviorally stated are not necessarily trivial. On the contrary, they force teachers to be more aware of the defensibility of their educational goals.

There is recognition that the objective alone is no magic solution to the problem confronting the practitioner, researcher, or learner. Eva Baker (1967) contrasted the behavioral and non-behavioral effects that stated objectives have on pupil learning. She concluded that irrespective of the character of the objective, the teacher must first be given specific training on how to use objectives in specifying instruction, and then be encouraged to use them.

A study by Carter (1971) tested the hypothesis that preservice elementary education majors given an operational definition of stated performance objectives in the form of assessment items demonstrate higher acquisition rates with respect to the desired behaviors than those not given the operational definitions in the form of assessment items.

The form of statement of objectives -- whether in behavioral terms or otherwise -- may be determined by looking at the purposes served by the objectives. Maguire (1969), and Krathwhol (1965) have suggested that objectives might be conceptualized as operating at three levels. At level one, the most abstract level, the objectives are conceptualized as broad, general statements useful for developing programs of instruction or for establishing courses that a student should cover. They are general goals toward which several years of education might be aimed. They provide an orientation to the main emphasis in educational programs, and are the first step toward translating the needs and values of society and of individuals into an educational program.

At the second level, the broad objectives are broken down into the objectives of courses of instruction. These objectives are stated in terms of behaviors and conglomerates of behaviors. At the third and most concrete level, objectives are stated in the specific behavioral terms necessary for creating instructional materials.

Taylor and Maguire (1966) differentiated among levels of objectives in their proposed model for curriculum evaluation. In this model, which is based on a rational - sequential approach to curriculum development, they suggested that the needs of society are interpreted by various social agents (newspaper writers, academicians, government officials, leaders of industry, PTA, etc.) into broad educational objectives by curriculum developers. These broad-category objectives are translated into behavioral statements, which are, in turn, transformed into classroom strategies. The students' interaction with these strategies is described as resulting in observable behaviors.

At closer look, both Krathwohl's ascendency of objectives and the Taylor - Maguire sequential model of evaluation suggest that evaluation of objectives has two components -- a measurement component and a value assessment component. The measurement component consists of establishing the degree of fidelity of each of the translations, that is, how accurately broad objectives are represented by the behavioral statements, how completely the behavioral objectives are manifested in the strategies, and how nearly congruent the outcomes and objectives are. The judgment role with respect to the broad objectives is seen as being concerned with their social worth. It is suggested that the worth of objectives be judged in terms of their importance to the entire educational program. Evaluation of student outcomes should be made in terms of their quality and with respect to how well the objectives have been achieved.

Studies Concerned with the Determination of Educational Needs and Goals via Evaluation of Objectives

A study reported by Baker (1972) explored the utility of objectives-based evaluation in mathematics in a needs assessment function at the junior high school level. The intent of the study was to test the feasibility of the approach of involving parents, students, and teachers in responding to objectives of common and discrepant interest. She concluded that this procedure has potential utility for the development of defensible goals. The Baker study was replicated by Malkin (1971) with similar results.

A major study on needs assessment via objectives was conducted by Bucks County Public Schools (1971). The purpose of this study was to define and clarify the "Ten Goals of Quality Education" adopted by the Pennsylvania State Board of Education in 1965. The Quality Education Program Study developed general needs assessment instruments, individual needs assessment instruments, and test instruments. The purpose of the general needs assessment instrument was to provide the means for a school district to assess its needs relative to the Ten Goals. This instrument could also serve as a medium to acquaint constituents (parents and students) with the goals of "Quality Education".

It was concluded that the statement of behavioral definitions from Pennsylvia's "Ten Goals of Quality Education" may serve as a guide for the evaluation and improvement of teaching and learning in the schools.

Several writers, Cronbach (1963), Fraser (1963), Wiles (1965), suggest that a program should be developed or modified to fit local needs, capitalizing on the capacities and experiences of local pupils, teachers, and parents. Bloom (1961) suggests that evaluation should become a local and beneficial teacher-training activity. The following remarks by Bloom are respresentative of a whole school of thought:

> "The criterion for determining the quality of a school and its educational functions would be the extent to which it achieves the objectives it has set for itself.

.... Participation of the teaching staff in selecting as well as constructing evaluation instruments has resulted in improved instruments on one hand and, on the other hand, it has resulted in clarifying the objectives of instruction and in making them real to teachers.

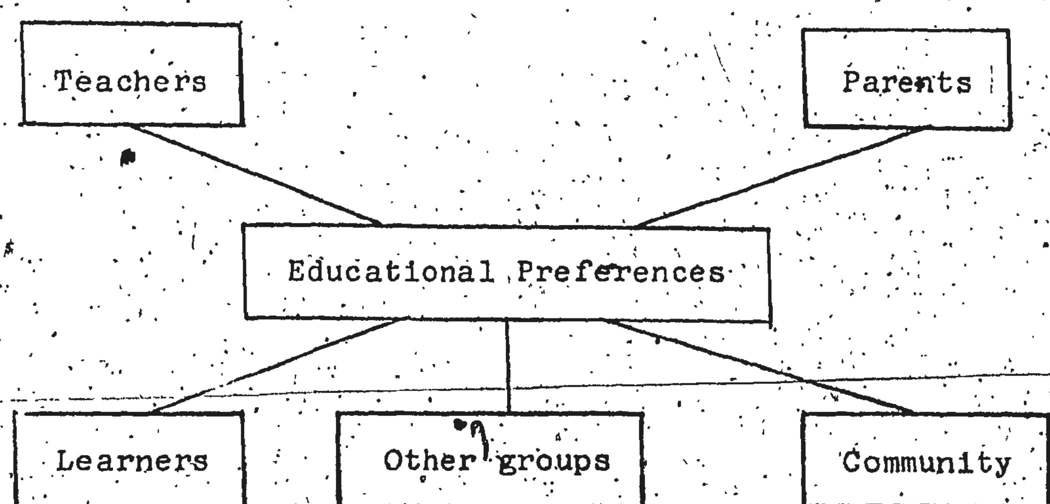
.... When teachers have actively participated in defining objectives and in selecting or constructing evaluation instruments, they return to the learning problems with great vigor and remarkable creativity.

.... Teachers who have become committed to a set of educational objectives which they thoroughly understand respond by developing a variety of learning experiences which are as diverse and as complex as the situation requires."

Baker and Popham (1973) have suggested a model for determining preferences among educational objectives. We can graphically depict this model as in Figure I.

FIGURE I

A MODEL FOR DETERMINING PREFERENCES AMONG EDUCATIONAL OBJECTIVES



Note from Figure I that beyond the more customary selections of teachers, parents, and students, other groups can be consulted. For example, a group of "futurists" could determine preferences among a set of objectives by ranking them according to their perceived suitability for a society of the 1980's or 1990's.

The present study attempted to determine preferences by using three of the groups of the above model -- teachers, parents, and learners. Baker and Popham (1973) argue that by consulting those clientele concerned with the education of the learners involved, a more defensible set of preferences can be secured.

Summary

Recapitulating, a review of the literature indicates a great deal of controversy over the form of statement of educational objectives. Views range from Mager's (1961) demand that the only proper way to state objectives is in terms of explicitly observable behaviors to Eisner's (1966) suggestion that it is not possible to even state some objectives in behavioral terms.

This controversy may be reconciled by considering the purposes served by the objectives. Krathwhol (1965), Taylor and Maguire (1966), and Maguire (1969) have suggested that objectives might be conceptualized as operating at three levels. At level one, the needs of society are interpreted by curriculum developers into broad educational objectives useful for developing programs of instruction. At the second level, these general statements are transformed into the objectives of courses of instruction. These objectives are stated in terms of behaviors and conglomerates of behaviors. At the third and most concrete level, objectives are stated in specific behavioral terms. The students' interaction with these specific behavioral objectives is described as resulting in observable behaviors.

The use of objectives in research to determine educational needs appears to be a rather recent development. Studies utilizing objectives-based evaluation have been carried out mainly in the early 1970's and for the most part have been conducted in the United States. They verify the feasibility of the approach of involving students, parents, and teachers in responding to educational objectives.

Results of studies that consult those clientele concerned with the education of the learners involved may lead to the development of a new program or the modifiction of a present program to fit local needs. Input in determining educational preferences among educational objectives by students, parents, and teachers results in a more defensible set of preferences.

CHAPTER III

METHODS AND MATERIALS

This study endeavoured to identify objectives perceived as important for grades seven and eight mathematics by students, parents, and teachers. The samples of students, parents, and teachers were all selected from persons associated with Ralph Laite Pentecostal Collegiate, Lewisporte, Newfoundland. The three groups rated a set of forty-eight objectives on a five-point scale from 1 -- not important to 5 -- very important. Since the samples were limited to one school system, the data obtained were analyzed utilizing nonparametric statistics.

Samples used in the study

Students

The sample used in this study for the purpose of measuring students' perceived importance of objectives consisted of all the students enrolled in mathematics in grades seven and eight at Ralph Laite Pentecostal Collegiate, Lewisporte, Newfoundland. This consisted of two grade seven classes and two grade eight classes, giving a grand total of one hundred and ten students.

Parents

The sample of parents used in this study was randomly selected from the total number of parents of the students enrolled in grades seven and eight mathematics. By use of a table of random numbers (Glass and Stanley, 1970) a sample of thirty parents was obtained from a total of one hundred and five parents.

Teachers

The sample of teachers consisted of the two mathematics teachers teaching grades seven and eight mathematics at Ralph Laite Pentecostal Collegiate and one mathematics teacher from each of the eight feeder schools, giving a total of ten teachers.

Instrumentation

The instrument used in this study was a questionaire based upon the NCTM Category I objectives (see Appendix A). It utilized a Likert-type scale consisting of five categories: 1 -- not important, 2 -- marginal importance, 3 -- average importance, 4 -- important, 5 -- very important. The ten skills or competencies which this instrument was used to investigate are listed below:

1. Numbers and numerals
2. Operations and properties
3. Mathematical sentences
4. Geometry
5. Measurement
6. Relations and functions
7. Probability and statistics
8. Graphing

9. Mathematical reasoning
10. Business and consumer mathematics

The NCTM Category I objectives consist of a total of forty-eight objectives. By utilizing a table of random digits these objectives were placed in random order to form two questionaires, FORM A and FORM B (see Appendix B).

