A STUDY OF TEACHERS' EMPHASIS OF THE OBJECTIVES OF THE GRADE SIX MATHEMATICS PROGRAM.

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A Study of Teachers' Emphasis of the Objectives of the Grade Six Mathematics Program

by

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ABSTRACT

The primary purpose of the study was to determine which mathematics objectives teachers emphasized at the grade six level in Newfoundland and Labrador elementary schools and to analyse the results in terms of basic skill areas defined by leading professional mathematics groups. A secondary purpose was to determine on which of the emphasized objectives teachers spent the most amount of instructional time and which areas of the curriculum were emphasized most. Also examined were the primary methods used by teachers to plan their mathematics program, the difference in emphasis between high and low cognitive level objectives, and the effect years of teaching experience had on the nature of objectives emphasized.

Twenty school districts in Newfoundland and Labrador were selected at random and from these districts 120 grade six teachers were selected at random. The teachers were sent a questionnaire to collect data on the experience of the teacher and the primary method they used to plan their classroom program. The teachers were also requested to complete a 78 card sort in order to obtain data on the objectives that were emphasized during the 1981-82 school year. Each of the 78 cards contained a test item which represented an objective included in a grade six mathematics program. Complete sets of data were returned by 56 teachers.

The four objectives most emphasized by grade six teachers in the sample dealt with skills used in computing with fractions. Other objectives involving fractions also were ranked highly by the teachers in the study. Computational types of objectives generally received high rankings, with division of whole numbers being ranked fifth. When the data were analyzed in terms of instructional time spent it was found that the most amount of instructional time was spent on operations with fractions, specifically subtraction, multiplication and division. Division of whole numbers was ranked fifth.

With respect to high and low cognitive level items, a significantly higher degree of emphasis was given to low cognitive level items than high cognitive level items.

The data collected on method of program planning were insufficient to allow analysis. However, from the respondents only six indicated they used the Newfoundland K-6 Mathematics Bulletin as their primary means to plan their program.

With respect to the content area being emphasized, number concepts, operations, and problem solving were rated much higher, and therefore received higher ranks than the geometry and measurement content areas. There was no significant difference in the rankings between teachers with different amounts of teaching experience.

Some suggestions for further study were given at the conclusion of the report. These related to determining if there were sufficient instructional time allocated to mathematics, the effects a decrease in emphasis on computation would have on overall mathematics programming, and a question related to the need to emphasize fractions as much as indicated by the report.

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CHAPTER 1

INTRODUCTION TO THE STUDY

Purpose

Mathematics curricula at the elementary level have, in the last two decades, undergone substantial reform. The initial reform was, to a large extent, a response to Sputnik and the desire of the United States to succeed in the space race. Suydam and Osborne (1977) stated that:

> The flight of the Sputnik in 1957 resulted in an acceleration of federal funding that allowed the foundation to begin the process of curricular reform on a larger scale. (p. 15)

The reform included the addition of new content areas at the elementary school level accompanied by teaching approaches directed towards students' comprehension of the mathematics being taught. Additions and major changes to the mathematics program included topics in metric and non-metric geometry, graphing, elementary statistics, different base systems, set notation, and problem solving. The objective of these changes was that students would become more mathematically competent by completing a comprehensive mathematics programme. It was also thought that students would comprehend more mathematics, enabling them to become more adept at problem solving. (NACOME, 1975) The early changes in content of the mathematics program were all linked to the eventual goal of curriculum modification, that being the push to produce graduates highly trained in mathematics and the sciences. This was evidenced by the major funding allocated toward the substantial revision of mathematics programs in the United States during the post Sputnik years (Suydam and Osborne, 1977). These changes were planned at the national level through large scale curriculum projects in the United States and eventually implemented at the state level. However, the inclusion of different mathematical content and the new approaches may not have been implemented to the extent that many mathematics educators thought. The National Advisory Committee on Mathematics Education (NACOME, 1975) studied the issue of mathematics curricular reform implementation. They raised doubts about the extent to which the so-called "new" mathematics was actually implemented. They made particular reference to the problems that existed at the elementary level. Their conclusion suggested that teachers at the elementary level continued to emphasize what they knew best and felt they could best teach, specifically computational skills with whole numbers, fractions and decimals.

On the Canadian scene, it appears from the research that has been conducted that the effect of the reforms occurring in the United States also were felt in this country. Robitaille and Sherrill (1980) replicated a study performed in the United States by Price, Kelley and Kelley (1977), obtaining information about teachers of mathematics and the teaching of mathematics. The study, conducted with 2144 elementary teachers in British Columbia, supported the results of the study by Price et al. Robitaille and Sherrill concluded that the same trend existed. "Teachers of mathematics and their classrooms have changed far less in the last 15 years than had been supposed." (p. 25)

In addition, Price, Kelley, and Kelley (1977) noted that curricular objectives rated most important by teachers were those concerned with traditional topics such as computational skills. Newer topics, such as geometry in the elementary school, were seen as being of less importance.

In Newfoundland, over the last two decades, mathematics curricula at the elementary level have undergone similar changes to those occurring in the United States and other Canadian provinces. New textbook adoptions in mathematics have incorporated the content changes and approaches that have been the trend in the United States. Little evidence, however, exists which indicates whether or not these changes have been implemented at the classroom level. Only limited statements can be made about current trends and practices of the mathematics program and its teachers and these are usually based on opinions and lack a research base.

In 1977 the Newfoundland Department of Education, through the guidance and direction of the Provincial Mathematics Curriculum Committee, directed a sub-committee to develop a comprehensive guide of the mathematics objectives for the Provincial K-6 Mathematics Program. The Committee's main task was to provide a guide that would serve as an indication of the direction and emphasis that should be given to the mathematics curricula at the elementary level. The changes in the content and approach suggested by various mathematics professional groups, such as the National Council of Supervisors of Mathematics (NCSM), formed the foundation for the guide and provided the framework for its organization. The extent to which teachers of mathematics use the guide as an aid in determining the objectives of instruction for their classroom is unknown.

Information on what aspects of the mathematics program are being offered at the classroom level is important for a variety of reasons. If the goals suggested by the Department of Education are not being met, then efforts need to be taken to ascertain if the provincial curriculum is being implemented in the expected manner. When problem areas are identified, then efforts can be made at the District and classroom level to have them corrected. At the District level the information could be useful to program coordinators whose role it is to assist in solving problems in the mathematics education area.

This study of the mathematics objectives at the grade six level was directed towards answering the following questions:-

What mathematics objectives do teachers emphasize most at the grade six level?

On which emphasized objectives do teachers spend the most instructional time?

Is there different emphasis given to high and low cognitive level items?

Do teachers who use the provincial mathematics bulletin emphasize different objectives than teachers who do not use it?

What is the emphasis on each major content area?

Is there a relationship between teaching experience and the content areas being emphasized?

How do the areas being emphasized by Newfoundland teachers compare with those recommended by various mathematics education groups?

Rationale

There is, at present, a lack of information pertaining to how teachers in Newfoundland view the mathematics program and the types of objectives that they stress within the mathematics program. From reviewing the literature of the last five years it was concluded that many schools in other areas of North America were pressured to orient their school programs to basic skills. Gibney and Kearns (1979) suggested that this movement caused most schools to define basic mathematics in terms of the "barebones" technical skills of simple arithmetic operations. Other studies, such as that conducted by Stake and Easley (1978), found that the elementary mathematics curriculum was traditional and dedicated to helping children learn to compute. Reports, such as Priorities in School Mathematics (NCTM, 1981), suggest schools should do more than just teach computational skills. From these studies information pertaining to the objectives being stressed by teachers can be evaluated and possible directions for curriculum revision and inservice education determined.

Suggestions arise from the literature giving indications of the type of mathematics curriculum that should be implemented at the classroom level. Areas of content, beyond computational skills, have been identified from many symposia and conferences. Several groups of mathematics educators have suggested specific content areas. The National Council of Supervisors of Mathematics issued a position paper in which they identified 10 basic areas of the mathematics curriculum (NCSM, 1977). Whether or not what occurs in mathematics classes in Newfoundland fits the description given by Stake and Easley, computational skill oriented, or fits that given by NCSM, broad content area oriented, remains an unknown. Information of this nature is important when inservice programs, mathematics curriculum evaluation, or other types of program improvements are being planned. Obtaining information on the present status of the mathematics program, and eliminating the unknown, should provide valid information for future planning.

Outline of the Study

Twenty school districts were selected at random from the 36 school districts that constitute the educational boundaries in Newfoundland and Labrador. Within these 20 school districts, 120 grade six teachers were chosen randomly. They were given a survey instrument and lists of test items that represent possible objectives of the current grade six mathematics program. They were asked to rate each test item based on the degree of importance they attached to it. They also were asked to rank the items on which they spent the most instructional time. Accompanying the survey was a brief questionnaire asking the grade six teachers questions relating to years of teaching experience and materials used to plan their year's program. Copies of the instruments appear in appendices A, B and C.

Definition of Terms

For this study the following definitions were formulated:

Mathematics Objectives - Those objectives found in the grade six section of the Mathematics Bulletin published by the Department of Education for Newfoundland and selected objectives from the grade six teacher's edition of Investigating School Mathematics (Addison-Wesley, 1974).

Instructional Time - The teacher's estimate of the amount of classroom time spent on the teaching and/or learning of mathematical topics.

Low Cognitive Level Objectives - Low cognitive level objectives are those which require recall of basic facts and terminology or the ability to carry out algorithms.

High Cognitive Level Objectives - High cognitive level objectives are those which require the understanding of concepts, the knowledge of structure, understanding the procedure to carry out the solving of a problem; or the recall of relevant knowledge, selection of an appropriate operation and performance of the operation in application of mathematics to everyday life.

Major Content Area - Objectives were written for each of five content areas in the grade six curriculum: number concepts, number operations, geometry, measurement, and problem solving.

Teaching Experience - Number of years engaged in the teaching profession.

Delimitations

In this study the sample of respondents was delimited to grade six teachers in 20 randomly selected school districts. This allowed for the interpretation of results to be limited to the grade six level. No attempt was made to isolate other factors such as class size, classroom organization, grade level organization, or urban setting. This also posed limitations on interpretation making it impossible to refer specifically to results in settings with particular characteristics.

Data were collected for this study during the 1981/82 school year. Whether or not the results obtained would be the same for past years is difficult to say since many of the respondents may have taught classes with different characteristics and therefore might have had a different set of objectives for their students.

