THE UNIVERSITY OF MANITOBA

AN EXPERIMENTAL STUDY OF THE EFFECTS ON ACHIEVEMENT OF THE USE OF A CULTURALLY RELEVANT MATHEMATICS PROGRAM

by

GORDON DAN REIMER

A THESIS

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A dissertation submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

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ABSTRACT

This study was designed (1) to investigate the effects on the achievement of native students, when a culturally relevant mathematics program was used, and (2) to determine if the use of such a program increased the student's level of enjoyment in mathematics, (3) to determine if students studying such a program would recognize greater value in mathematics (4) to determine if teachers believed the use of this program contributed to student enjoyment and to achievement in mathematics.

To investigate the effects on achievement, an experimental setting was used to compare the achievement of 175 grade seven students from eleven schools within Frontier School Division. This sample was divided into treatment and control groups. The first group received the culturally relevant curriculum unit, while the second group received a parallel unit based on the present authorized curriculum and texts in the Province of Manitoba. The units dealt with mathematical word problems which were developed by the writer

for this study. Using a pretest and posttest, an analysis of covariance was used to test the null hypothesis of no significant difference in achievement between the two groups.

To determine the effects of this program on student enjoyment of mathematics and the value students see in mathematics, a student questionnaire was used. This was analysed and the responses reported comparatively between the treatment and the control groups.

To determine if teachers considered the use of such a program important in student enjoyment and achievement in mathematics, two teacher questionnaires were utilized. The first was completed by all eleven teachers upon completion of the experimental study, while the second was completed by the control teachers only upon receipt of a culturally relevant curriculum unit. These were analysed and the responses reported comparatively between the treatment and control groups.

With regard to the effects on achievement of the use of a culturally relevant curriculum unit, the analysis showed (1) that students studying the culturally relevant unit scored significantly higher than students using a nonrelevant unit ($p<0.001$); (2) that the place of residence of a student within the community (ie: reserve, off reserve, recently new to community) was not significant when comparing achievement between these categories within treatments ($p>0.05$); (3) that the sex of the student was not significant when comparing achievement between these categories within treatments ($p>0.05$).

With regard to the effects on student enjoyment of mathematics, the study showed that students studying a culturally relevant unit seemed to enjoy mathematics more than students studying the culturally nonrelevant unit.

With regard to the value which students place on mathematics, there was no apparent difference between the two groups of students.

With regard to the effects of such a program on student enjoyment and achievement as perceived by teachers, the study showed (1) that teachers felt student enjoyment of mathematics would be greater with such a program as compared to a culturally nonrelevant program, (2) that teachers felt student achievement in mathematics would be greater with such a program as compared to a culturally nonrelevant program, and (3) that teachers felt more mathematics should be presented in such a culturally relevant manner.

The study indicated a need for the development and use of mathematics materials, units, and programs culturally relevant for native students in northern Manitoba.

TO MY WIFE

M A R I E

ACKNOWLEDGMENTS

I wish to express my sincere appreciation

to the administration, principals, and grade seven mathematics teachers and students of Frontier School Division #48 for participating in this study;

to Dr. L. Jansson, the chairman of my thesis committee, for his assistance throughout this research study;

to Dr. H. Gruneau and Prof. D. B. Sealey, members of my thesis committee, for their reading and commenting upon the thesis;

to my children James, Sharon and Robert who didn't see as much of their dad as he would have liked;

to my wife, Marie, for her encouragement and patience especially near the end when she so often heard "not yet, just a few more pages";

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CHAPTER I

INTRODUCTION

I. THE NEED FOR THE STUDY

The significance of this study lies in the concern many educators have about the low achievement and high dropout rate of Native students as compared to Non-native students within the public school system in Canada. The difference in achievement is clearly reflected in the dropout rates of the two groups. In a study at the national level conducted by Hawthorn (1967), the dropout rate for Native students from Kindergarten to Grade Twelve was found to be twelve percent annually. Kirkness (1973) projected a Manitoba based study to the 1974-75 school year and predicted ninety-one percent dropout on the basis of figures available on Native students at that time. In studies conducted by Goucher (1967) and Kirkness (1973) the dropout rate in Native schools and the dropout rate for Native students in integrated schools was found to be many times that of the rest of the population.