Procedures

Students' Responses

The questionaire was administered simultaneously to all students in the sample by the researcher. This was accomplished by having the students congregate in the lecture auditorium of the school. This simultaneous administration of the questionaire provided control of a number of variables including physical surroundings, time of day, and communication among students which may have occurred if the questionaire were administered to different classes during different periods.

Prior to the students' arrival in the auditorium FORM A and FORM B of the questionaire were alternately placed on the desks. Two forms of the questionaire were used to avoid any copying which might have occurred with the use of just one form. Upon arriving, the students were told the purpose of the study and the procedure for completing the questionaire was explained. Any questions on the questionaire or the study were answered by the researcher.

Parents' Responses

About a week prior to sending the questionaire to the sample of parents used in this study, a letter explaining the purposes of the study and soliciting their cooperation in conducting the study was mailed to the parents, (see Appendix C).

The questionaires together with a covering letter were mailed to the parents on April 8, 1975. An envelope was addressed to each of the thirty parents in the sample. Fifteen copies of FORM A of the questionaire and fifteen copies of FORM B of the questionaire were randomly placed in the envelopes. There was also enclosed a self-addressed, postage-paid envelope which the parents could use to return the questionaire.

The initial response of the parents was rather meager. Consequently a follow-up letter was sent on May 6, 1975 (see Appendix C). This resulted in the return of a few more questionaires. On May 15th and 16th the researcher telephoned all parents who had not responded. The purpose of the study was reiterated and their cooperation was again solicited. The researcher also attempted to clarify any difficulties which the parents were experiencing with completing the questionaire. The response was favorable and in total a return of 73 percent was obtained.

Teachers' Responses

The researcher discussed the purposes of the study with the mathematics teachers of Ralph Laite Pentecostal Collegiate school system. Their cooperation in conducting the study was solicited and a copy of the questionaire together with a covering letter (see Appendix C) was given to each teacher in the sample. There was a 100% response from the teachers.

The Methods of Analysis

The raw data for the statistical analysis consisted of 48 ratings for each of the students, parents, and teachers used in the sample. This basic data is ordinal in nature since it comes from a Likert-type scale.

Ordinal scales of the type used in this study are considered weak measurements (Stevens, 1951). Stevens argues that measurement scales are models of object relationships and, for the most part, rather poor models which can lead far astray from the truth if scores they yield are added when they should only be counted. Opposing this view, Baker, Hardyck, and Petrinovich (1966) have argued for the use of strong statistics such as the t-test, the F-tests, or the Chi-square test. They experimented with transformations in data for different measurement scales -- ordinal, interval and ratio. Their findings indicated that strong statistics such as the t- and F-tests and the chi-square test are more than adequate, to cope with weak measurements, and that associated probabilities are little affected by the kind of measurement scale used.

This study sought to identify mathematical needs in one local area of Newfoundland. The researcher was not interested in generalizing his findings to the total population of grades seven and eight mathematics students in the Province. Indeed, the sample is biased with respect to the total population, and, therefore, generalization would be both inappropriate and possibly erroneous. Consequently, parametric statistics were considered unacceptable to analyze the data obtained in this study.

Since the sample used in this study was limited to one school system, the Ralph Laite Pentecostal Collegiate school system, Lewisporte, Newfoundland, the data obtained were analyzed utilizing nonparametric statistics. The use of such statistics in education has been defended by a number of writers. Kerlinger (1964) suggests that nonparametric statistical tests are hemmed in by fewer and less stringent assumptions than parametric tests. They are particularly free of assumptions about the characteristics or the form of the distribution of the populations of research samples. As Siegel (1956) puts it, "A nonparametric statistical test is a test whose model does not specify conditions about the parameters of the populations from which the sample was drawn."

The use of the Kendall Coefficient of Concordance W to determine the association among the ratings of objectives by students, parents, and teachers has been suggested by Siegel (1956) and Kerlinger (1964).

The approach suggested is to imagine how our data would look if there were no agreement among the K sets of rankings. The coefficient of concordance W would then be an index of the divergence of the actual agreement shown in the data from the minimum possible (no) agreement.

The coefficient of concordance, W, expresses the mean agreement on a scale from .00 to 1.00 among K rankings. The reason that W cannot be negative is that when more than—two sets of ranks are involved, the rankings cannot all disagree completely. For example, in this study, if the parents and students are in disagreement on the perceived importance of an objective, and the parents are also in disagreement with the teachers, then the students and teachers must agree. That is, when more than two judges are involved, agreement and disagreement are not symmetrical opposites. K judges may all agree, but they cannot all disagree completely. Therefore W must be zero or possitive.

There are two ways to define W. The Kendall method will be presented here. According to this method W can be expressed as the ratio between the between-groups (or ranks) sum of squares and the total sum of squares of a complete analysis of variance of the ranks. This ratio, then, is the correlation ratio squared, E^2, of ranked data.

When there are K rankings of n individual objects, Kendall's coefficient of concordance is defined by

$$W = \frac{12s}{k^2(n^3-n)} \quad \text{or} \quad W = \frac{s}{\frac{1}{12}k^2(n^3-n)} \qquad (4.1)$$

where s = sum of the deviations squared of the totals of the n ranks from their mean. s is the between-groups sum of squares for ranks. It is like ss_b (In fact, if we divide s by k, s/K, we obtain the between sum of squares we would obtain in a complete analysis of variance of the ranks.)

$\frac{1}{12}k^2(n^3-n)$ = maximum possible sum of the squared deviations, i.e., the sum s which would occur with perfect agreement among k rankings.

The effect of tied ranks is to depress the value of W as found by formula (4.1). If the proportion of ties is large, a correction may be introduced which will increase slightly the value of W over what it would have been if uncorrected. That correction factor is the same one used with the Spearman r_s:

$$T = \frac{\Sigma(t^3-t)}{12}$$

where t = number of observations in a group tied for a given rank

Σ directs one to sum over all groups of ties within any one of the k rankings.

With the correction of ties incorporated, the Kendall coefficient of concordance is

$$W = \frac{12s}{k^2(n^3-n)-k\sum_T T} \qquad (4.2)$$

where $\sum_T$ T directs one to sum the values of T for all the k rankings.

According to Siegel (1956), when n is larger than 7, the expression given in formula (4.2) is approximately distributed as chi-square with

$$\begin{aligned} df &= n-1 \\ \chi^2 &= k(n-1)W \end{aligned} \qquad (4.3)$$

That is, the probability associated with the occurrence under H_o of any value as large as an observed W may be determined by finding χ^2 by formula (4.3) and then determining the probability associated with so large a value of χ^2 by referring to a table of critical values of chi squared.

If the value of χ^2 as computed from formula (4.3) equals or exceeds that shown in a table of critical values of chi squared for a particular level of significance and a particular value of df = n-1, then the null hypothesis that the k rankings are unrelated may be rejected at that level of significance.

Kerlinger (1964) suggests that the significance of W may be evaluated using the following formula for the F-ratio.

$$F = \frac{(k-1)W}{1-W} \tag{4.4}$$

If the value of F as computed from formula (4.4) equals or exceeds that shown in a table of critical values of the F-distribution for a particular level of significance and a particular degree of freedom, it may be concluded that W is significant at that particular level of significance.

Hypothesis 1 of this study, given on Page 3, was analyzed using the above procedure. Since the numbers of parents, students, and teachers were different, the ratings of the members of each rating group were lumped together by averaging. Thus each of the forty-eight objectives was assigned a mean rating for each of the three rating groups. Based upon this mean rating, the objectives were ranked. The coefficient of concordance W was computed and its significance, at the 0.01 level of significance, was tested by finding χ^2 and then determining the probability associated with so large a value of χ^2. The F-test at the 0.01 level of significance was also used as a basis for rejection of the null hypothesis.

In addition to making statistical comparisons for hypothesis testing, the mean ratings of the objectives for each of the ten skills or competencies being investigated were described. A grand mean for each of the ten skills was calculated. The Coefficient of Concordance, W, was determined for each of the ten competencies. This helped to determine which competencies were considered most important, which of average importance, and which of least importance by the parents, students and teachers. Subsequently, comparisons were made with the importance given grades seven and eight mathematics objectives by the Newfoundland Department of Education, outlined in the Mathematics Curriculum Bulletin, 1975. The discrepancies observed were considered needs requiring educational amelioration.

The results of the above analysis are presented in the following chapter.

CHAPTER IV

DATA ANALYSIS AND RESULTS

This chapter begins with a discussion of the validity and reliability of the instrument used. Reasons are given for assuming the instrument to be valid for the purpose for which it was used in this study. The split-half procedure used to obtain a reliability correlation coefficient is described.

In the second section of this chapter the statistical analysis of results of the study is considered in relation to the hypothesis presented on Page 3. To test the null hypothesis, no significant agreement among the three groups -- parents, students, and teachers -- the ratings of the 48 objectives were analyzed using Kendall's Coefficient of Concordance, W.

The χ^2 test and the F-test at the 0.01 level of significance were used as a basis for rejection of the null hypothesis.

A descriptive analysis of what the mean rating of each of the ten competencies actually represents is dealt with in the third part of this chapter. The mean scores and the Coefficient of Concordance W for each of the ten categories are presented in determining which skills were considered most important, which of average importance, and which least important.

Comparisons of skills considered important by the parents, students, and teachers and skills outlined as important in the <u>Mathematics Curriculum Bulletin</u>, 1975-76 are presented in the final part of this chapter.

Validity and Reliability of the Instrument

Validity

Feeling a responsibility to the Mathematics profession as well as to the public to establish guidelines for the mathematical needs of all citizens, the National Council of Teachers of Mathematics Board of Directors accordingly appointed a committee in March, 1970, to draw up a list of basic mathematical competencies, skills, and attitudes essential for enlightened citizenship in contemporary society. This committee consisted of E.L. Edwards, Jr., Chairman, Eugene D. Nichols, and Glyn H. Sharpe.

Edwards, Nichols, and Sharpe spent two years researching the kind of mathematics needed by the enlightened citizen. The great deal of sophisticated mathematics required for the functioning of present-day society was considered. The dramatic changes in the mathematics curriculum as a result of the revolutionary work of the University of Illinois Committee on School Mathematics, the School Mathematics Study Group, the Commission on Mathematics, and other groups, were studied. The

Committee recognized that the highly complex problems of our technological society require complex mathematics to solve them. They acknowledged that the demand for increased competencies in mathematics has become a reality for many.