CHAPTER 11

REVIEW OF RELATED LITERATURE

In this chapter the nature of curriculum reform in elementary mathematics during the Post-Sputnik era is reviewed. Also discussed are responses and reactions made to curriculum innovations, the "back-to-basics" movement, and current status studies dealing with the effectiveness of curriculum change at the elementary level. Various suggestions of trends in future directions for mathematics programs at the elementary level are discussed. Information related to the problems that changes in the mathematics program had caused and how these problems were addressed by various groups are also given.

Overview of Curriculum Reform In The Elementary School From 1958-1981

Mathematics curricula have undergone considerable change in the last two decades. Initially this change was accelerated by the Soviet launching of Sputnik and the inability of the United States to lead in the space race. In summarizing curriculum reform of the last two decades the National Advisory Committee on Mathematics Education (1975) stated:

> Spurred by technological competition with the Soviet Union, federal agencies and private foundations have invested heavily in mathematics curriculum in grades K-12. The goal has been the major reconstruction of the scope, sequence and pedagogy of school mathematics. (p. 1X)

Initial attempts at reform included efforts to improve the mathematics program through the addition of new content areas. New topics, new organization of the topics, and the movement of traditional topics across grades were the focus of the improvement. The School Mathematics Study Group (1966) was among the various funded committees directed towards improvement in mathematics curricula at the national level in the United States. This group introduced topics such as probability, statistics, sets, geometry, different bases, and functions into the curriculum. Changes such as these were based on recommendations that arose from reports like that of the Commission on Mathematics of the College Entrance Examination Board (1959). These reports inferred that reforms were necessary if two needs were to be met. The need for more sophisticated scientific manpower and the need to lead towards a better understanding of the mathematics being taught were major concerns underlying their recommendations. The reform movement was not concentrated at the secondary school level. Changes were evident at the elementary school level as well. Bruner's (1960) argument, that any subject can be taught effectively in some intellectually honest form to any child at any stage of development, was the rationale given that the changes in the elementary mathematics program could be both psychologically and mathematically justified.

A summary of the reform movement was given by Green (1976):

> Unfamiliar subjects and symbols were introduced and expressions and terms were used that were hereto-fore foreign to the elementary school. Expressions such as commutative, associative and distributive, teaching for understanding and mod were but a few of the new expressions heard in elementary education circles. Bases other than 10, modulo arithmetic, and set language represent some of the new topics that made up modern elementary mathematics. (p. 98)

Many of these changes met with only limited success. Suydam and Osborne (1977), in their review of the history of mathematics education from 1955-1975, suggested that a continual problem was how to generate impact and effect change in the schools. How teachers responded to these changes has been an area of much discussion.

Response to Curriculum Change At The Elementary Level

Change is difficult to achieve in an educational setting. This is evidenced by the fact that much of the curriculum reform that was planned for by mathematics educators did not occur at the classroom level. The NACOME Report (1975) listed some reasons why the reform movement was somewhat unsuccessful. They stated that:

> Despite their general willingness to try new curricula and teaching methods, elementary teachers are seldom mathematics specialists and few inservice training programs prepared them to exploit fully the letter and spirit of the new curriculum materials. (p. 11)

The degree of implementation of the "new mathematics" seemed to be less than hoped for. Many questions arose about its actual purpose and usefulness. There was evidence that teachers were found teaching set language and operations in the elementary school in the same way that they had been taught in college and university classes (Green, 1976). A similar finding was reported by NACOME (1975). They wrote:

> The subtle function of these unifying concepts was often poorly incorporated by new curriculum materials and by classroom teachers. The proposed means to deepen understanding became ends in themselves. (p. 16)

Teachers, confused by lack of direction and in-service training, questioned the rationale behind the mathematics reform movement. A study conducted by Green (1976) dealing with 700 elementary school teachers from 14 counties in Georgia identified areas of concern teachers had about the "new mathematics". The conclusions drawn were that elementary school teachers had very real and genuine concerns about teaching modern mathematics and they need more help in understanding the purposes of methods of teaching, use of textbooks and materials, and content of modern mathematics. This study indicated that many teachers were still not incorporating these changes some 10-15 years after these changes had been made.

Throughout the period of the content reform it appears that not only teachers had serious misgivings about the nature of the change. The noted mathematics educator, Kline, severely criticized the changes and indicated they were "out of reach" for many students in the elementary school. In his book, <u>Why Johnny Can't Add</u>, he directed blame for declining computational ability on the ineptness of the new mathematics to provide the necessary drill and practise in computational skill (Kline, 1973). Suydam and Osborne (1977) cited the following example of the misgivings concerning the nature of the reform movement.

> A new type of attack on schools evolved during this period of change: scarcely anyone was unaware of the accounts of experience and observations by writers like Holt (1964); Kohl (1967); Kozol (1967); and Silberman (1970). Mathematics and other curriculum areas provided illustrations of how instruction was intensifying the problem of children being led or dragged through meaningless content and being "turned off" by schools. (p. 22)

These types of attacks forced the schools to provide the type of mathematics program that ensured a certain level of skill development. In the next section reactions to the types of pressure referred to previously are discussed.

Towards Minimal Competency in Mathematics

Collins (1981) brought attention to decreasing achievement scores in schools when he stated:

> In the face of declining standardized test scores, writers in both professional and general interest publications have either condemned or defended educational innovations of the past two decades. The debate has hardly spared mathematics. In many areas mathematics has indeed been in the eye of the hurricane. (p. 51)

The general public did not sit idly by and let the content reform movement go unnoticed. In reports of national assessment such as those written by the College Entrance Examination Board (1969), it was indicated that mathematics achievement was on the decline and the general public soon started to blame the reform movement for the lack of achievement.

To counteract the declining test scores and the perceived state of flux in the mathematics program, efforts were made in the early 70's to define mathematics curricula in terms of "basic skills". These efforts lead toward specifying goals of education as precise abilities to be acquired by all students. They have led the way for many state legislatures to mandate "minimal competency objectives", particularly in mathematics. NACOME (1975) reported that over 30 states had some form of minimal mathematic goals or objectives. It seems that these listings of objectives were in response to either legislative accountability demands or initiatives from state departments of education. In Canada, several provinces have developed lists specifying the objectives of the mathematics program. British Columbia, Alberta, Manitoba, and Newfoundland have mathematics bulletins listing their province's mathematics objectives (Newfoundland Department of Education, 1978). These lists, however, are not minimal competency lists.

The accountability movement was a major influence to "back-to-basics" in mathematics. According to Taylor (1977) a number of forces helped to bring about the back-to-basics movement. These included the rising costs of education, the results of national assessment, and the increasing awareness of the need for remedial and compensatory programs.

The "back-to-basics" trend had certain implications for mathematics education. Several conferences, such as those reported by Denmark (1980), Esty (1975) and NCSM (1977), were held to address and define the importance of basic skills in mathematics. These were planned to lessen the possible narrow interpretation of basic skills. NCSM (1977) suggested:

> The current rallying cry of "back-to-basics" has become a slogan of many who perceive a need for certain changes in education. The result is a trend that has gained considerable momentum and initiated demands for programs and evaluations which emphasize narrowly defined skills. (p. 1)

Mathematics educators, aware of the possible effects of this nature, started actions of their own to counteract the back-to-basics movement and to ensure that mathematics education did not consist of only the teaching and learning of computational skills.

Response to the "Back-to-Basics" Movement

The back-to-basics movement was the overall result of dissatisfaction with changes in the mathematics curriculum over the last two decades. This dissatisfaction surfaced from several sources, including teachers, parents, school boards, and the general public as a whole. Mathematics educators, as professionals interested in quality mathematics programs for children, were particularly concerned. Taylor (1977) summarized this concern:

> Today, we in schools are being urged (or in some cases pressured) to go back to basics. With respect to instruction in mathematics this trend has potential for both progress and peril. The emphasis on going back to the mathematical skills of yesterday for today's students who must live in an increasingly complex technological society. (p. 32)

Concerns like this have also been expressed by the National Council of Teachers of Mathematics (1981). The Council has stated its concern posed by the possibility that the back-to-basics movement might downplay teaching for understanding. This possible downplaying, due to the "basics" movement, has prompted several mathematics professional groups to respond by issuing statements aimed at providing models of a comprehensive mathematical level of competency needed to live in a technological world.

The first such undertaking was the Euclid Conference on Basic Mathematical Skills and Learning (Esty, 1975). The purpose of that conference was to investigate, through research and development, ways to assist all children to obtain skills essential for functioning adequately in school and society. Mathematics educators representing several geographical areas of North America presented papers in an attempt to define basic mathematical skills and learnings. Even though views on the question varied, the conference did provide goals that "represent the overall mathematical outcomes appropriate for twelve years of school" (Esty, 1975). The list of basic goals arrived at were:

- Appropriate computation skills;
- Links between mathematical ideas and physical situations;
- Estimation and approximation;
- Organization and interpretation of numerical data, including using graphs;
- Measurement;
- Alertness to reasonableness of results;
- Qualitative understanding;
- Notions of probability;
- Computer uses;
- Problem solving (p. 17-20)

The National Council of Supervisors of Mathematics (NCSM) was also concerned about the back-to-the-basics movement and its effect upon mathematics curricula. During the 1976 annual meeting of this group more than 100 members met to discuss the Euclid Conference Report. It was agreed that there was a need for a unified position on basic mathematical skills. This would allow for provision of more effective leadership within their respective school districts, adequate rationale and direction in the task of implementing a basic mathematics program, and the framework necessary to expand the definition of basic skills (NCSM, 1977). The published list, with one exception, coincided with the list developed by the working group at the Euclid Conference. The one exception was that NCSM members felt that the learning of geometric concepts were needed to function effectively in the three-dimensional world. A list similar to that of NCSM and the list which came from the Euclid Conference is contained in the NCTM publication Priorities in School Mathematics (NCTM, 1981).

Suydam (1979) also endorsed efforts which came from the Euclid Conference and the position paper by NCSM. She concluded, after listing the ten basic skill areas defined by NCSM, that:

> We must not prepare students for the world of 1850 or 1900 or even 1950. We must stop teaching only grocery store arithmetic to students who will have access to computers and use calculators. (p. 11)

Suydam also asserted that mathematical literacy is vitally needed and a mathematics curriculum with a broad base to keep careers open seems essential. Her view that mathematics is more than computation was stressed by the expression "children must not be cheated in learning a range of mathematical ideas" (p. 12). Collins (1981) argued the same point when he suggested that:

> The challenge is in the re-emphasis of basic arithmetic skills within the context of a total elementary mathematics program. (p. 51)

The response to the back-to-basics movement in terms of defining basic mathematical skills will undoubtedly proceed in the near future. Suggestions now seem to place the emphasis upon basic mathematical skills within the major goal of problem solving. A major recommendation contained in NCTM's An Agenda for Action (1980) was that:

"Problem solving must be the main focus of
the school mathematics in the 1980's." (p. 2)

Similar demands appeared in articles written by Devault (1981) and Suydam (1979).