The Committee's report, completed in 1972, divided mathematical competencies into three categories. Category I consisted of a list of forty-eight objectives which define mathematics as a tool for effective citizenship and personal living. This list of objectives constituted the instrument used in the present study (see Appendix A). Because these objectives were supported by the NCTM, and they were drawn up by mathematics educators whose opinions are respected and who spent a considerable amount of time researching minimum competency objectives, the validity of the instrument was assumed.

Reliability

A reliability estimate of the instrument was obtained for each of the three samples, students, parents, and teachers, by the split-half procedure. By the same technique, an overall reliability correlation coefficient was also obtained.

The scores on the odd-numbered items of the questionaire were correlated with the scores on the even-numbered items. Since this procedure underestimates the reliability of the whole questionaire, the Spearman-Brown prophecy formula was employed to transform the split-half correlation into an appropriate reliability estimate for the total questionaire. As is shown in Table I, an overall reliability correlation coefficient of 0.46 was obtained.

Calculation of Kendall's Coefficient of Concordance, W, for Hypothesis Testing

The instrument used in this study was a questionaire based upon the forty-eight NCTM Category I objectives.

By utilizing a table of random digits these objectives were placed in random order to form two questionaires, FORM A and FORM B. The number of questionaires administered to students and sent to parents and teachers and the percentage return are reported in Table II.

The raw data of this study were acquired through rating a Likert-type scale from 1 -- not important to 5 -- very important for each of forty-eight objectives by each student, parent, and teacher used in the samples. The ratings of the members of each rating group were lumped together by averaging. Thus each of the forty-eight objectives was assigned a mean rating for each of the three rating groups. Based upon this mean rating, the objectives were ranked. These ratings are presented in Table III.

The coefficient of concordance, W, expresses the average agreement on a scale from 0.00 to 1.00 among k rankings. The Kendall method of computing W is discussed

TABLE I

SPLIT-HALF RELIABILITY

CORRELATION COEFFICIENTS

Sample	Correlation r
Students	0.34
Parents	0.61
Teachers	0.38
Overall Split-half correlation	0.46
N = 48	

TABLE II

NUMBER AND PERCENTAGE RETURN

OF QUESTIONAIRES

Sample	No. Sent	No. Received	Percentage Return
Students	110	110	100%
Parents	30	22	73%
Teachers	10	10	100%
Total	150	142	95%

TABLE III

AVERAGE RATINGS OF PERCEIVED IMPORTANCE OF MATHEMATICS OBJECTIVES BY STUDENTS, PARENTS, AND TEACHERS

Objective	Students' rating	Rank	Parents' rating	Rank	Teachers' rating	Rank
1	3.5	13.5	2.9	30.5	3.2	33.0
2	2.4	44.5	2.7	36.0	2.9	41.0
3	3.2	21.0	3.8	10.0	4.2	3.5
4	3.6	10.5	3.8	10.0	3.9	15.5
5	3.6	10.5	3.0	27.0	3.5	26.0
6	2.7	42.5	2.4	45.5	1.9	47.0
7	3.0	30.5	2.3	47.0	3.0	39.5
8	3.1	25.5	3.5	17.0	3.6	22.5
9	3.9	3.0	3.9	7.0	4.2	3.5
10	3.2	21.0	2.9	30.5	3.1	36.0
11	3.8	4.5	4.0	4.0	4.3	2.0
12	3.5	13.5	4.1	1.5	4.1	7.5
13	3.4	15.5	3.6	15.5	4.0	12.0
14	3.0	30.5	3.4	19.0	3.7	19.5
15	2.9	35.5	2.6	41.0	4.0	12.0
16	2.9	35.5	2.7	36.0	3.7	19.5
17	3.1	25.5	3.0	27.0	3.1	36.0
18	3.0	30.5	3.0	27.0	3.6	22.5
19	3.8	4.5	3.8	10.0	4.1	7.5
20	3.0	30.5	2.8	33.5	2.8	42.0
21	2.9	35.5	2.6	41.0	2.7	44.0
22	2.8	39.5	3.4	19.0	3.6	22.5
23	3.3	17.0	2.6	41.0	3.4	30.0
24	3.7	7.0	3.6	15.5	4.4	1.0
25	3.6	10.5	3.7	13.0	4.1	7.5
26	3.7	7.0	4.0	4.0	4.0	12.0
27	3.3	17.0	3.7	13.0	3.8	18.0
28	3.6	10.5	3.2	22.5	4.1	7.5
29	3.0	30.5	2.6	41.0	3.0	39.5
30	3.1	25.5	3.3	21.0	3.1	36.0
31	3.3	17.0	3.2	22.5	3.1	36.0
32	1.8	47.0	2.4	45.5	2.7	44.0
33	1.6	48.0	1.7	48.0	1.5	48.0
34	3.2	21.0	2.9	30.5	3.5	26.0
35	2.9	35.5	2.6	41.0	3.4	30.0
36	3.0	30.5	2.9	30.5	3.4	30.0
37	2.4	44.5	2.6	41.0	2.7	44.0
38	2.8	39.5	2.7	36.0	2.4	46.0
39	3.2	21.0	2.8	33.5	3.6	22.5

TABLE III (Continued)

Objective	Students' rating	Rank	Parents' rating	Rank	Teachers' rating	Rank
40	2.7	42.5	2.6	41.0	3.5	26.0
41	2.8	39.5	3.1	24.5	3.4	30.0
42	2.8	39.5	3.1	24.5	3.9	15.5
43	4.0	1.5	3.7	13.0	3.9	15.5
44	3.4	15.5	4.0	4.0	4.1	7.5
45	3.2	21.0	3.9	7.0	3.9	15.5
46	3.1	25.5	4.1	1.5	3.4	30.0
47	3.7	7.0	3.9	7.0	4.1	7.5
48	4.0	1.5	3.4	19.0	3.1	36.0

in detail in Chapter III (see pages 22 to 25). According to this method W can be expressed as the ratio between the between-groups (or ranks) sum of squares and the total sum of squares of a complete analysis of variance of the ranks. This ratio, then, is the correlation ratio squared, E^2, of ranked data.

To compute W using Kendall's formula (see formula (4.2), page 24) consider the data of Table IV. This table reproduces the ranks on the right of the columns of Table III, plus certain calculations to be used in the computation of W.

Since the proportion of ties in the ranks is large, one should correct for ties in computing the value of W.

In the students' rankings, there are fourteen sets of ties.

$$T = \frac{\Sigma(t^3-t)}{12} = 54.5$$

In the parents' rankings, there are seventeen sets of ties.

$$T = \frac{\Sigma(t^3-t)}{12} = 42.0$$

In the teachers' rankings, there are eleven sets of ties.

$$T = \frac{\Sigma(t^3-t)}{12} = 50.0$$

Knowing the values of T for the students', parents', and teachers' rankings, their sum may be found.

$$\Sigma_T T = 54.5 + 42.0 + 50.0 = 146.5$$

TABLE IV

RANKS OF DATA OF TABLE III FOR CALCULATION OF W

Objective	Students' rank	Parents' rank	Teachers' rank	X	X^2
1	13.5	30.5	33.0	77.0	5,929.00
2	44.5	36.0	41.0	121.5	14,762.25
3	21.0	10.0	3.5	34.5	1,190.25
4	10.5	10.0	15.5	36.0	1,296.00
5	10.5	37.0	26.0	63.5	4,032.25
6	42.5	45.5	47.0	135.0	18,225.00
7	30.5	47.0	39.5	117.0	13,689.00
8	25.5	17.0	22.5	65.0	4,225.00
9	3.0	7.0	3.5	13.5	182.25
10	21.0	30.5	36.0	87.5	7,656.25
11	4.5	4.0	2.0	10.5	110.25
12	13.5	1.5	7.5	22.5	506.25
13	15.5	15.5	12.0	43.0	1,849.00
14	30.5	19.0	19.5	69.0	4,761.00
15	35.5	4.0	12.0	88.5	7,832.25
16	35.5	36.0	19.5	91.0	8,281.00
17	25.5	27.0	36.0	88.5	7,832.25
18	30.5	27.0	22.5	80.0	6,400.00
19	4.5	10.0	7.5	22.0	484.00
20	30.5	33.5	42.0	106.0	11,236.00
21	35.5	41.0	44.0	120.5	14,520.25
22	39.5	19.0	22.5	81.0	6,561.00
23	17.0	41.0	30.0	88.0	7,744.00
24	7.0	15.5	1.0	23.5	552.25
25	10.5	13.0	7.5	31.0	961.00
26	7.0	4.0	12.0	23.0	529.00
27	17.0	13.0	18.0	48.0	2,304.00
28	10.5	22.5	7.5	40.5	1,640.25
29	30.5	41.0	39.5	111.0	12,321.00
30	25.5	21.0	36.0	82.5	6,806.25
31	17.0	22.5	36.0	75.5	5,700.25
32	47.0	45.5	44.0	136.5	18,632.25
33	48.0	48.0	48.0	144.0	20,736.00
34	21.0	30.5	26.0	77.5	6,006.25
35	35.5	41.0	30.0	106.5	11,342.25
36	30.5	30.5	30.0	91.0	8,281.00
37	44.5	41.0	44.0	129.5	16,770.25
38	39.5	36.0	46.0	121.5	14,762.25
39	21.0	33.5	22.5	77.0	5,929.00
40	42.5	41.0	26.0	109.5	11,990.25
41	39.5	24.5	30.0	94.0	8,836.00

TABLE IV (Continued)

Objective	Students' rank	Parents' rank	Teachers' rank	X	X^2
42	39.5	24.5	15.5	79.5	6,320.25
43	1.5	13.0	15.5	30.5	900.00
44	15.5	4.0	7.5	27.0	729.00
45	21.0	7.0	15.5	43.5	1,892.25
46	25.5	1.5	30.0	57.0	3,249.00
47	7.0	7.0	7.5	21.5	462.25
48	1.5	19.0	36.0	56.5	3,192.25

$\Sigma X = 3,498$ $\Sigma X^2 = 320,148.75$

$(\Sigma X)^2 = 12,236,004$

With the above information, W may be computed, corrected for ties:

$$W = \frac{12s}{k^2(n^3-n)-k\sum_T T} \qquad (4.2)$$

$$= \frac{12\left[320{,}148.75 - \frac{12{,}236{,}004}{48}\right]}{3^2(48^3-48) - 3(146.5)}$$

$$W = 0.787$$

The relation between the three sets of ranks is substantial.

Testing the Significance of W

According to Siegel (1956), when n is larger than 7, the expression given in formula (4.2) is approximately distributed as chi square with

$$df = n-1$$

$$\chi^2 = k(n-1)W \qquad (4.3)$$

In this study of ratings of importance of objectives by students, parents, and teachers, k = 3, n = 48, and W was found to be 0.787. One may determine the significance of this relation by applying formula (4.3).

$$\chi^2 = K(n-1)W$$

$$= 3(48-1)(.787)$$

$$= 110.967$$

Referring to a table of critical values of chi-square, one finds with

$$df = n-1 = 48-1 = 47$$

a critical value of 72.4149 at the 0.01 level of significance.

χ^2 was computed to be 110.967, which is greater than the critical value of 72.4149. Therefore one can conclude that W = 0.787 has probability of occurrence under H_0 of P<0.01. It may be concluded with considerable assurance that the agreement among the three rating groups is higher than it would be by chance. The very low probability under H_0 associated with the observed value of W enables one to reject the null hypothesis that the students', parents', and teachers' ratings of the importance of objectives are unrelated to each other.

According to Kerlinger (1964), the significance of W may be evaluated by using the following formula for the F-ratio.

$$F = \frac{(k-1)W}{1-W}$$

By substitution one finds that

$$F = \frac{(3-1).787}{1-.787} = 7.39 \qquad (4.4)$$

By referring to a table of critical values of the F-distribution, one finds that

$$_{.99}F_{48,48} = 1.99$$

F was computed to be 7.39, which is greater than the critical value of 1.99. It may be concluded, therefore, that the observed value of W is significant at the 0.01 level of significance. The null hypothesis that there is no significant agreement of the perceived importance of the objectives among parents, students, and teachers is rejected.

Descriptive Analysis of the Mean Ratings for Competencies

In measuring students', parents' and teachers' perception of the importance of objectives for grades seven and eight mathematics, two aspects were of interest. The first aspect dealt with hypothesis testing of agreement among the three groups as to the importance of the objectives. The second aspect is of interest because it is concerned with the actual meaning of competency ratings. The question arises as to what the mean ratings for competencies actually tell us about the importance of these competencies for grades seven and eight mathematics.

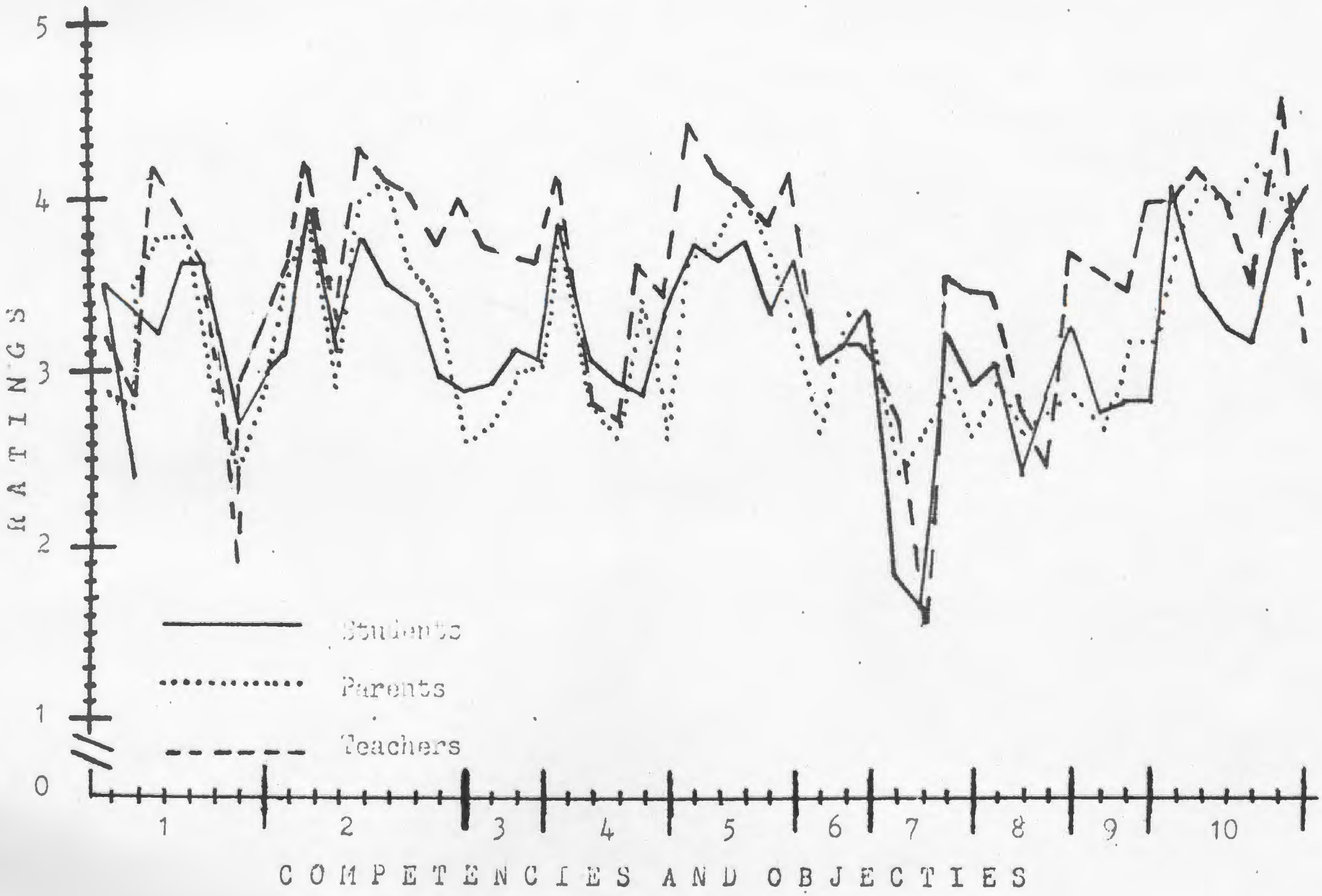
The instrument consisted of 48 objectives covering 10 mathematical competencies or skills. The objectives were randomly distributed throughout two Forms, A and B, of the instrument. The response mode for all items was of the format 1 -- not important, 2 -- marginal importance, 3 --, average importance, 4 -- important, 5 -- very important. The 10 skills and objectives covering each skill is presented in Appendix A.

A consideration of the frequency polygon (Figure II) indicates that most of the mathematical skills assessed in this study are considered of above average importance.

FIGURE II

FREQUENCY POLYGON REPRESENTING THE DISTRIBUTION OF MEAN RATINGS OF OBJECTIVES

BY STUDENTS, PARENTS, AND TEACHERS



Notable exceptions are competencies 1, 7, 8, and 9, which are rated of average or of below average importance. The polygon also reflects the significant agreement among the three rating groups. It may be observed, however, that, generally, teachers rated the objectives of greater importance than did either the students or the parents.

Teachers ratings of the forty-eight objectives were relatively high, with a mean across all objectives of 3.47 out of 5 points. Students and parents were not quite so sanguine about the objectives and produced mean ratings of 3.16 and 3.18 respectively.

The mean scores, medians and modes for each of the ten competencies are presented in Table V. The combined means and combined medians for the three rating groups are given for each competency in Table VI. The range and standard deviations for comparisons of parents, students, and teachers ratings for each competency are summarized in Table VII. A consideration of the above tables (see pages 43 to 45) will reveal that competencies 2, 5, and 10 were rated most important, competencies 1, 3, 4, 6, were rated of average importance, competency 7 was rated of marginal importance by all three rating groups, and competencies 8 and 9 were rated of marginal importance by parents and students but of average importance by teachers.

The three competencies rated most important by all three rating groups were: Number 2: "Operations and

TABLE V

MEANS, MEDIANS AND MODES FOR COMPARISONS OF PARENTS', STUDENTS', AND TEACHERS' RATINGS

Competency	Parents mean	Parents median	Parents mode	Students mean	Students median	Students mode	Teachers mean	Teachers median	Teachers mode
1. Numbers and Numerals	3.0	2.85	3.8	3.2	2.95	3.6	3.2	3.05	-
2. Operations and Properties	3.5	3.55	-	3.4	3.30	-	3.9	4.00	4.0
3. Mathematical Sentences	2.9	2.87	3.0	3.0	3.00	-	3.5	3.60	-
4. Geometry	3.0	3.20	2.6	3.2	3.00	-	3.3	3.40	-
5. Measurement	3.6	3.66	3.7	3.6	3.62	-	4.1	4.06	4.1
6. Relations and Functions	3.0	3.20	-	3.1	3.10	-	3.1	3.08	3.1
7. Probability and Statistics	2.4	2.50	-	2.4	2.35	-	2.8	3.05	-
8. Graphing	2.8	2.75	-	2.9	2.90	-	3.0	3.05	-
9. Mathematical Reasoning	2.9	3.08	3.1	2.8	2.78	2.8	3.6	3.50	-
10. Business and Consumer Mathematics	3.8	3.88	3.9	3.6	3.38	4.0	3.8	3.88	3.9 4.1

TABLE VI

COMBINED MEANS AND COMBINED MEDIANS OF PARENTS',

STUDENTS', AND TEACHERS' RATINGS

Competency	Combined Mean	Combined Median
1. Numbers and Numerals	3.1	3.0
2. Operations and Properties	3.6	3.6
3. Mathematical Sentences	3.1	3.0
4. Geometry	3.2	3.0
5. Measurement	3.8	3.7
6. Relations and Functions	3.1	3.1
7. Probability and Statistics	2.5	2.6
8. Graphing	2.9	2.8
9. Mathematical Reasoning	3.1	2.8
10. Business and Consumer Mathematics	3.7	3.8

TABLE VII

RANGE AND STANDARD DEVIATIONS FOR COMPARISONS OF PARENTS', STUDENTS', AND TEACHERS' RATINGS

Competency	Parents		Students		Teachers	
	Range	S.D.	Range	S.D.	Range	S.D.
1. Numbers and Numerals	1.5	0.46	1.2	0.47	2.3	0.75
2. Operations and Properties	1.5	0.52	1.0	0.37	1.1	0.39
3. Mathematical Sentences	0.3	0.17	0.2	0.10	0.6	0.32
4. Geometry	1.2	0.53	1.0	0.41	0.9	0.58
5. Measurement	0.8	0.29	0.4	0.16	0.6	0.21
6. Relations and Functions	0.7	0.38	0.3	0.15	0.1	0.07
7. Probability and Statistics	1.2	0.51	1.6	0.79	2.0	0.92
8. Graphing	0.3	0.14	0.8	0.34	1.2	0.56
9. Mathematical Reasoning	0.5	0.21	0.1	0.07	0.5	0.26
10. Business and Consumer Mathematics	0.7	0.25	0.9	0.39	1.0	0.41

Properties", Number 5: "Measurement", and Number 10: "Business and Consumer Mathematics". The objectives contained in these three competencies (see Appendix A) reflect the more pratical and useful mathematics to the average citizen of modern society.