Research on Classroom Implementation Of New Mathematics Curricula

Edwards (1972) suggested that the demand of increased competence in mathematics has become a reality. If this competence is not at least aimed for, students will not be prepared to function as citizens in today's society. That was the case in the early 1970's before the accountability demands and the back-to-basics movement surfaced. Similarly, Bell (1974) suggested that a sound mathematical base well beyond mere calculation skills was essential for more and more people in their working lives. These, however, were suggestions and little evidence existed to indicate if students were being taught more than just computational skills or if, in fact, a sound mathematical base was being aimed for by teachers of mathematics. Before statements are made regarding directions in which mathematics education is moving, evidence must be obtained on the actual impact those directions are having at the classroom level.

The NACOME Report provided one of the first attempts to analyze new mathematics curriculum at the elementary level (NACOME, 1975). In its assessment of curricular implementation at the elementary level the report stated:

> The label "arithmetic" has appropriately given way to "mathematics" as curricula incorporate varying amounts of geometry, probability and statistics, functions, graphs, equations, inequalities, and algebraic properties of number systems. Despite presence in most textbook series, these topics are often skipped in favor of more time to develop computational skills that are comfortable to teach and valued by elementary teachers. (p. 11)

An exploratory study, Overview and Analysis of School Mathematics, Grades K-12, commissioned by NCTM in 1975 attempted to obtain from second and fifth grade teachers their opinions on issues involving the content of the curriculum. Their conclusion was that the implementation of curricular reform at the classroom level showed only modest improvement over what was expected. It showed that 78% of the teachers surveyed reported spending fewer than 15 class periods per year on geometry. Furthermore, it showed that 55% of the grade two teachers surveyed and 74% of the grade five teachers spent less than five periods in total per year on graphs, probability and statistics. These figures do not suggest great success in curriculum reform (NCTM, 1975). It seems that curriculum reform, when evaluated at the classroom level, was not overly successful.

Other surveys have been completed to determine the degree of curriculum implementation. Denmark and Kepner (1980) attempted to obtain teachers' views on a variety of matters pertaining to basic mathematical skills. Of the 1214 survey forms returned, of which 22% were elementary teachers, indications were that conditions seemed to have improved from those reported by NCTM (1975). The survey results indicated that there was a wide acceptance of a broad interpretation of basic skills. The main difference from position statements originating from NCSM was a low priority given to elementary statistics and the predictive uses of probability. These results, however, should be viewed cautiously. The method employed to obtain the sample, selecting NCTM members, may have biased the results since NCTM members would more likely be in agreement with a comprehensive elementary curriculum than those teachers who, because they are not NCTM members, are more likely to be uninformed.

A more representative study was performed by Price, Kelley and Kelley (1977). It included 1220 returns from random samples of second and fifth grade teachers in the United States. Price et al attempted to replicate the findings of the Denmark (1980) survey. The major findings were the following:

> The overwhelming conclusion to be drawn from these findings is that mathematics teachers and classrooms have changed far less in the past 15 years than had been supposed. If there is indeed declines in mathematics test scores, only a small decline can be attributed to "new mathematics" since little "new mathematics" has actually been implemented into the classroom. (p. 329)

Qualitative studies by Stake and Easley (1978) also found that the elementary mathematics curriculum is traditional and dedicated to helping children compute. Fey (1979), reporting on the data of Stake and Easley, stated that only 8% of the kindergarten through grade six schools are using any of the innovative curricula whose development was sponsored by the National Science Foundation (NSF).

On the Canadian scene only one relevant study was found. Robitaille and Sherrill (1980) surveyed 3500 mathematics teachers of which 2144 responded in British Columbia using a similar instrument and design as Price et al (1977). They found that topics rated as most important by teachers were those dealing with arithmetic. The overall results closely resembled those reported by Price et al in the United States. It appears that the new mathematics curricular improvements and the efforts to refine the mathematics on the basis of a comprehensive set of objectives are meeting with little success in the classrooms of British Columbia. What has happened in this regard elsewhere in Canada remains unknown.

There is not much doubt that elementary mathematics programs have changed substantially over the last two decades. This process of change has continued recently as efforts are directed towards listing comprehensive learning outcomes in elementary mathematics. The reasons why changes have not been evident at the classroom level are still not clear and it is not known whether or not these efforts for improvement will go in vain.

It seems that more information, from across the

United States and Canada, is needed to determine the actual success or failure of past attempts at changing curricula. When this is completed perhaps an intensive program can be established to compile and disseminate the information found in reported studies. One such program can be of an inservice nature addressing the merits of the basic skills to be included in a comprehensive curriculum like those outlined by NCSM. In this way it may lessen the likelihood of the external forces, discussed in an earlier section of this review, acting upon the curriculum to keep it focussed upon narrow arithemetic skills.

CHAPTER 111

EXPERIMENTAL DESIGN OF THE STUDY

The major purpose of this study was to determine the objectives emphasized by grade six mathematics teachers. Related information regarding method of program planning, teacher experience, and time spent on objectives was also sought. In this chapter the experimental design of the study, including the population and sample and the methods used to gather data, are described. Also included is the list of questions referred to in Chapter 1 and the methods used to analyze the data related to each question.

Design of the Study

In this study an attempt was made to determine which objectives were stressed by teachers of grade six mathematics. Thirty-nine objectives were selected by the investigator from the Newfoundland Elementary Mathematics Curriculum Bulletin (1979) and the grade six teacher's edition of Investigating School Mathematics (Eicholz et al, 1974) which is the only recommended text used in the elementary classes in Newfoundland and Labrador. These objectives were selected to represent the five major areas in grade six mathematics: number concepts, operations, measurement, problem solving and geometry. Test items representing high and low cognitive levels were written which corresponded to each of the objectives. This was done with anticipation that teachers' reaction would be more valid if test items, rather than statements of objectives, were presented to them. The objectives and corresponding test items are included in appendix A of this report.

Data were collected by means of a mail survey. The instrument was comprised of a two-part questionnaire and a four-column sheet in which accompanying cards were to be sorted by a randomly selected sample of grade six mathematics teachers.

Participating teachers were given the 78 test items, corresponding to the 39 objectives, on a series of 78 cards and were asked to place each card in the column which best described the degree of emphasis given to it during the current school year. After the 78 items were categorized the respondents were asked to rank the items in column 1, those receiving the most emphasis, on the basis of the amount of instructional time given to each.

Along with the card sort, teachers were asked to respond to two questions dealing with the number of years teaching experience and the method or material they used to plan their mathematics program. A copy of the questions and the column sheet, with instructions, are included in appendices B and C of this report.

Population and Sample

The population studied consisted of all grade six classroom teachers in the Province of Newfoundland

and Labrador.

A random sample of 20 school districts from the total of 36 that form the educational districts of Newfoundland and Labrador were chosen.

After the 20 school districts had been randomly selected, a random sample of 120 grade six teachers was selected from all such teachers in the 20 districts. The services of the district mathematics coordinators were solicited to assist in the selection of the sample of teachers. Letters, requesting names and school addresses of all grade six teachers in the 20 selected districts, were sent to the district mathematics coordinators. All 20 coordinators responded and the lists received were used to randomly select the 120 teachers for the study. Information packages for the study were sent directly to the 120 teachers in the sample.

Instrumentation

Description of the Instruments

In this study two instruments were used to collect the required data. Both instruments were developed by the investigator and were piloted with a sample of sixth grade teachers prior to the main study. In this report the information sheet is referred to as instrument A and the column sheet is referred to as instrument B.

Instrument A consisted of two questions and was attached to the introductory letter. The two questions were used to obtain information on the number of years teaching experience of the respondents and the method or material they used to plan their program. This information was required to determine if teaching experience or program planning had any effect on the types of objectives that were emphasized.

Instrument B consisted of an instruction sheet, column sheet, and a series of 78 cards with test items from the grade six mathematics program written on them. The 78 test items were paired to represent each of the 39 objectives. Each objective had one test item corresponding to a low cognitive level and one corresponding to a high cognitive level. Definitions for high and low levels were included in Chapter 1. These objectives were also chosen to be representative of five major content areas. These content areas, number concepts, operations, problem solving measurement and geometry, were chosen since they generally include the 10 basic skill areas outlined in Chapter 2 of this report and endorsed by NCSM as representing a broad mathematics program. Column cards, labelled one through four, were also provided to properly identify the choice of categories. Respondents had four choices included in the column sheet in which they were to place each test item. The choices were: Column 1 indicated items emphasized with all students; column 2 indicated items emphasized with some students; column 3 indicated items not emphasized, but which would have been if more time were available; and column 4 indicated items not emphasized and would not have been emphasized even if time were available. After they had placed all 78 items in the column of their choice respondents were requested to rank the cards in the first column on the basis of instructional time spent. Cards were then labelled with the enclosed column card labels and elastic bands were provided to secure them.

Since both these instruments were developed by the investigator it was necessary to pilot the procedure before the actual study. Five teachers, from a board not selected for the main study, were chosen and were asked to complete the task. This was carried out in February of 1982. Based on the information received from these teachers, the column headings were reworded to decrease the chances of misinterpretation and the instruction sheet was modified slightly. The final version of both instruments A and B appears in appendices B and C respectively.

Validity and Reliability

The objectives chosen for this study were represented by text items at two levels of cognition. The test items were written by the investigator and this necessitated a check of the content validity. Two mathematics consultants were asked to review the test items and provide feedback indicating whether or not the item represented a high or low level cognitive objective. Test items which caused difficulty were re-written for inclusion in the final instrument. The consultants also reviewed the objectives used in the study and reported that they were representative of the objectives of a grade six mathematics program.

Instrument B was developed by the investigator. It was piloted and revised in February of 1982. In September of 1982, 20 teachers were selected and the instrument was administered to them on two occasions with a two week interval between the administrations. Rankings were determined for each administration of the instrument using the same procedure described later in this chapter for the analysis of the data with respect to question 1. The Spearman's rank-correlation coefficient between the two sets of rankings was found to be 0.72.