Although parents, students, and teachers agree that competencies 2, 5, and 10 are most important, a consideration of Table VIII reveals that only for competency 2 do they agree significantly as to the importance of the objectives contained within the competencies: There is no significant agreement as to which objectives are more important than others in competencies 5 and 10.

However, all objectives contained within competencies 5 and 10 received uniformly high ratings by parents, students and teachers. For competency 5, parents' mean rating was 3.6 and standard deviation .29, students' mean rating was 3.6 and standard deviation .16, and teachers' mean rating was 4.1 and standard deviation .21. For all three rating groups the lowest rated objective was within -2 standard deviations of the mean. For competency 10, parents' mean rating was 3.8 and standard deviation .25, students' mean rating was 3.6 and standard deviation .39, teachers' mean rating was 3.8 and standard deviation .41. For students the lowest rated objective was within -2 standard deviations of the mean, for parents and teachers the lowest rated objective was within -1 standard deviation

TABLE VIII

COEFFICIENTS OF CONCORDANCE FOR COMPETENCIES

Competency	W	Significance of W
1. Numbers and Numerals	0.835	0.01 level
2. Operations and Properties	0.832	0.01 level
3. Mathematical Sentences	0.083	0.01 level
4. Geometry	0.639	not significant
5. Measurement	0.035	not significant
6. Relations and Functions	0.750	0.01 level
7. Probability and Statistics	1.000	0.01 level
8. Graphing	0.822	0.01 level
9. Mathematical Reasoning	0.444	0.01 level
10. Business and Consumer Mathematics	0.152	not significant

of the mean.

One may interpret the above results as indicating that parents, students, and teachers prefer practical and basic concepts in arithmetic and consider these to be most important for grades seven and eight mathematics. Though they agree that basic competencies are most important, they do not agree significantly as to which objectives contained within these competencies are more important than the others.

The three competencies rated of marginal importance were: Number 7: "Probability and Statistics," Number 8: "Graphing", Number 9: "Mathematical Reasoning". All three rating groups rated competency 7 of marginal importance. The combined mean for the three rating groups for competency 7 is 2.5. However, the nean rating, 2.8, of teachers is higher than the mean rating, 2.4, of both parents and students. Competencies 8 and 9 were rated of marginal importance by parents and students, but of average importance by teachers. For competency 8 teachers' mean rating was 3.0 as compared to 2.8 for parents and 2.9 for students. For competency 9 teachers' mean rating was 3.6 as compared to 2.9 for parents and 2.8 for students.

The higher rating by teachers may be related to the specific nature of the objectives in Competencies 7, 8, and 9. Objectives of competencies 7 and 9 dealt with aspects of mathematics with which most parents and students have had little or no experience. Objectives of these competencies presuppose a knowledge of the nature of proof and of the structure of mathematics. Thus the higher rating by teachers may reflect their greater training in mathematics.

The four competencies rated of average importance by all three rating groups were: Number 1: "Numbers and Numerals", Number 3: "Mathematical Sentences", Number 4: "Geometry", and Number 6: "Relations and Functions". The combined means for each of these competencies are 3.1, 3.1, 3.2, 3.1 respectively (see Table VI, page 44). A look at Table VIII (see page 47) also shows that the parents, students, and teachers agree upon the relative importance of the objectives within each of these competencies, except competency 4.

Comparison of Skills Considered Important by Parents, Students, and Teachers, and Skills Outlined as Important by the Newfoundland Department of Education for Grades Seven and Eight Mathematics

The *Mathematics Curriculum Bulletin* (1975-76) divides the topics to be studied in grades seven and eight mathematics into three categories. These three categories together with the skills to be learned in each category are given below:

CORE

1. Computations of Whole Numbers
2. Fractions and Decimals
3. Per Cent
4. Integers
5. Exponential Notation
6. Rational Numbers
7. Number Theory (fractoring, L.C.M, G.C.F.)
8. Geometry - Congruence and Constructions
9. Measurement - Areas and Volume

INTRODUCTORY

1. Solving Equations
2. Real Numbers
3. Similar Figures

ENRICHMENT

1. Polynomials
2. Probability and Statistics
3. Mathematical Systems
4. Areas and Volumes (circle, prism, cylinder)

The skills listed in the Core category are considered most important and form a large part of the grades seven and eight mathematics programs. They may be compared to the competencies rated most important and of average importance by the parents, students, and teachers used in this study.

The topics contained in the Introductory category are given a very cursory treatment in grades seven and eight mathematics. Mastery of these concepts occurs in later grades. Topics enumerated under Enrichment are designed for the more mathematically inclined student. Generally, they are not studied by a majority of students. Thus these two categories may be compared to the competencies rated of marginal importance by parents, students, and teachers.

The juxtaposition of competencies rated of average or above average importance by parents, students, and teachers with the skills outlined as important by the Newfoundland Department of Education, given in Table IX, aids in a comparison of these skills. It can be seen in this table that most of the core topics are covered in the competencies rated of average or above average importance. However, there are two notable exceptions. Business and Consumer Mathematics was rated most important by parents, students, and teachers. Relations and Functions was rated of average importance. Neither of these topics is being taught in grades seven or eight mathematics. They appear to be needs requiring educational amelioration.

A consideration of Table X reveals that there is very limited relationship between competencies rated of marginal importance and topics considered Introductory or Enrichment for grades seven and eight mathematics. Probability and

TABLE IX

JUXTAPOSITION OF COMPETENCIES RATED OF AVERAGE OR ABOVE AVERAGE IMPORTANCE WITH CORE TOPICS FOR GRADES SEVEN AND EIGHT MATHEMATICS

Competencies	Core Topics
1. Operations and Properties (fractions, percent)	1. Computations of Whole Numbers
2. Numbers and Numerals (Whole, rational, roman)	2. Fractions and Decimals
3. Mathematical Sentences	3. Per Cent
4. Relations and Functions	4. Integers
5. Geometry	5. Exponential Notation
6. Measurement	6. Rational Numbers
7. Business and Consumer Mathematics	7. Number Theory
	8. Geometry
	9. Measurement

TABLE X

JUXTAPOSITION OF COMPETENCIES RATED OF MARGINAL IMPORTANCE WITH INTRODUCTORY AND ENRICHMENT TOPICS

Competencies	Introductory and Enrichment Topics
1. Probability and Statistics	1. Solving Equations
2. Graphing	2. Real Numbers
3. Mathematical Reasoning	3. Similar Figures
	4. Polynomials
	5. Mathematical Systems
	6. Probability and Statistics
	7. Areas and Volumes

Statistics was rated of marginal importance by parents, students, and teachers. The Newfoundland Department of Education considers this topic enrichment for grades seven and eight mathematics. Possibly it should be introduced at this level and continued into higher grades.

Recapitulation

To test the null hypothesis that there is no significant agreement of the perceived importance of the objectives, as revealed on an appropriate instrument, among parents, students, and teachers, the ratings of the 48 objectives were analyzed using Kendall's Coefficient of Concordance, W. An average rating was found for each of the 48 objectives for each of the three rating groups. Based upon the average ratings, three sets of ranked objectives were obtained - one for parents, one for students, and one for teachers. W, which expresses the average agreement on a scale from 0.00 to 1.00 among the three rankings, was computed to be 0.787. Using both the χ^2 test and the F-test, it was found that this value of W is significant at the 0.01 level of significance. The null hypothesis was therefore rejected.

Three measures of central tendency - mean, median, and mode, two measures of variability - range and standard deviation, as well as the Coefficient of Concordance, W, were computed for each of the ten mathematical skill or competencies being investigated to determine which skills were considered most important, which of average importance, and which least important. Three competencies were rated most important by all three rating groups. Number 2, "Operations and Properties", Number 5, "Measurement", and Number 10, "Business and Consumer Mathematics". Four skills were rated of average importance by all three rating groups. Number 1, "Numbers and Numerals", Number 3, "Mathematical Sentences", Number 4, "Geometry", and Number 6, "Relations and Functions". Parents, students, and teachers rated Competency 7, "Probability and Statistics", of marginal importance. Competency 8, "Graphing", and Competency 9, "Mathematical Reasoning" were rated of marginal importance by parents and students but of average importance by teachers.

Comparison of competencies rated of average or of above average importance by parents, students, and teachers with skills considered important for grades seven and eight mathematics by the Newfoundland Department of Education revealed substantial agreement. There were two notable exceptions. Business and Consumer Mathematics was rated most important by parents, students, and teachers. Relations and Functions was rated of average importance. Neither of these skills was prescribed by the Newfoundland Department of Education for grades seven and eight mathematics. They appeared to be needs requiring educational amelioration.

CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Summary

This study attempted to test the feasibility of the approach of involving parents, students, and teachers in responding to a set of objectives which define what might be considered minimal mathematical competencies expected of an enlightened citizen in contemporary society. Samples of parents, students, and teachers rated the perceived importance of these objectives on a Likert-type scale. Results were used to identify objectives which these three groups perceive as important and feel should be a major proportion of the objectives of the grades seven and eight mathematics program. These objectives were compared to the present objectives of grades seven and eight mathematics. Any discrepancy between the objectives identified as important by the parents, students, and teachers and the present program objectives was considered a need requiring educational amelioration.

The instrument used was a questionaire consisting of forty-eight objectives drawn up by a committee appointed by the National Council of Teachers of Mathematics. These objectives defined ten mathematical skills or competencies considered minimal for an enlightened citizen -- Numbers and Numerals, Operations and Properties, Mathematical Sentences, Geometry, Measurement, Relations and Functions, Probability and Statistics, Graphing, Mathematical Reasoning, Business and Consumer Mathematics. By utilizing a table of random digits the objectives were placed in random order to make two versions of the questionaire, FORM A and FORM B.

Samples in the study consisted of 110 grades seven and eight mathematics students, 30 parents, and 10 mathematics teachers. The sample of students consisted of all of the students enrolled in mathematics in grades seven and eight at Ralph Laite Pentecostal Collegiate, Lewisporte, Newfoundland. The sample of parents was randomly selected from the total number of parents of the students used. The sample of teachers consisted of the two mathematics teachers teaching grades seven and eight mathematics at Ralph Laite Pentecostal Collegiate and one mathematics teacher from each of the eight feeder schools. Students were administered either FORM A or FORM B of the instrument. Parents and teachers were randomly given either FORM A or FORM B. The response mode was 1 -- not important, 2 -- marginal importance, 3 -- average importance, 4 -- important, 5 -- very important.

Data from the study were analyzed using Kendall's Coefficient of Concordance, W. The χ^2 test and the F-test at the 0.01 level of significance were used as a basis for rejection of the null hypothesis. The hypothesis tested was: There is no significant agreement of the perceived importance of the objectives, as revealed on an appropriate instrument, among parents, students, and teachers.

In addition to statistical testing of the hypothesis, the researcher endeavoured to identify any educational needs which may exist in grades seven and eight mathematics. This required answering three questions.

1. Which of the skills or competencies being investigated are perceived as being most important, which as being of average importance, and which of least importance by the parents, students, and teachers?

2. What skills or competencies are considered important for grades seven and eight mathematics by the Newfoundland Department of Education and outlined in the <u>Mathematics Curriculum Bulletin</u>, 1975-76?

3. What discrepancies are observed between the skills perceived as important by the parents, students, and teachers and the skills outlined as important by the Department of Education?

In answering the above questions a descriptive analysis of the mean rating of each of the ten competencies was presented. The mean scores and the Coefficient of Concordance W for each of the ten skills was discussed. Comparisons among parents', students', and teachers' responses were made by analyzing means, modes, medians, ranges, and standard deviations.

Conclusions and Discussion

The conclusions and discussion presented in this section are based on the data analysis and results from Chapter IV. The analysis of Chapter IV involved hypothesis testing in obtaining a measure of the agreement among the parents, students, and teachers as to the perceived importance of the objectives.

It should be re-emphasized that this study sought to identify mathematical needs in one local area of Newfoundland. The researcher was not interested in generalizing his findings to the total population of grades seven and eight mathematics students in the Province. Indeed, the sample was biased with respect to the total population, and, therefore, generalization would be both inappropriate and possibly erroneous. Consequently, the conclusions presented in this section are mainly significant for the Ralph Laite Pentecostal Collegiate school system.

Kendall's Coefficient of Concordance, W, revealed a significant agreement among parents, students, and teachers as to the perceived importance of the objectives. The high value of W, 0.787, may be interpreted as meaning that the three groups applied essentially the same standard in ranking the forty-eight objectives, and consequently the ten skills or competencies, under study. It should be emphasized, however, that a high value of W does not mean that the orderings observed were necessarily correct, with respect to some external criterion. However, the high value of W did provide a significant consensual ordering of the objectives. The particular ordering obtained established an importance - priority of objectives which reflect the needs of the local clientele.

The meaning of the ratings obtained may be related to the specific nature of the competency considered. Objectives most favorably rated by parents, students, and teachers dealt with Arithmetic Operations, Measurement, and Business and Consumer mathematics. One interpretation of these results is that the three rating groups prefer the more practical and basic concepts in arithmetic.

Teachers rated Graphing and Mathematical Reasoning of average importance whereas parents and students rated these skills of marginal importance. One may interpret this discrepancy in ratings to be a reflection of the unfamiliarity by parents and students with the content involved. However, a less optimistic suggestion is that the teachers might have preferred what they felt was easiest to teach.

The procedures used for the determination of curriculum goals historically have been based on the judgments of teachers, curriculum workers and "blue ribbon panels". The collection of data regarding student reactions to school goals has been scarce and often confounded with instructional techniques where the learner takes great initiative and responsibility for his learning. Parental responses have been sought but usually in relationship to goals stated in relatively broad language. This study departed from tradition in asking teachers, parents, and students to respond to objectives stated at what might be described as the instructional level, in that they call for behavioral demonstrations of competence with regard to specified sets of stimuli. It may be concluded that this procedure of active involvement of local clientele at the instructional level is helpful in the identification of target program goals. For example, the descriptive analysis presented in Chapter IV identified two target program goals. Business and Consumer Mathematics was considered most important, Relations and Functions of average importance by parents, students and teachers. Neither of these topics was considered important for grades seven and eight mathematics by the Newfoundland Department of Education and neither is being taught in the present grades seven and eight mathematics courses. One may conclude that the high rating of Business and Consumer Mathematics and the average rating of Relations and Functions by parents, students, and teachers reflected two needs not being met.

The descriptive analysis presented revealed a very close agreement between competencies rated of average or above average importance by parents, students, and teachers and competencies considered "core" topics, and thus most important for grades seven and eight mathematics, by the Newfoundland Department of Education. There was also close agreement between competencies rated of marginal importance by parents, students, and teachers and competencies considered "introductory" or "enrichment", and thus of marginal importance for grades seven and eight mathematics, by the Newfoundland Department of Education (see Tables IX and X, pages 52 - 53). This leads to the conclusion that the relative emphasis or importance given to topics in grades seven and eight mathematics very favorably reflected the relative perceived importance of these topics by the local clientele. One may conclude that, with the exception of the two needs identified above, the present grades seven and eight mathematics courses are fairly adequately meeting the mathematical needs of students.

Implications

For Curriculum

A general conclusion of this study was that the relative emphasis or importance presently given to topics in grades seven and eight mathematics reflected the relative importance of these topics as perceived by parents, students, and teachers. This implies that no major revision of the grades seven and eight mathematics program is necessary. However, there are two exceptions to this generalization. First, Business and Consumer mathematics was rated very important by parents, students, and teachers. The Ralph Laite Pentecostal Collegiate school system should consider modifying the grades seven and eight mathematics program to include more consumer-type mathematics. This may be done by providing students with experiences in the application of mathematics on a broader basis to include problems in business and consumer mathematics. For example, when the chapter on per cent is being taught, students could apply this concept to the determination of the amount of tax one would have to pay on an article if the per cent of tax is ten per cent. Students could calculate the amount of interest one would have to pay on a loan if the per cent of interest is twelve per cent. A field trip to a local bank would be an appropriate experience.

Secondly, Relations and Functions was rated of average importance by parents, students, and teachers. The school system should consider introducing this topic in grades seven and eight. Because functions is a unifying concept in mathematics, the school system could consider a functional approach to teaching grades seven and eight mathematics. An in-depth study of functions per se, however, would be inappropriate since grades seven and eight students do not possess the mathematical facility to do so. Also, an in-depth study of functions is provided in the mathematics program of higher grades.

One intent of this study was to test the feasibility of the approach of involving parents, students, and teachers in responding to objectives of common and discrepant interest. The researcher was encouraged, not only by the willingness of the parents, students, and teachers to participate, but more generally with the potential utility of the procedure. The procedure of consulting those clientele concerned with the education of the learners involved can lead to the modification of the present program to better meet local needs. Input in determining priorities among educational objectives by students, parents, and teachers can result in a more defensible set of preferences.

For Research

Some possible implications for further research are:

1. The present study was concerned with the identification of needs in one subject area only, mathematics, and at two grade levels only, seven and eight. Similar studies could be conducted in other subject areas and at other grade levels.

2. The present study investigated only one aspect of mathematics, the NCTM Category I -- Mathematics as a tool for effective citizenship and personal living. Further research should investigate Category II -- Mathematics as a tool for the functioning of the technological world and Category III -- Mathematics as a system in its own right.

BIBLIOGRAPHY

BIBLIOGRAPHY

Atkin, J.M. "Some Evaluation Problems in a Course Content Improvement Project," Journal of Research in Science Teaching, 1: 129-132, 1963.

Atkin, J.M. "Behavioral Objectives in Curriculum Design: A Cautionary Note," Science Teacher, 35: 27-30, 1968.

Baker, Bela O., Curtis D. Hardyck and Lewis F. Petinovich. "Weak Measurements vs. Strong Statistics: An Empirical Critique of S.S. Stevens Proscriptions on Statistics," Educational and Psychological Measurement, 26(2): 291-309, 1966.

Baker, E.L. "The Differential Effects of Behavioral and Nonbehavioral Objectives Given to Teachers on the Achievement of their Students," unpublished Ed. D. dissertation, University of California, 1967.

Baker, E.L. "Parents, Teachers, and Students as Data Sources for the Selection of Instructional Goals," American Educational Research Journal, 9: 403-411, 1972.

Baker, E.L. and W.J. Popham. Expanding Dimensions of Instructional Objectives. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1973.

Bloom, B.S. Taxonomy of Educational Objectives: Handbook I. New York: David McKay Co., 1956.

Bloom, B.S. Quality Control in Education - Tomorrow's Teaching. Oklahoma City: Frontiers of Science Foundation, 1961.

Bucks County Public Schools. General Needs Assessment: Quality Education Program Study, Booklet B. Doylestown, Pennsylvania: Pennsylvania State Dept. of Ed., Jan., 1971, ERIC Microfilm, 1971, No. ED063357.

Carter, Heather L. "A Study to Determine the Value of Providing the Learner with Regularly scheduled Assessment Items to Assess Behavioral Acquisition," A paper presented at the Annual Meeting of American Educational Research Assoc., New York, 1971. Austin, Texas: Research & Dev. Center for Teacher Education, University of Texas, 1971.

Cronbach, L.J. "Course Improvement Through Evaluation," Teacher College Record, 64: 672-683, 1963.

Dressel, P.R. and L.B. Mayhew. General Educational Expoloration in Evaluation. Washington, D.C.: American Council of Ed., 1954.