Limitations of the Study

Because of the design of the study, several limitations were unavoidable. One of the limitations resulted from the use of high and low levels of cognitive objectives. Test items in this study represented only two levels of cognitive ability. Test items for the same objectives could be written at other cognitive levels. Therefore an indication that an objective was not emphasized does not imply that the same objective at a different cognitive level was not emphasized.

Several limitations were due to the use of the survey approach. The survey was sent late in the school year, the latter two weeks of May, 1982, and because it took 40-60 minutes to complete, respondents may not have taken the proper amount of time needed to complete the task. Furthermore, no assumptions can be made about the nature of respondents. One cannot assume that the people who respond to a survey are the same as the people who do not respond. Also, due to limited control over the response rate, care must be exercised in generalizing the results. Limitations have also arisen due to the sampling of districts in the study. Although districts were chosen randomly, it was possible that not all types of Newfoundland society were included.

Questions and Methods of Analysis

This study was concerned with seven questions related to the objectives that teachers emphasized in grade six mathematics. These questions, along with the methods used to describe the data collected, are given below.

Question 1

What mathematics objectives do teachers emphasize most at the grade six level?

Teachers were requested to place each of the 78 items in one of four categories. Each category was assigned a value corresponding to the following: category 1 - 4 points; category 2 - 3 points; category 3 - 2 points; and category 4 - 1 point. For each of the 78 items a mean rating was determined by dividing the total score that item received across the four columns by the number of respondents. The 78 items were then ranked with the first item being the one with the highest mean score down to the last item being the one with the lowest mean score. Items were interpreted as objectives and a discussion of the rankings followed.

<u>Question 2</u>

On which emphasized objectives do teachers spend the most instructional time?

The first 15 ranked items from category 1 for each teacher were selected. The following values were assigned to these items for each teacher: 15 to the first item; 14 to the second item; etc., down to 1 for the fifteenth. A total was then obtained for each item and the total divided by the number of respondents to obtain a mean ranking. The items were then ranked in descending order beginning with the item receiving the highest rating. Items were again interpreted as objectives and discussed in this manner.

Question 3

Is there different emphasis given to high and low cognitive level items?

Items were written for each objective at two cognitive levels, high and low, based on the definition given by Wilson (1964).

Hypotheses 1: There is no significant difference in the amount of emphasis given to high and low cognitive level items.

This hypothesis was tested with a dependent t-test (Ferguson, 1971) on the difference in the grand means for high and low level items. The grand means were determined using the individual mean ratings obtained by each item and found in question 1.

Each objective was also examined by calculating the difference in the rankings of the corresponding high and low level items and indicating whether the difference in rankings was positive, negative or equal. This was determined by subtracting the two rankings and indicating negative if the difference was greater than or equal to -10, positive if the difference was greater than or equal to +10 and equal if the difference was between -10 and +10.

Question 4

Do teachers who use the Newfoundland K-6 Mathematics Bulletin emphasize different objectives than teachers who do not use it?

Respondents had four choices to indicate the method or material they used to plan their year's program. The choices were: a) past experience; b) teacher's edition of I.S.M.; c) Newfoundland Curriculum Guide; and d) local Curriculum Guide. Rankings were determined for each choice by using the mean ratings for each objective within each group as well as for choices a, b and d combined. Comparisons were then made between each of groups a, b and d with c and groups a, b and d combined were compared with c. Comparisons were made using Kendall's Tau (Ferguson, 1971).

Question 5

What is the emphasis on each major content area?

The five content areas in the grade six mathematics program are number concepts, operations, geometry, measurement, and problem solving. Each of the 78 items used in the study was placed under the appropriate content area and mean ratings for each content area were determined using the ratings given each item which was calculated in question 1. These ratings were then discussed.

Question 6

Is there a relationship between teaching experience and content area being emphasized?

Teachers were asked to indicate the number of years they had been teaching. The five intervals provided were: a) 1-5; b) 6-10; c) 11-15; d) 16-20; and e) more than 20. For each group the number of teachers was found and mean ratings for each content area within groups were determined using the ratings given each items for individual groups. For each group the content areas were then ranked in order from 1-5 and rankings between groups were compared and discussed.

Question 7

How do the areas being emphasized by Newfoundland teachers compare with those recommended by various mathematics education groups?

The data, as it applies to this question, is discussed in Chapter V of the report. Information on areas that were emphasized and areas that were not emphasized was drawn from the data. This information was compared to suggestions made by groups such as NCSM on important content areas within the mathematics curriculum.

CHAPTER 1V

THE RESULTS OF THE STUDY

The major purpose of this study was to determine the mathematics objectives that were emphasized by grade six teachers. In this chapter the results of the analysis of data relating to the seven questions are presented.

The population in this study consisted of all grade six teachers in the Province of Newfoundland and Labrador for the school year 1981-1982. The instrument used in the study was sent to 120 grade six teachers selected for the study. From this number, 56 teachers responded. The analysis of the data from these teachers as it relates to each question is presented below.

Question 1

What mathematics objectives do teachers emphasize most at the grade six level?

The answer to this question was sought to determine which objectives of the grade six mathematics program were emphasized most by teachers and which objectives received low emphasis. Two test items were developed for each objective, one indicating a high cognitive level interpretation of the objective and one indicating a low cognitive level interpretation. For purposes of this question, each item was considered to be a different objective. In table 1, a ranking of the items that were categorized by the 56 respondents in the study is presented. The items appear in descending order of emphasis.

The four objectives receiving the highest mean ratings were related to fractions. The first, item 4a, dealt with the reduction of an improper fraction, the second, item 35a, dealt with determining the sum of fractions with unlike denominators while the third, item 11a, and fourth, item 10a, were concerned with least common multiple and greatest common factor respectively. Other items dealing with fractions also received fairly high rankings. Items 9a, 9b, 10b, 11b, 14b and 35b were all ranked in the top 21 and were representative of objectives dealing with fractional concepts, operations, or problem applications.

Item 1a, concerning place value, and item 13a, related to division of whole numbers, were ranked fifth and sixth respectively. Other items related to objectives dealing with number operation and place value also were ranked fairly high. Four items dealt with addition and subtraction of decimals, 37a, 37b, 38a, and 38b. These items were ranked in the top 31 items chosen by the respondents. Other items dealing with place value, items 1b, 2a, 2b, 31a and 31b were ranked between 30 and 56. These items, although ranked relatively low, received fairly high mean ratings. Generally teachers tended to rate a large number of items as being emphasized with all

Table 1

Ranking of the Items Emphasized by Teachers of Grade Six Mathematics

Rank	Item	Mean Rating	Rank	Item	Mean Rating
1.	4a	3.98	22.	29a	3.68
2.	35a	3.97	23.	8a	3.67
3.	11a	3.96	24.	34b	3.66
4.	10a	3.95	25.	38a	3.65
5.	1a	3.93	26.	29b	3.64
6.	13a	3.92	27.	34a	3.63
7.	36a	3.91	28.	30a	3.62
8.	13b	3.88	29.	7a	3.61
9.	3a	3.87	30.	31a	3.60
10.	38b	3.86	31.	37b	3.59
11.	9a	3.85	32.	17a	3.58
12.	14a	3.82	33.	28a	3.54
13.	16b	3.79	34.	36b	3.53
14.	6b	3.77	35.	33a	3.52
15.	35b	3.75	36.	16a	3.50
16.	10b	3.73	37.	6a	3.49
17.	11b	3.72	38.	15a	3.48
18.	37a	3.71	39.	15b	3.47
19.	9b	3.70	40.	7b	3.46
20.	30b	3.70	41.	8b	3.41
21.	14b	3.69	42.	20a	3.40

Table 1 (continued)

Ranking of the Items Emphasized by Teachers of Grade Six Mathematics

Rank	Item	Mean Rating	Rank	Item	Mean Rating
43.	26b	3.39	61.	24b	2.68
44.	2a	3.38	62.	25b	2.66
45.	3b	3.37	63.	25a	2.64
46.	1b	3.36	64.	22b	2.61
47.	17b	3.35	65.	19a	2.52
48.	28b	3.34	66.	32a	2.46
49.	5a	3.30	67.	18a	2.45
50.	26a	3.29	68.	23a	2.39
51.	21a	3.27	69.	21b	2.23
52.	22a	3.21	70.	39a	2.21
53.	5b	3.20	71.	32b	2.20
54.	24a	3.13	72.	23b	1.95
55.	31b	3.16	73.	27a	1.93
56.	2b	2.86	74.	19b	1.91
57.	20b	2.82	75.	12a	1.84
58.	33b	2.77	76.	27b	1.75
59.	39b	2.75	77.	12b	1.66
60.	4b	2.74	78.	18b	1.43

students. This tendency resulted in high mean ratings for a large number of items with 55 of the 78 items receiving ratings over 3.

From a close inspection of table 1 it was noted that most of the geometry items included in the study were ranked in the lower half. Their mean ratings could be interpreted as meaning that these objectives were not emphasized all the time, but would be if there were more time available. Of the 18 geometry items in the study the highest ranking was 42.

Of the objectives ranked lowest several had to do with the use of formulae in geometry, items 18b, 12b, 12a and 19a. Several other of the lowest ranked items dealt with coordinate geometry, item 27b, and three-dimentional geometry, item 23b. The low mean ratings for these items were interpreted to mean that for a majority of teachers these objectives would not be emphasized even if more time were made available for mathematics instruction.

Question 2

On which emphasized objectives do teachers spend the most instructional time?

Teachers were asked to rank those items found in category one on the basis of instructional time spent. The rankings for each objective are reported in table 2.

The first four ranked objectives dealt with operations on fractions. Teachers indicated that they

Table 2

Ranking of Items Receiving the Most Instructional Time

Rank	Item	Mean Rating	Rank	Item	Mean Rating
1.	36a	5.54	23.	9b	2.36
2.	14a	5.25	24.	34a	2.34
3.	35a	5.16	25.	6b	2.29
4.	4a	4.66	26.	3a	2.10
5.	13a	4.60	27.	29a	2.09
6.	1a	3.88	28.	29b	1.98
7.	11a	3.86	29.	38b	1.96
8.	9a	3.70	30.	1b	1.89
9.	10a	3.43	31.	6a	1.80
10.	35b	3.34	32.	30b	1.73
11.	36b	3.21	33.	5a	1.60
12.	11b	3.18	34.	37b	1.55
13.	13b	3.13	35.	28b	1.49
14.	14b	2.90	36.	4b	1.39
15.	34a	2.89	37.	15b	1.39
16.	37a	2.82	38.	28a	1.38
17.	10b	2.78	39.	5b	1.14
18.	38a	2.73	40.	31a	0.96
19.	16a	2.68	41.	2a	0.95
20.	15a	2.52	42.	8b	0.84
21.	16b	2.50	43.	17a	0.70
22.	30a	2.38	44.	8a	0.55

Table 2 (continued)

Ranking of Items Receiving the Most Instructional Time

Rank	Item	Mean Rating	Rank	Item	Mean Rating
45.	3b	0.51	62.	25a	0.20
46.	17b	0.51	63.	25b	0.20
47.	22a	0.50	64.	27a	0.19
48.	20a	0.45	65.	32b	0.16
49.	26b	0.41	66.	24a	0.16
50.	31b	0.41	67.	12a	0.14
51.	39a	0.41	68.	26a	0.13
52.	20b	0.39	69.	33a	0.13
53.	7b	0.38	70.	39b	0.13
54.	2b	0.32	71.	27b	0.04
55.	7a	0.32	72.	23b	0.04
56.	18a	0.32	73.	12b	0
57.	19a	0.29	74.	18b	0
58.	22b	0.25	75.	21b	0
59.	32a	0.23	76.	23a	0
60.	19b	0.21	77.	24b	0
61.	21a	0.21	78.	33b	0

spent the most time developing skills in subtracting, multiplying, and dividing with fractions. Changing a mixed numeral to a fraction was ranked fourth in terms of time spent. The fifth ranked objective, item 13a, dealt with division of whole numbers. The first five ranked objectives received fairly high mean ratings. These five received much higher mean ratings than all the others which suggested a high degree of agreement among the teachers on the five objectives which received the most instructional time.

Items involving problem solving were generally ranked after items concerning the development of computational skills. Items 35b, 36b, 13b and 14b were ranked among the top 14. This indicated that teachers spend a relatively large time on allowing students to use computational skills involving fractions in the solution of word problems.

Six of the items in the study received an average rating of zero. This result was due to the calculation technique used to determine the mean ratings. None of these six items was listed in the top 15 objectives emphasized by teachers.

Question 3

Is there different emphasis given to high and low cognitive level items?

Hypothesis 1 was tested to indicate whether there was a difference between the grand mean ratings for high cognitive level items and the grand mean ratings for low cognitive level items.

> Hypothesis 1: There is no significant difference in the amount of emphasis given to high and low cognitive level items.

This hypothesis was tested using a t-test for dependent samples. The results are summarized in table 3.

Table 3

Results of a T-test on Difference in Emphasis between High and Low Cognitive Level Items

Item	N	Grand Mean	Standard Deviation	Standard Deviation of Difference	t-value
High	39	3.09	0.82	0.339	4.50*
Low	39	3.34	0.58		

* $p < 0.01$

In order to be significant at the 0.01 level of significance for 38 degrees of freedom, a t-value of greater than 2.70 was required. The value of t found was 4.50 which lies above the critical value of 2.70. Therefore the null hypothesis was rejected and it was concluded there is a significant difference in the amount of emphasis given to high and low cognitive level items and that significantly more emphasis was given to the low level items.

This difference was investigated further by using the difference in the rankings between the high and low cognitive level item for each objective. These differences are summarized in table 4. For each objective the ranking for the high cognitive level item was subtracted from the ranking for the low cognitive level item. A + was assigned if this difference in rankings was greater than or equal to +10, a - if the difference was less than or equal to -10 and an = if the difference was between -10 and +10. A majority, 20, of the high cognitive level items were ranked lower than the corresponding low cognitive level items. For only five items was the high cognitive level item ranked higher than the corresponding low cognitive level item. There were 14 instances in which there was no difference in the rankings of the high and low cognitive level items, that is the absolute value of the difference in rankings was less than 10.

Table 4

Difference between High and Low Level Items by Mean Rating and Ranking

Objective	Mean Ratings		Rankings		Difference	Criteria
	Low (a)	High (b)	Low (a)	High (b)		
1.	3.93	3.36	5	46	-41	-
2.	3.38	2.86	44	56	-12	-
3.	3.86	3.37	9	45	-36	-
4.	3.98	2.74	1	60	-59	-
5.	3.30	3.20	49	53	- 4	=
6.	3.49	3.77	37	14	+23	+
7.	3.61	3.46	29	40	-11	-
8.	3.67	3.41	23	41	-18	-
9.	3.85	3.70	11	19	- 8	=
10.	3.95	3.73	4	16	-12	-
11.	3.96	3.72	3	16	-13	-
12.	1.84	1.75	75	76	- 1	=
13.	3.92	3.88	6	8	- 2	=
14.	3.82	3.69	12	21	- 9	-
15.	3.48	3.47	38	39	- 1	=
16.	3.50	3.79	36	13	+13	+
17.	3.58	3.35	32	47	-15	-
18.	2.45	1.43	67	78	-13	-
19.	2.52	1.91	65	74	- 9	-
20.	3.40	2.82	42	57	-15	-
21.	3.27	2.23	41	69	-28	-

Table 4 (continued)

Difference between High and Low Level Items by Mean Rating and Ranking

Objective	Mean Ratings		Rankings		Difference	Criteria
	Low (a)	High (b)	Low (a)	High (b)		
22.	3.21	2.61	42	64	-22	-
23.	2.39	1.95	68	72	- 4	=
24.	3.13	2.68	54	61	- 7	=
25.	2.64	2.66	63	62	+ 1	=
26.	3.29	3.39	50	43	+13	+
27.	1.93	1.75	73	76	- 3	=
28.	3.54	3.34	33	48	-15	-
29.	3.68	3.64	22	26	- 4	=
30.	3.62	3.70	28	20	+ 8	=
31.	3.60	3.16	30	55	-15	-
32.	2.46	2.20	66	71	- 5	=
33.	3.52	2.77	35	58	-23	-
34.	3.63	3.66	27	24	+ 3	=
35.	3.97	3.75	2	15	-13	-
36.	3.91	3.53	7	34	-27	-
37.	3.71	3.59	18	31	-13	-
38.	3.15	3.81	25	10	+15	+
39.	2.21	2.75	70	59	+11	+
	$\overline{X}_L = 3.34$	$\overline{X}_H = 3.09$				

Question 4

Do teachers who use the Newfoundland K-6 Mathematics Bulletin emphasize different objectives than teachers who do not use it?

There were 56 respondents in the study. The breakdown of the four methods of program planning revealed the following: two teachers used a district developed curriculum guide; six teachers used the Mathematics Bulletin; 41 teachers used the teacher's edition of Investigating School Mathematics; and seven teachers used past experience. The number of respondents in each category does not necessarily mean that this was the only source the teacher used to plan the year's program. For example, there could have been teachers who used both the teacher's edition and the Newfoundland K-6 Mathematics Bulletin, but since the teacher's edition may have been used more often, that was the choice that was indicated on the questionnaire.

Due to the low numbers in three of the choices, particularly the choice of Mathematics Bulletin, it was not possible to compare the rankings using Kendall's Tau. The mean ratings for each of the four choices are reported in appendix D.

Question 5

What is the emphasis on each major content area?

The mean rating for each content area is tabulated in table 5. Number concepts received the highest mean rating and was ranked first while number operations and problem solving were ranked second and third respectively. Each received a mean rating 3.38 or above. The fourth and fifth ranked content areas were geometry and measurement with each of these receiving a mean rating 2.78 or below.

Table 5

Mean Rating for Content Areas in Grade Six Mathematics

Content Area	Number of Items	Mean Rating
Number Concepts	10	3.60
Number Operations	27	3.44
Geometry	14	2.78
Measurement	8	2.41
Problem Solving	19	3.38

Question 6

Is there a relationship between teaching experience and content area being emphasized?

The data for this question are summarized in table 6. Generally, for the five groups, the order was number concepts, operations, problem solving, geometry, and measurement. There was no difference in the rankings of the five content areas except for a minor change of order for the 6-10 year group which ranked problem solving second and number operations third. One trend evident in the table was that the 16-20 year group tended to rate each content area higher than the other groups.

Table 6

Years of Teaching Experience and Mean Rating for the Five Content Areas

	CONTENT AREA									
	Number Concepts		Operations		Geometry		Measurement		Problem Solving	
Teaching Experience	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean
0- 5 (N=4)	1	3.35	2	3.24	4	2.66	5	2.56	3	3.05
6-10 (N=17)	1	3.56	3	3.46	4	2.80	5	2.32	2	3.49
11-15 (N=14)	1	3.48	2	3.23	4	2.66	5	2.36	3	3.21
16-20 (N=8)	1	3.68	2	3.66	4	3.13	5	2.72	3	3.58
more than 20 (N=13)	1	3.69	2	3.66	4	2.50	5	2.39	3	3.44

Summary

In Chapter 1V the analysis of the data collected in the study has been presented relative to the questions stated in Chapter 1. In Chapter V a discussion of the results and implications are given.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

The mathematics curriculum has undergone considerable change since the early 1960's. While it is not clear exactly what the impact of these changes has been and how much of the additional content is now included by teachers, there is much agreement on the nature of the elementary mathematics curriculum by leading mathematics educators and professional groups. Skills involving approximation, estimation, measurement, problem solving, geometric understanding and applications have been suggested by different groups to help provide the framework of a mathematics program for today's students. These same skills have been endorsed by NCTM in publications such as School Priorities in Mathematics (NCTM, 1981) and have been the topics of numerous articles, in particular, those written by Suydam (1979), DeVault (1981) and Collins (1981).

The primary purpose of this study was to determine which mathematics objectives teachers emphasized at the grade six level and to analyse the results in terms of the basic skills referred to earlier in this report. A secondary purpose was to determine on which of the emphasized objectives teachers spent the most amount of instructional time and which areas of the curriculum were emphasized most. Also examined were the primary methods used by teachers to plan their mathematics programs, the difference in emphasis between high and low cognitive level objectives, and the effect years of teaching experience had on the nature of objectives emphasized.

Twenty school districts in Newfoundland and Labrador were selected at random and from these districts 120 grade six teachers were selected at random. The teachers were sent a questionnaire to collect data on the experience of the teacher and the primary method they used to plan their classroom program. The teachers were also requested to complete a 78 card sort in order to obtain data on the objectives that were emphasized during the 1981-1982 school year. Each of the 78 cards contained a test item which represented an objective included in a grade six mathematics program. Complete sets of data were returned by 56 teachers and used in the analysis.