Edwards, E.L., E.D. Nichols and G.H. Sharpe. "Mathematical Competencies and Skills Essential for Enlightened Citizens," The Mathematics Teacher, 65: 671-677, 1972.

Eisner, E.W. "Educational Objectives: Help or Hindrance," School Review, 75: 250-260, 1966.

Fraser, D.M. "Deciding What To Teach," Project on the Instructional Program of Public Schools. Washington, D.C.: National Education Assoc., 1963.

Glass, Gene V. and Julian C. Stanley. Statistical Methods in Education and Psychology. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970.

Kerlinger, Fred N. Foundations of Behavioral Research. New York: Holt, Rinehart and Winston, Inc., 1964.

Krathwohl, R. "Stating Objectives Appropriate for Program, for Curriculum, & for Instructional Materials," Journal of Teacher Education, 16: 83-92, 1965.

Mager, R.F. Preparing Objectives for Programmed Instruction. San Francisco: Fearson Publishers, 1962.

Maguire, T.O. "Decisions and Curriculum Objectives," Alberta Journal of Educational Research, 15: 17-30, 1969.

Malkin, Harold. "Needs-Assessment in Social Studies," Unpublished Manuscript cited by E.L. Baker, American Educational Research Journal, 9: 405-411, 1972.

Nicholas, E.D. "Are Behavioral Objectives the Answer?," The Arithmetic Teacher, 19: 474-476, 1972.

Popham, W.J. and E.L. Baker. Establishing Instructional Goals. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1970.

Siegel, S. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw Hill, 1956.

Smith, E.R., R.W. Tyler and the Eval. Staff. Appraising and Recording Student Progress. New York: Harper & Bros., 1962.

Stevens, S.S. "Mathematics, Measurement and Psychophysics," In S.S. Stephens (Ed.), Handbook of Experimental Psychology. New York: John Wiley & Sons, 1951.

Taba, H. Curriculum Development: Theory & Practice. New York: Harcourt, Brace & World, 1962.

Taylor, P.A. and T.O. Maguire. "A Theoretical Evaluation Model," Manitoba Journal of Educational Research, 1: 12-17, 1966.

Walbesser, H.H. Constructing Behavioral Objectives. College Park, Md.: Maryland Book Exchange, 1970.

Walbesser, H.H. "Behavioral Objectives, a Cause Celebre," The Arithmetic Teacher, 19: 436-440, 1972.

Walbesser, H.H., E.B. Kurtz, L.D. Goss and R.M. Robl. Constructing Instruction Based on Behavioral Objectives. Stillwater, Okla.: Dept. of Aerospace and Mechanical Engineering, Oklahoma State University, 1970.

Wiles, Kimball. "Seeking Balance in The Curriculum," Readings in Curriculum. Boston: Allyn and Boston, Inc., 1965.

APPENDICES

APPENDIX A

NCTM CATEGORY I OBJECTIVES

1. Numbers and numerals

   (a) Express a rational number using decimal notation
   (b) List the first ten multiples of 2 through 12
   (c) Use the whole numbers in problem solving
   (d) Recognize the digit, its place value, and the number represented through billions
   (e) Describe a given positive rational number using decimal, percent, or fractional notation
   (f) Convert to roman numerals from decimal numerals and conversely (e.g., date translation)
   (g) Represent very large and very small numbers using scientific notation

2. Operations and properties

   (a) Write equivalent fractions for given fractions, such as 1/2, 2/3, and 3/5
   (b) Add, subtract, multiply, and divide positive rational numbers
   (c) Recognize and use properties of operations (grouping, order, etc.) and properties of certain numbers with respect to operations ($a \cdot 1 = a$; $a + 0 = a$; etc.)
   (d) Solve addition, subtraction, multiplication, and division problems involving fractions
   (e) Solve problems involving percent
   (f) Perform arithmetic operations with measures
   (g) Estimate results
   (h) Judge the reasonableness of answers to computational problems

3. Mathematical sentences

   (a) Construct a mathematical sentence from a given verbal problem
   (b) Solve simple linear equations such as $a + 3 = 12$; $16 - n = 4$; $n/3 = 7$; and $4a - 2 = 18$
   (c) Translate mathematical sentences into verbal problems

4. Geometry

   (a) Recognize horizontal lines, vertical lines, parallel lines, perpendicular lines, and intersecting lines
   (b) Classify simple plane figures by recognizing their properties

(c) Compute perimeters of polygons
(d) Compute the areas of rectangles, triangles, and circles
(e) Be familiar with the concepts of similarity and congruence of triangles.

5. Measurement

(a) Apply measures of length, area, volume (dry or liquid), weight, time, money, and temperature
(b) Use units of length, area, mass, and volume in making measurements
(c) Use standard measuring devices to measure length, area, volume, time, and temperature
(d) Round off measurements to the nearest given unit of the measuring device (ruler, protractor, thermometer, etc.) used
(e) Read maps and estimate distances between locations

6. Relations and functions

(a) Interpret information from a graphical representation of a function
(b) Apply the concepts of ratio and proportion to construct scale drawings and to determine percent and other relations
(c) Write simple sentences showing the relations =, <, >, and ≠ for two given numbers

7. Probability and statistics

(a) Determine mean, median, and mode for given numerical data
(b) Analyze and solve simple probability problems such as tossing coins or drawing one red marble from a set containing one red and four white marbles
(c) Estimate answers to computational problems
(d) Recognize the techniques used in making predictions and estimates from samples

8. Graphing

(a) Determine measures of real objects from scale drawings
(b) Construct scale drawings of simple objects
(c) Construct graphs indicating relationships of two variables from given sets of data
(d) Interpret information from graphs and tables

9. Mathematical reasoning

(a) Produce counterexamples to test the validity of statements
(b) Detect and describe flaws and fallacies in advertising and propaganda where statistical data and inferences are employed
(c) Gather and present data to support an inference or argument

10. Business and consumer mathematics

(a) Maintain personal bank records
(b) Plan a budget including record keeping of personal expenses
(c) Apply simple interest formulas to installment buying
(d) Estimate the real cost of an article
(e) Compute taxes and investment returns
(f) Use the necessary mathematical skills to appraise insurance and retirement benefits

APPENDIX B

MATHEMATICS QUESTIONAIRE

FORM A

The following objectives or aims are proposed for grades VII and VIII mathematics.

Please rate each objective by circling the number which in your opinion most accurately describes its importance as a tool for effective citizenship and personal living.

The following is an explanation of abbreviations used in this questionaire.

STATEMENT	ABBREVIATION
Not important	NI
Marginal importance	MI
Average importance	AI
Important	I
Very important	VI

		NI	MI	AI	I	VI
Objective 1.	Compute the areas of rectangles, triangles, and circles	1	2	3	4	5
Objective 2.	Apply the concepts of ratio and proportion to construct scale drawings and to determine percent and other relations	1	2	3	4	5
Objective 3.	Gather and present data to support an inference or argument	1	2	3	4	5
Objective 4.	Estimate results	1	2	3	4	5

		NI	MI	AI	I	VI
Objective 5.	Use the whole numbers in problem solving	1	2	3	4	5
Objective 6.	List the first ten multiples of 2 through 12	1	2	3	4	5
Objective 7.	Translate mathematical sentences into verbal problems	1	2	3	4	5
Objective 8.	Read maps and estimate distances between locations	1	2	3	4	5
Objective 9.	Apply measures of length, area, volume (dry or liquid), weight, time, money, and temperature	1	2	3	4	5
Objective 10.	Judge the reasonableness of answers to computational problems	1	2	3	4	5
Objective 11.	Analyze and solve simple probability problems such as tossing coins or drawing one red marble from a set containing one red and four white marbles	1	2	3	4	5
Objective 12.	Write equivalent fractions for given fractions, such as 1/2, 2/3, and 3/5	1	2	3	4	5
Objective 13.	Recognize horizontal lines, vertical lines, parallel lines, perpendicular lines, and intersecting lines	1	2	3	4	5
Objective 14.	Interpret information from a graphical representation of a function	1	2	3	4	5

		NI	MI	AI	I	VI
Objective 15.	Perform arithmetic operations with measures	1	2	3	4	5
Objective 16.	Compute taxes and investment returns	1	2	3	4	5
Objective 17.	Express a rational number using decimal notation	1	2	3	4	5
Objective 18.	Classify simple plane figures by recognizing their properties	1	2	3	4	5
Objective 19.	Add, subtract, multiply, and divide positive rational numbers	1	2	3	4	5
Objective 20.	Convert to roman numerals from decimal numerals and conversely (e.g., date translation)	1	2	3	4	5
Objective 21.	Describe a given positive rational number using decimal, percent, or fractional notation	1	2	3	4	5
Objective 22.	Determine measures of real objects from scale drawings	1	2	3	4	5
Objective 23.	Determine mean, median, and mode for given numerical data	1	2	3	4	5
Objective 24.	Use the necessary mathematical skills to appraise insurance and retirement benefits	1	2	3	4	5
Objective 25.	Maintain personal bank records	1	2	3	4	5
Objective 26.	Construct scale drawings of simple objects	1	2	3	4	5

		NI	MI	AI	I	VI
Objective 27.	Construct a mathematical sentence from a given verbal problem	1	2	3	4	5
Objective 28.	Construct graphs indicating relationships of two variables from given sets of data	1	2	3	4	5
Objective 29.	Represent very large and very small numbers using scientific notation	1	2	3	4	5
Objective 30.	Solve problems involving percent	1	2	3	4	5
Objective 31.	Use units of length, area, mass, and volume in making measurements	1	2	3	4	5
Objective 32.	Estimate the real cost of an article	1	2	3	4	5
Objective 33.	Produce counter-examples to test the validity of statements	1	2	3	4	5
Objective 34.	Recognize the techniques used in making predictions and estimates from samples	1	2	3	4	5
Objective 35.	Recognize the digit, its place value, and the number represented through billions	1	2	3	4	5
Objective 36.	Detect and describe flaws and fallacies in advertising and propaganda where statistical data and inferences are employed	1	2	3	4	5

		NI	MI	AI	I	VI
Objective 37.	Solve addition, subtraction, multiplication, and division problems involving fractions	1	2	3	4	5
Objective 38.	Estimate answers to computational problems	1	2	3	4	5
Objective 39.	Be familiar with the concepts of similarity and congruence of triangles	1	2	3	4	5
Objective 40.	Interpret information from graphs and tables	1	2	3	4	5
Objective 41.	Compute perimeters of polygons	1	2	3	4	5
Objective 42.	Round off measurements to the nearest given unit of the measuring device (ruler, protractor, thermometer, etc.) used	1	2	3	4	5
Objective 43.	Recognize and use properties of operations (grouping, order, etc.) and properties of certain numbers with respect to operations (a x 1 = a; a + 0 = a; etc.)	1	2	3	4	5
Objective 44.	Write simple sentences showing the relations =, <, >, and ≠ for two given numbers	1	2	3	4	5
Objective 45.	Apply simple interest formulas to installment buying	1	2	3	4	5
Objective 46.	Solve simple linear equations such as a + 3 = 12; 16 - n = 4; n/3 = 7; and 4a - 2 = 18	1	2	3	4	5

		NI	MI	AI	I	VI
Objective 47.	Use standard measuring devices to measure length, area, volume, time, and temperature	1	2	3	4	5
Objective 48.	Plan a budget including record keeping of personal expenses	1	2	3	4	5

MATHEMATICS QUESTIONAIRE

FORM B

The following objectives or aims are proposed for grades VII and VIII mathematics.