In the previous chapter, the analysis of the data was reported with respect to each of the questions asked in the study. The results of this analysis are summarized and discussed in detail in the following section of this report.

Summary of Results

The four objectives most emphasized by grade six teachers in the sample dealt with skills used in computing with fractions. Other objectives involving fractions also were ranked highly by the teachers in the study. Computational types of objectives generally received high rankings, with division of whole numbers being ranked fifth.

The objectives used in this study were also analysed in terms of the amount of instructional time spent on them. It was determined that teachers in the sample spent the most amount of instructional time on the operations of subtraction, multiplication, and division of fractions with changing a mixed numeral to a fraction ranked fourth. Division of whole numbers was ranked fifth. There was a noticable spread in mean ratings between the first five objectives and the objectives ranked from six onward. This indicated a high degree of agreement on the objectives receiving the five highest mean ratings.

With respect to high and low cognitive level items a significantly higher degree of emphasis was given to low cognitive level items than high cognitive level items. On further analysis, it was concluded that there were only a few instances where a low cognitive level item was ranked lower than the corresponding high cognitive level item.

Also investigated was the emphasis given to objectives by teachers who used the provincial mathematics bulletin as compared to teachers who used other methods as their primary source of information to plan their program. It was found that of the 56 teachers who responded, only six indicated that they used the mathematics bulletin as their primary means to plan their program. From the data collected it was impossible to determine which other methods of planning these teachers used. This was also the case of the 41 who indicated they used the teacher's edition of Investigating School Mathematics as the main source to plan their program.

With respect to the content area emphasized, number concepts, operations and problem solving were rated much higher, and therefore received higher ranks, than the geometry and measurement content areas. There was no difference in the rankings between teachers with different amounts of teaching experience.

Discussion of Results

One of the major questions in this study related to the objectives being emphasized by grade six teachers. It was determined that items matching objectives which generally related to number operations received the highest rankings by the 56 teachers in the study. Receiving the highest mean ratings and rankings were items that dealt specifically with fractional number operations and fractional concepts that lead to facility in dealing with fractional operations. These objectives were also ranked high in terms of instructional time given. This finding, when compared to the fact that most of the teachers in this study used the teacher's edition as the main source to plan their program, may suggest that teachers emphasize fractions due to the heavy emphasis given to fractions in the teacher's edition and possibly the traditional role fractions have played in grade six over the years. The amount of time and emphasis given to objectives of this type is certainly questionable given the fact that our measurement system is now metric and the use of fractions in day to day living is decreasing. The emphasis on fractions should be, at most, directed at operations with common fractions.

It was not surprising to find the high mean ratings given to items that related to objectives dealing with number concepts, number operations and problem solving. Objectives of this type have been the foundation of the grade six mathematics program in the past and are emphasized in the grade six Investigating School Mathematics program. What is questionable about objectives of this nature is the degree to which teachers emphasize them, perhaps at the expense of other important objectives such as those involving geometry and measurement. Perhaps clear statements on the exact level of computational ability should be provided, since it is likely that time given to them takes away from time that teachers indicated they would need in order to emphasize geometry and measurement. Unlike objectives dealing with formula application and non-metric geometry, which received the lowest ratings and rankings, teachers felt that if more time were available, they would place greater emphasis on (metric) geometry and measurement. How to achieve a balance in program emphasis is one area which requires further investigation.

Problem solving items in this study received high mean ratings and were ranked highly in both emphasis and amount of instructional time. It should be noted that in this study the objectives which were considered to require problem solving behavior dealt mainly with the application of number operations in a manner similar to that required in "word problems" which are found at the end of chapters in the Investigating School Mathematics program. In the current literature this is suggested to be a narrow interpretation of problem solving. In the broader interpretation it is suggested that skills and strategies be taught and applied to problems in non-routine ways. In this study problem solving emphasized in the broad context of skills and strategies was not differentiated from the narrow context of the application of computational skills. It is, however, an area worthy of further investigation since it was suggested in the recent publication <u>An Agenda for Action</u> (NCTM, 1981) that problem solving in the broader context should be the main focus of mathematics for the 1980's.

In this study place value items received high rankings while the four objectives which dealt with decimal operations received generally low rankings in emphasis and amount of instructional time spent. The reason for this is unclear since one would assume that an emphasis on place value, to hundredths and thousandths, is in preparation for decimal operations. One possible explanation is that time restraints posed problems with teachers who may have wanted to emphasize decimal operations. The mean ratings given to the four objectives dealing with decimal operations might indicate a further time problem in the program since operations, generally, were emphasized by teachers. Another possible explanation could be that teachers view place value as preparation for decimal operations and place more emphasis on it while leaving the development of decimal operations to the next grade level.

An additional objective of this study to determine if there was a difference in emphasis between high and low cognitive level objectives. It was found that there was a significant difference in emphasis with low cognitive level objectives receiving more emphasis than high level objectives. This may have been due in part to the emphasis on computational skills in the study since most of these objectives were low level. Also, it was found that the problem solving objectives which utilized computational skills were ranked highly whereas the problem solving objectives that emphasized geometry and measurement were ranked lower. Since most of the problem solving objectives were application of computational skills it may have resulted in artificially high mean ratings for the problem solving category. If computation is involved in problem solving, perhaps the focus is on the skill rather than the process. This is not clear from the data, but could be investigated in future studies.

The primary method used by teachers to plan their program was also investigated in this study. It was found that a majority of teachers, 41 out of 56, used the teacher's edition of the Investigating School Mathematics program as their major source to plan their year. It is not clear from the data gathered whether or not the teachers used a combination of methods or materials along with the one they indicated. It was therefore difficult to relate what teachers emphasize to the particular method they used to plan their program. This area is certainly an area of concern since good program planning involves many means. Curriculum bulletins provide a broad balance in a program, the teacher's edition suggests sequence and materials, while past experience provides the reference point to help plan the program. All methods aid in the operation of a successful mathematics program. It was difficult to determine the extent, if any, of the combinations of methods which may have been used to plan the mathematics program. This information would assist in future program modification, but due to the nature of the question used in this study no suggestions of this nature could be made.

As indicated earlier it was found that generally two separate classes of content immerged: concepts, operations and problem solving; and geometry and measurement. The former received high ratings and corresponding high rankings while the latter received low ratings and rankings. Again the reasons for this are not clear, but time for instruction in mathematics might have been involved. The overall ratings given to geometry and measurement might be interpreted as suggesting they would receive more emphasis if more time were available, although some individual objectives would not be taught even if more time were available. To suggest that an increase in time would result in these entire areas being emphasized is speculation at best.

Over the past few years various professional groups, such as NCSM and NCTM, and leading mathematics educators, like Suydam and Osborne, have suggested the common content and skill areas that should constitute an elementary mathematics program. The skills and content areas emphasized by teachers in Newfoundland have been discussed above and are now compared with those considered to be most important by these other sources. For reference, it has been suggested by NCSM (1977) that the ten basic skill areas are: problem solving, estimation, approximation, reasonableness of results, appropriate computational skills, geometry, measurement, graphing, probability and computer literacy. Some of these have clusters of objectives related to them while others are objectives in themselves and vary with the nature of the skill being taught. These same skills have been the subject of much debate over the last few years and have been generally accepted by the mathematics education community at large.

It has already been established that the teachers in this study ranked geometry and measurement fourth and fifth respectively with generally low ratings given to them. Roberts (1979) reported a similar finding which may suggest teachers consider these enrichment areas to be completed if time permits. Another area given low ratings, while being part of the grade six program objectives as stated in the Newfoundland curriculum bulletin, included operations with decimals. Also, graphing skills seem not to be emphasized since the objectives dealing with graphing received low ratings, specifically those dealing with graphing in the coordinate plane. The low ratings associated with these objectives suggest that Newfoundland teachers may not be consistent with policy statements made by NCTM (1980) and may have a different definition of basic skill areas in mathematics.

Another area of importance is the area of appropriate computational skills. In one of the recommendations in An Agenda for Action it was suggested that performing paper and pencil calculations with numbers of more than two digits should be deemphasized (NCTM, 1980). The question that still remains from this study is whether or not the computational skills, especially those dealing with fractions, that were ranked highest of the objectives, are the appropriate ones. If, as represented in Investigating School Mathematics, emphasis is given to computational skills with numbers containing more than two digits, then this would result in the loss of instructional time needed to complete the other areas of the program.

Furthermore, it seems that the computational skills are taught with the idea of estimation and approximation since the objectives of this nature received a fairly high rating. This is indicated by the items dealing with rounding and estimating, specifically estimating large numbers, item 1b, which received a mean rating of 3.36 and estimating fractions, item 28b, which received a mean rating of 3.34. The emphasis on reasonableness of results was not determined from this study because it was not identified as an objective, but assumed to be a part of the skill of problem solving. As was suggested earlier, the area of problem solving, as used in this study to mean word problems, is likely to be inconsistent with recent definitions and perhaps should be the focus of a major study in the future.

Implications

In this study it was determined that there were areas of the grade six mathematics program that were not emphasized by teachers. Furthermore, it may be likely that instructional time is lacking since the mean ratings of many of the objectives that were not emphasized may be interpreted to suggest those not emphasized would have been emphasized had more time been available. The question of the amount of instructional time needed should be analysed from two points of view: first to ensure that the proper time exists to offer a broad mathematics program and second, to ensure a proper balance of all subjects in the primary/elementary program. The fact that most objectives received a mean rating larger than 0, and that many of the objectives tended to be placed in the third category could be interpreted that teachers in this study would do everything if time permitted. This should be considered when addressing the instructional time issue with the view that what people say and do are sometimes very different.

Computational skills with fractions and whole numbers were indicated as being emphasized and ranked highly in instructional time. If too much time is spent on developing computational skills that can easily be replaced by using a calculator, then areas such as measurement and geometry may remain omitted. Some type of balance is needed to ensure that students are proficient in the appropriate computational skills and that they are also provided with opportunities to learn geometry and measurement.

The role of the provincial elementary mathematics bulletin should be assessed to determine if it is having any impact upon the elementary mathematics program. Teachers in this study indicated that they use their teacher's edition and not the curriculum guide as their primary source of information. The question of why it is not used should be determined in order to correct this possible problem.

Inservice education is another method that may be utilized to improve the mathematics program at the grade six level. The objectives chosen for this study are examples of objectives that are recommended in the curriculum guide for inclusion in the grade six mathematics program in Newfoundland and Labrador, yet, there were several objectives that received very low ratings, even to the extent that they would be omitted even if time permitted. These objectives can be made the center of an activity inservice program to familiarize teachers with them. Also inservice directed at focusing on current literature about basic skills and strategies to teach these skills would provide teachers with a broadened background to help them deliver a good mathematics program.

Problem solving objectives in this study were ranked highly by teachers. If it were the case that problem solving just meant simple application of computational skills, then this suggests another area of endeavor for an inservice program. Ample opportunity should be provided so that teachers can be given the broad interpretation of problem solving and experiment with methods that can be used in their program to develop this important area.

While some important information about the types of objectives emphasized by grade six mathematics teachers has been determined in this study, much remains to be investigated. Some questions that need to be answered by further research are:

(a) Is there sufficient instructional time allocated to the teaching of mathematics?

(b) Would a decrease in emphasis on computational algorithms at the elementary level result in more time being available for geometry, measurement and problem solving?

(c) Do operations with fractions require the emphasis they receive from teachers?

(d) What content areas of the elementary mathematics curriculum are being emphasized by teachers at the K-5 levels?

(e) How can higher cognitive level objectives be incorporated into mathematics to allow students an adequate understanding of mathematical concepts?

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APPENDIX A

OBJECTIVES & SAMPLE TEST ITEMS

1. Given a numeral which has as many as nine digits, the child will be able to read the numeral by recognizing and naming the periods.

   (a) In the numeral: 534 896 201 give the place value of the following digits:

      (a) 8

      (b) 5

      (c) 2

   (b) Which of the following amounts of money would a millionaire have?

      (a) $ 100.00

      (b) $ 3 046.00

      (c) $ 7 000 000.00

      (d) $ 426 000.00

2. Given a decimal, the child will be able to round it to a specified place value.

   (a) Give the missing numbers:

      (a) 0.28 rounded to the nearest tenth is ____ ?

      (b) 0.57362 rounded to nearest hundredth is ____ ?

   (b) A square measures 4.89 cm on each slide.

      (a) What is its area rounded to the nearest tenth ____ ?

3. Given a number with an exponent (such as 3^4), the child will be able to raise the base to the power given by the exponent.

   (a) Fill in the missing numbers:

(a) 7^2 = ____

(b) 3^4 = ____

(b) Why doesn't 2^3 and 3^2 give the same result?

4. Given an improper fraction, the child will be able to write it as a mixed numeral by dividing the denominator into the numerator and writing the remainder as a fraction.

(a) Give the mixed numeral for each fraction:

(a) 15/2 = ____

(b) 37/5 = ____

(b) Draw a diagram to show that:

(a) 3 1/4 = 13/4

5. Given a fraction, the child will be able to express it as a decimal.

(a) Convert the following fractions to decimals:

(a) 1/8 = ____

(b) 3/16 = ____

(b) The fraction 2/3 is nearly equivalent to which decimal:

(a) 6.6

(b) .62

(c) .65

(d) 6.5

6. Given a dividend and divisor in whole numbers, the child will be able to find the quotient and express any remainder as a decimal.

(a) Express the quotient of the following in decimal form:

(a) 7 $\overline{)284}$

(b) 5 $\overline{)421}$

(b) Three boys shovelled a path. They were given 32 dollars for their work.

(a) How much money did each boy receive?

7. Given a set of elements and a description of one element in the set, the child will be able to select the element desired.

(a) Find the next element in the set described by:

A = (6,12,18,24 ...)?

(b) Given that Set A = (1,2,3,4,5,6,7,8,9,10) find the element that fits the following:

(a) the element is less than 5

(b) the element is even

(c) the element is larger than 2

8. Given two sets, the child will be able to find their union.

(a) If Set A = (3,4,5,6) and

Set B = (7,8,9,10)

what is ... Set AuB?

(b) If Set A = (1,3,5,7,9,11) and

AuB = (0,1,2,3,4,5,7,9,10,11)

what is ... Set B?

9. Given a number less than 500, the child will be able to find its prime factorization by building a factor tree and recognizing prime factors.

(a) Using a factor tree, write a prime factorization for:

(a) 250

(b) 720

(b) John and Mary wrote a prime factorization for 90. John started his factor tree with 9 x 10 while Mary started hers with 2 x 45. Would they both have the same prime factorization for 90?

10. Given two numbers, the child will be able to find their greatest common factor.

(a) Find the greatest common factor of the following:

(a) 7 and 20

(b) 6 and 10

(b) Find two pairs of numbers that have common factor of 6.

11. Given two numbers, the child will be able to find the least common multiple of the pairs.

(a) Give the least common multiple for the following:

(a) 21 and 6

(b) 3 and 16

(b) Find two pairs of numbers that have a least common multiple of 20.

12. Given the radius or diameter of a circle, the child will be able to find its circumference by applying the formula:

circumference = π x diameter

(a) If the radius of a circle is 6 cm, use the formula C = π x d to find the circumference.

(b) A circle has a diameter of 3 cm and a circumference of 9.4 cm. How can you show that π (pi) is approximately 3.14?

13. Given a division problem which has a 2-digit divisor, the child will be able to find the quotient by using the long division algorithm.

(a) Find the following quotients:

(a) $89\ \overline{)49647}$

(b) $62\ \overline{)4613}$

(b) There are 27 rows in an auditorium. 230 students are to meet for assembly. How many students will be in each row?

14. Given any two fractional numbers, the child will be able to find the product by multiplying the numerators together and the denominators together.

(a) Find the following products:

(a) 3/8 x 2/6 = ____

(b) 6/7 x 3/5 = ____

(b) Andy ran 1/2 of the way to school. Sue ran 3/4 as far as Andy. What part of the way to school did Sue run?

15. Given two decimals with no more than three (3) places to the right of the decimals, the child will be able to find their product.

(a) Find the following products:

(a) $\begin{array}{r} 3.7 \\ \times\ \underline{0.06} \end{array}$

(b) $\begin{array}{r} .47 \\ \times\ \underline{0.67} \end{array}$

(b) Tickets cost $1.20 each. Drinks cost 0.5 times as much. How much do drinks cost?

16. Given two fractional numbers expressed as decimals, the child will be able to find their quotient.

(a) Determine the quotients for the following:

(a) $0.4\ \overline{)29.6}$

(b) $0.11\ \overline{)0.638}$

(b) If you divide $56.40 equally among 4 people, how much money does each person get?

17. Using fractional numbers, the child will demonstrate his ability to apply the following basic principles:

- zero principle for addition
- commutative and associative principles and the one principle for multiplication

(a) Define the following terms:

(a) zero principle for addition of fractions

(b) commutative principle for addition of fractions

(b) Which basic principle is used for:

6/8 x 8/8 = 6/8?

18. Given the length, width and height of a rectangular prism, the child will be able to find its volume.

(a) Use the formula:

V = 1 x w x h to find the volume of a box with length = 2 cm

" height = 3 cm

" width = 5 cm

(b) You are given 27 centicubes. What are the dimensions of the rectangular prism (cube) that can be constructed using the 27 centicubes?

19. Given the base and height of a triangle, the child will be able to find its area.

(a) Use the formula:

area = height x 1/2 base (a = 1/2b x h) to find the area of a triangle with a height of 10cm and a base of 8 cm.

(b) A square has an area of 16 cm^2. What is the area of each triangle made by drawing the diagonal from opposite corners?

20. Given an angle, the child will be able to find its measure in degrees by using a protractor.

(a) Use a protractor to find the measure of these angles:

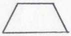
(a) 

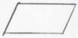
(b) 

(b) Draw an angle of 70^{o} without using a protractor and then check it using the protractor.

21. Given rectangles, squares, parrallelograms, trapezoids and quadrilaterals, the child will be able to recognize them.

(a) Which of the following is an example of a parrallelogram:

(a) 

(b) 

(c) 

(b) If you made a square out of string, how would you use this same string to make a rectangle?

22. Given isoceles, equilateral and right triangles, the child will be able to identify them.

(a) Define the following terms:

(a) isosceles triangle

(b) equilateral triangle

(c) right triangle

(b) What type of triangles are formed if you draw a diagonal connecting opposite angles of a square?

23. Given appropriate materials, the child will be able to construct models of 3-dimensional figures.

(a) Draw an example of a box with dimensions of

3 cm (height)

4 cm (width)

5 cm (depth)

(b) How many cubes would it take to make a cube that had a column of 64 cm^3?

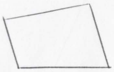
24. Given compass and straight edge, the child will be able to draw triangles.

(a) Using a compass and ruler, draw an equilateral triangle.

(b) Using a compass and a ruler, draw two triangles, one being twice as large as the other.

25. Given the words: side, angle, edge and diagonal, the child will be able to identify each.

(a) Label the following parts for the given figure:



(a) side

(b) edge

(c) angle

(d) diagonal

(b) What name is given to the polygon that has the following characteristics:

(a) 3 sides

(b) no diagonals

(c) 3 angles

(d) 3 verticies

26. Given perpendicular lines, the child will be able to recognize them.

(a) Define and draw an example for a perpendicular line.

(b) Give three examples of perpendicular lines in your home.

27. Given the co-ordinate plane, the child will be able to graph points whose coordinates include positive and negative integers.

(a) Connect the following points in the graph with a line:

A = (3,-4)

B = (-3,-2)

(b) Why aren't (-3,4) and 4,-3) the same points in the coordinate plane?

28. Given short story problems which involve fractional numbers, the child will be able to estimate answers to the problem.

(a) 98.5 miles rounded to the nearest mile is:

(a) 98.6 miles

(b) 99 miles

(c) 100 miles

(d) 98.0 miles

(b) If apples cost 12 1/2 ¢ each, about how many can you buy for $1.00?

29. Given a word problem whose solution requires one step, the child will be able to write and solve an equation for the problem.

(a) For the following problem, circle the correct answer.

John had 27 trout. He gave 16 to Mary. How many did he have left?

(a) 27 + 16 = 43

(b) 27 = 16 + 11

(c) 27 - 16 = 11

(d) 27 + 11 = 38

(b) Write and solve an equation for the following problem:

Joseph scored 27 points in a basketball game. Tim scored 18 points. How many more points did Joseph score than Tim?

30. Given a word problem whose solution requires two steps, the child will be able to write and solve an equation for the problem.

(a) For the following problem circle the correct answer.