Please rate each objective by circling the number which in your opinion most accurately describes its importance as a tool for effective citizenship and personal living.

The following is an explanation of abbreviations used in this questionaire.

STATEMENT	ABBREVIATION
Not important	NI
Marginal importance	MI
Average importance	AI
Important	I
Very important	VI

		NI	MI	AI	I	VI
Objective 1.	Solve problems involving percent	1	2	3	4	5
Objective 2.	Compute taxes and investment returns	1	2	3	4	5
Objective 3.	Apply simple interest formulas to installment buying	1	2	3	4	5
Objective 4.	Produce counterexamples to test the validity of statements	1	2	3	4	5
Objective 5.	Interpret information from graphs and tables	1	2	3	4	5

		NI	MI	AI	I	VI
Objective 6.	Recognize the techniques used in making predictions and estimates from samples	1	2	3	4	5
Objective 7.	Use the necessary mathematical skills to appraise insurance and retirement benefits	1	2	3	4	5
Objective 8.	Plan a budget including record keeping of personal expenses	1	2	3	4	5
Objective 9.	Apply measures of length, area, volume (dry or liquid), weight, time, money, and temperature	1	2	3	4	5
Objective 10.	Judge the reasonableness of answers to computational problems	1	2	3	4	5
Objective 11.	Construct scale drawings of simple objects	1	2	3	4	5
Objective 12.	Determine measures of real objects from scale drawings	1	2	3	4	5
Objective 13.	Read maps and estimate distances between locations	1	2	3	4	5
Objective 14.	Solve simple linear equations such as $a + 3 = 12$; $16 - n = 4$; $n/3 = 7$; and $4a - 2 = 18$	1	2	3	4	5
Objective 15.	Perform arithmetic operations with measures	1	2	3	4	5
Objective 16.	Use standard measuring devices to measure length, area, volume, time, and temperature	1	2	3	4	5

		NI	MI	AI	I	VI
Objective 17.	Detect and describe flaws and fallacies in advertising and propaganda where statistical data and inferences are employed	1	2	3	4	5
Objective 18.	Analyze and solve simple probability problems such as tossing coins or drawing one red marble from a set containing one red and four white marbles	1	2	3	4	5
Objective 19.	Be familiar with the concepts of similarity and congruence of triangles	1	2	3	4	5
Objective 20.	Describe a given positive rational number using decimal, percent, or fractional notation	1	2	3	4	5
Objective 21.	Compute perimeters of polygons	1	2	3	4	5
Objective 22.	Express a rational number using decimal notation	1	2	3	4	5
Objective 23.	Construct graphs indicating relationships of two variables from given sets of data	1	2	3	4	5
Objective 24.	Construct a mathematical sentence from a given verbal problem	1	2	3	4	5
Objective 25.	List the first ten multiples of 2 through 12	1	2	3	4	5

		NI	MI	AI	I	VI
Objective 26.	Recognize and use properties of operations (grouping, order, etc.) and properties of certain numbers with respect to operations (a x 1 = a; a + 0 = a; etc.)	1	2	3	4	5
Objective 27.	Use units of length, area, mass, and volume in making measurements	1	2	3	4	5
Objective 28.	Represent very large and very small numbers using scientific notation	1	2	3	4	5
Objective 29.	Estimate answers to computational problems	1	2	3	4	5
Objective 30.	Determine mean, median, and mode for given numerical data	1	2	3	4	5
Objective 31.	Convert to roman numerals from decimal numerals and conversely (e.g., date translation)	1	2	3	4	5
Objective 32.	Estimate results	1	2	3	4	5
Objective 33.	Estimate the real cost of an article	1	2	3	4	5
Objective 34.	Compute the areas of rectangles, triangles, and circles	1	2	3	4	5
Objective 35.	Recognize the digit, its place value, and the number represented through billions	1	2	3	4	5
Objective 36.	Recognize horizontal lines, vertical lines, parallel lines, perpandicular lines, and intersecting lines	1	2	3	4	5

		NI	MI	AI	I	VI
Objective 37.	Solve addition, subtraction, multiplication, and division problems involving fractions	1	2	3	4	5
Objective 38.	Translate mathematical sentences into verbal problems	1	2	3	4	5
Objective 39.	Gather and present data to support an inference or argument	1	2	3	4	5
Objective 40.	Apply the concepts of ratio and proportion to construct scale drawings and to determine percent and other relations	1	2	3	4	5
Objective 41.	Classify simple plane figures by recognizing their properties	1	2	3	4	5
Objective 42.	Write equivalent fractions for given fractions, such as 1/2, 2/3, and 3/5	1	2	3	4	5
Objective 43.	Add, subtract, multiply, and divide positive rational numbers	1	2	3	4	5
Objective 44.	Use the whole numbers in problem solving	1	2	3	4	5
Objective 45.	Round off measurements to the nearest given unit of the measuring device (ruler, protractor, thermometer, etc.) used	1	2	3	4	5
Objective 46.	Interpret information from a graphical representation of a function	1	2	3	4	5

		NI	MI	AI	I	VI
<u>Objective 47</u>.	Write simple sentences showing the relations $=$, $<$, $>$, and $\neq$ for two given numbers	1	2	3	4	5
<u>Objective 48</u>.	Maintain personal bank records	1	2	3	4	5

APPENDIX C

Ralph Laite Pentecostal Collegiate

P.O. Box 640 Lewisporte Newfoundland Telephone 535-2402

April 8, 1975

Dear Parent:

In a combined effort with the Graduate Department of Curriculum and Instruction of Memorial University of Newfoundland we are undertaking a study of our Grades Seven and Eight Mathematics Program. This study will also help Mr. Wilkins fulfil the requirements for obtaining a M.Ed. degree in Mathematics Education.

We have developed a questionnaire containing a list of objectives or aims which describe mathematics as a tool for effective citizenship and personal living in a modern society. We are attempting to obtain an indication of the importance of these objectives as perceived by (i) the students themselves, (ii) their parents, and (iii) mathematics teachers.

Results of this investigation will help us identify the objectives which the above three groups consider important and feel should be aims of our grades seven and eight Mathematics Program. Any discrepancy or difference between the objectives identified as important by the students, parents and teachers and the present program objectives may lead to a modification or change of emphasis in our program.

We realize that you, the parents, know the necessity of a knowledge of Mathematics in our complex society. We are aware that you desire the best possible mathematics program for your children. We feel, therefore, that it is very important that you become involved in this study.

May we solicit your cooperation in completing the attached questionnaire and returning same as quickly as possible in the enclosed, self-addressed, postage paid envelope. If you have difficulty completing the questionnaire and would like clarification of some objectives, feel

2

free to call Mr. Wilkins collect at 535-2424.

Permit us to emphasize the importance of your help in developing a sound mathematics program for your children.

Thank you for your continued cooperation.

Sincerely yours,

Domino Wilkins
Mathematics Department Head

DW/js
Enc.

Ralph Laite Pentecostal Collegiate

P.O. Box 640 Lewisporte Newfoundland Telephone 535-2462

May 6, 1975

Dear Parent:

We wish to inform you that our study of the Grades Seven and Eight mathematics program is progressing favorably. The mathematics questionaires have been completed by the Grades Seven and Eight students and we have received very favorably response from the teachers and parents. May we thank you for taking the time to complete the questionaire and returning it to us.

If you have not yet completed the questionaire, please do so and return same by May 12, 1975. If you would like clarification of some objectives, feel free to contact Mr. Wilkins by calling him collect at 535-2424.

Permit us to emphasis the importance of your help in developing a sound mathematics program for your children.

Thank you for your continued cooperation.

Sincerely yours,

Domino Wilkins
Mathematics Department Head

Ralph Laite Pentecostal Collegiate

P.O. Box 640 Lewisporte Newfoundland Telephone 535-2162

April 8, 1975

Dear Fellow Teacher:

In a combined effort with the Graduate Department of Curriculum and Instruction of Memorial University of Newfoundland we are presently undertaking a study of our Grades Seven and Eight Mathematics Program. This study will also help Mr. Wilkins fulfil the requirements for obtaining a M.Ed. degree in Mathematics Education.

We have developed a questionaire containing a list of objectives or aims which describe Mathematics as a tool for effective citizenship and personal living in a modern society. We are attempting to obtain an indication of the importance of these objectives as perceived by (i) the students themselves, (ii) their parents, and (iii) Mathematics teachers.

Results of this investigation will help us identify the objectives which the above three groups consider important and feel should be aims of our Mathematics Program. These objectives will be compared to the present objectives of our grades seven and eight Mathematics program. Any discrepancy or difference between the objectives identified as important by the students, parents, and teachers and the present program objectives may lead to a modification or change of emphasis in our program.

We realize that you, the teacher, know the necessity of a knowledge of mathematics in our complex society. We are aware that you desire the best possible mathematics program for your students. We feel, therefore, that it is very important that you become involved in this study.

May we solicit your cooperation in completing the attached questionaire and returning same as quickly as possible.

Permit us to emphasize the importance of your help in developing a sound mathematics program for your students.

Thank you for your continued cooperation.

Sincerely yours,

Domino Wilkins
Mathematics Department Head

DW/js
Enc.