What is the quotient when the sum of 64 + 8 is divided by 9?

(a) $64 = 8 + 9$

(b) $64 + 8 = 9$

(c) $\frac{64 + 8}{9} = 8$

(d) $\frac{64}{8} = 9$

(b) Write and solve an equation for the following problem:

John had $27.10. He bought a pair of shoes for $6.50 and a basketball glove for $11.50. How much does he have left?

31. Given a relatively large number expressed in base 10, the child will be able to write it in scientific notation.

(a) Write the following in scientific notation:

(a) 500 000

(b) 100 000 000

(b) The distance to the moon is 6×10^7 km.

The distance to the sun is 4×10^{12} km.

Which is farther from earth, the moon or the sun?

32. Given a base 10 numeral, the child will be able to write it as a base 5 numeral.

(a) Write the base 5 numeral for the following base 10 numerals:

(a) 16 = $\_\_\_\_\__5$

(b) 7 = $\_\_\_\_\__5$

(b) Which of the following base 5 numerals is the largest base 10 numeral:

14_5 or 41_5 ?

33. Given a polygon, the child will be able to find its perimeter by finding the sum of its side.

(a) What is the perimeter of a rectangle with sides of 2 cm, 4 cm, 2 cm and 4 cm?

(b) Construct a rectangle with a perimeter of 28 cm.

34. Given two ratios, the child will be able to determine if they are equal.

(a) Find the missing numeral in the following ratios:

(a) $\frac{3}{6} = \frac{n}{12}$

(b) $\frac{4}{7} = \frac{8}{n}$

(b) If three scouts could be assigned to 1 tent, how many tents would be needed for 18 scouts?

35. Given two fractional numbers to add, the child will be able to find the sum by using fractions with the least common denominator.

    (a) Find the sum of the following fractions:

        (a) 3/10 + 3/5 =

        3/7 + 7/12 =

    (b) Cindy ate 1/4 of the pie while Mary ate 1/5 of it. How much of the pie did they eat altogether?

36. Given two fractional numbers to subtract, the child will be able to find differences by using fractions with the least common denominator.

    (a) Find the difference of the following:

        (a) 5/6 - 1/9 =

        (b) 7/8 - 1/2 =

    (b) How much must be taken away from 3/4 to have 1/8 left?

37. Given decimals in addition exercises which require regrouping, the child will be able to find the sum.

    (a) Find the sum of the following:

        (a) $\begin{array}{r} 0.65 \\ +\ \underline{0.85} \end{array}$

        (b) $\begin{array}{r} 29.37 \\ +\ \underline{\ \ 4.93} \end{array}$

    (b) Bill weighs 72.5 kg while Mary weighs 45.6 kg. How much do they weigh together?

38. Given decimals in subtraction exercises which require regrouping, the child will be able to find their difference.

(a) Find the differences in the following:

(a)
```
   0.68
 - 0.19
```

(b)
```
  700.3
- 267.4
```

(b) Jane received a cheque for $10.55. She spent $4.89 for a record. How much change did she receive?

39. Given an equation which involves percent and which has an unknown factor or product, the child will be able to find the missing term.

(a) Solve the following equation for n;

75% x n = 30

(b) Tim had 30 items correct on a test. His teacher gave him a mark of 75%.

How many items in all were on the test?

APPENDIX B

520B Pennsylvania Drive
Stephenville, Nf
A2N 2W8

15 May 1982

Dear Teacher:

As part of my master's programme at Memorial University of Newfoundland, I am presently carrying out a study of test items and their importance in a grade six mathematics program. The study involves a random sample of grade six teachers from Newfoundland and Labrador. You have been chosen as a part of this random sample and I ask that you take a few minutes of your time to complete the questionnaire and card sort that have been developed.

I would appreciate if you could complete this project within the period May 17 to June 4 and return the results in the stamped, self-addressed envelope enclosed in this package.

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

****

1. Please indicate the number of years' teaching experience:

   (a) 0 - 5 years
   (b) 6 - 10 years
   (c) 11 - 15 years
   (d) 16 - 20 years
   (e) more than 20 years

2. Please circle the method or material you use most when you plan your mathematics program:

   (a) Teacher's Edition of Investigating School Mathematics
   (b) Past experience
   (c) Elementary Mathematics Curriculum Guide for Newfoundland
   (d) Local District Curriculum Guide

APPENDIX C

INSTRUCTIONS FOR SURVEY

Enclosed are a series of 78 .... 3 x 5 cards containing examples of test items which might be used at the grade six mathematics level. Also enclosed is a large sheet of folded paper having four columns on it. Please sort the cards by following these directions:

1. Open the large folded sheet of paper and place it on an appropriate working area.
2. Taking each card separately, place it in the column which best describes the test item in relation to the importance you placed on it in your mathematics program this year. For example, an item which represents something you emphasize with all students would be placed in COLUMN ONE.
3. Continue placing all the cards in the column of your choice. ALL columns do not necessarily have to have the same number of items.
4. When you have finished placing all the cards in the column of your choice, take the cards in COLUMNS TWO, THREE & FOUR and place the elastic band around them and label them with the appropriate column number.
5. The cards you have left in COLUMN ONE are now to be arranged in order with the first card indicating an item on which you spend the most instructional time and the last card in COLUMN ONE representing an item

on which you spend the least amount of instructional time.

6. When you have completed arranging the cards, please place the elastic band around the cards and attach the label which indicates COLUMN ONE.

   <u>REMEMBER</u>: Cards in COLUMN ONE should be in order with the first card indicating an item on which you spend the most amount of time and following through to the last card which indicates an item in COLUMN ONE on which you spend the least amount of time.

7. When you have completed your task, please place the cards in the self-addressed stamped envelope and place it in the mail.

TEST ITEMS & DEGREE OF EMPHASIS

COLUMN ONE	COLUMN TWO	COLUMN THREE	COLUMN FOUR
Items emphasized with all students	Items emphasized with some students	Items not emphasized but which would have been, if more time available	Items not emphasize and would not have been emphasized eve if time available.

APPENDIX D

Comparison of Method of Program Planning
and Mean Rating of Items

	(N=2)	(N=6)	(N=41)	(N=7)
Objective	Local Guide	Provincial Guide	Teacher's Edition	Past Experience
1a	4.0	4.0	3.95	3.71
1b	2.5	4.0	3.27	3.57
2a	3.5	3.85	3.34	3.29
2b	2.5	3.5	3.01	2.71
3a	4.0	4.0	3.90	3.57
3b	4.0	3.67	3.34	3.14
4a	4.0	4.0	4.0	3.71
4b	3.5	3.5	2.56	3.14
5a	3.0	4.0	3.22	3.29
5b	3.0	4.0	3.10	3.14
6a	4.0	3.5	3.44	3.57
6b	4.0	3.67	3.80	3.57
7a	4.0	3.83	3.61	3.14
7b	4.0	4.0	3.44	3.0
8a	4.0	4.0	3.68	3.14
8b	2.5	3.83	3.44	3.14
9a	3.5	4.0	3.93	3.43
9b	3.5	4.0	3.76	3.43
10a	3.5	4.0	3.98	3.86
10b	3.5	3.5	3.78	3.71

Comparison of Method of Program Planning
and Mean Rating of Items

	(N=2)	(N=6)	(N=41)	(N=7)
Objective	Local Guide	Provincial Guide	Teacher's Edition	Past Experience
11a	2.0	4.0	3.98	3.86
11b	2.0	3.67	3.73	3.71
12a	1.5	1.67	1.80	2.29
12b	1.5	1.0	1.78	2.0
13a	4.0	4.0	3.85	3.86
13b	4.0	4.0	3.80	3.57
14a	4.0	4.0	3.85	4.0
14b	4.0	4.0	3.68	3.29
15a	3.5	3.83	3.44	3.43
15b	4.0	3.67	3.41	3.57
16a	4.0	3.83	3.44	3.43
16b	4.0	4.0	3.76	3.71
17a	4.0	4.0	3.46	3.43
17b	4.0	4.0	3.17	3.71
18a	2.0	3.0	2.31	2.86
18b	1.0	1.67	1.54	1.86
19a	2.5	2.67	2.41	3.0
19b	2.5	1.83	1.83	2.29
20a	4.0	3.83	3.34	3.14
20b	2.5	2.83	2.88	2.57

Comparison of Method of Program Planning and Mean Rating of Items

	(N=2)	(N=6)	(N=41)	(N=7)
Objective	Local Guide	Provincial Guide	Teacher's Edition	Past Experience
21a	3.0	3.83	3.22	3.14
21b	2.5	3.33	2.02	2.43
22a	3.5	2.83	3.12	3.14
22b	1.5	3.5	2.44	3.0
23a	2.5	2.63	2.37	2.29
23b	2.0	2.5	1.85	2.14
24a	3.5	3.67	3.05	3.0
24b	2.5	2.67	2.66	2.57
25a	2.5	2.16	2.66	3.0
25b	2.5	3.0	2.66	2.43
26a	4.0	3.83	3.17	3.57
26b	4.0	3.83	3.37	3.0
27a	3.0	2.0	1.93	2.14
27b	3.0	1.67	1.70	2.0
28a	4.0	3.67	3.46	3.71
28b	3.5	4.0	3.27	3.43
29a	4.0	4.0	3.68	3.29
29b	3.5	4.0	3.63	3.43
30a	4.0	4.0	3.54	3.71
30b	4.0	3.83	3.66	3.71

Comparison of Method of Program Planning
and Mean Rating of Items

	(N=2)	(N=6)	(N=41)	(N=7)
Objective	Local Guide	Provincial Guide	Teacher's Edition	Past Experience
31a	2.5	c.83	3.61	3.57
31b	2.5	3.33	3.10	2.71
32a	2.0	2.0	2.39	2.29
32b	2.0	2.33	2.20	2.29
33a	4.0	3.67	3.39	3.43
33b	3.5	2.83	2.71	2.57
34a	4.0	4.0	3.56	3.57
34b	4.0	4.0	3.63	3.43
35a	4.0	4.0	3.95	4.0
35b	4.0	4.0	3.76	3.57
36a	4.0	4.0	3.90	3.86
36b	3.5	3.5	3.63	3.0
37a	4.0	4.0	3.70	3.43
37b	4.0	4.0	3.66	2.71
38a	4.0	4.0	3.63	3.43
38b	4.0	4.0	3.90	3.43
39a	3.0	1.83	2.17	2.57
39b	2.0	2.0	2.71	2.43