Many educators feel that low achievement, which is a factor in the high dropout rate, is in part due to the use of curriculum in both all Native and integrated schools that does not take into account the culture of the Native student. In a book entitled The Disadvantaged, Fantini (1968) related the dropout rate to the level of achievement. Fantini also related achievement, which was measured by the grade achieved prior to leaving school, to a curriculum that was culturally relevant for the student.

Berger (1972) conducted a study in Alberta and found that the nine Native families studied placed the highest priorities on "culture" and "education" given a list of thirteen topics of concern.

In view of the suggested relationship between dropout, achievement, and cultural relevance, many educators have contended that the development of culturally relevant curriculum materials be made a matter of priority. Such educators have also contended that new materials should be developed in literature, social studies, art, science, and mathematics.

This study attempts to ascertain whether or not a relationship between achievement and cultural relevance does exist in a particular curriculum area.

II. THE IMPORTANCE OF THE STUDY

Achievement in school depends to a considerable extent on the achievement each student experiences in mathematics. Since development of a student's skills in mathematics is one of the important tasks of the public school system, the ability of students to utilize mathematical skills effectively in everyday life is an important goal for most teachers. This ability, namely to translate a problem into computational terms and then employ computational skills to solve the problem, is one which each student must possess to some degree in order to experience achievement within the public school system and within the socioeconomic parameters of modern society.

The stated purpose of the school division in which this study was conducted is to inculcate in its students intellectual skills and knowledge as well as social skills, which will fit the students for productive, self-fulfilling lives, in or out of their communities, with an educational background that will enable them to compete on equal terms with graduates from any other public school system. Unless this purpose is achieved the students of Frontier School Division, most of whom are Native students, will fill the ranks of the unemployed rather than making the contributions of which they are capable to the economic, cultural and intellectual life of Manitoba.

In order to assure that the best possible education has been made available to the students of Native ancestry the possibility of culturally relevant education having an effect on achievement should not be left to chance.

III. THE PURPOSE OF THE STUDY

The purpose of this study was to ascertain, whether or not under experimental conditions, achievement in mathematics would increase when a culturally relevant program of studies in mathematics was used.

To determine this, a curriculum unit in mathematics was developed and then translated into culturally relevant terms for students in northern Manitoba. The two resulting units were then utilized in the experimental part of the study.

IV. QUESTIONS

Following are the questions to be answered by the study:

1. Do students at the grade seven level in mathematics using a culturally relevant mathematics curriculum unit show greater achievement than students using a culturally non-relevant mathematics curriculum unit?

2. Do students enjoy mathematics more if a culturally relevant mathematics curriculum unit is used rather than a culturally nonrelevant mathematics curriculum unit?

3. Do students see a greater value in mathematics if a culturally relevant mathematics curriculum unit is used rather than a culturally nonrelevant mathematics unit?

4. Do teachers using a culturally relevant mathematics curriculum unit consider their unit to be more important in student enjoyment and achievement than do teachers using a culturally nonrelevant mathematics curriculum unit?

Question one, as stated above, will be answered by the experimental portion of this study, while the remaining questions will be answered by a descriptive analysis of several student and teacher questionnaires.

V. DEFINITIONS OF TERMS

The following are definitions of terms as they were used in this study.

Achievement: In this study "achievement" refers to the level or degree of excellence attained 1) within a grade, 2) within a course, 3) within a unit of study within a course. In the "Review of Related Research and Literature" (Chapter II) achievement may also refer to the grade level attained prior to the discontinuance of formal education in the public school system.

Culture: In this study "culture" refers to all the knowledge, beliefs, customs, and skills a person acquires as a member of society. It refers to the "way of life" in the communities in which the student lives who is taking part in this study. This then differentiates "culture" from "cultural heritage" which refers to the way in which cultures of the past have contributed to culture as it is today.

Cultural Awareness: In this study "cultural awareness" means more than the acknowledgment of the existence of another culture. It also includes the acceptance of that culture as a valid system and at the same time makes an attempt to take into account, in any contact with that culture, the available knowledge concerning that culture.

Culturally Relevant: In this study "culturally relevant" refers to the characteristics of the curriculum unit the author has developed in which an attempt has been made to take into account the culture of the student involved in this study.

Curriculum: In this study "curriculum" refers to any planned activities including courses which the student participates in under the direction of a school.

Curriculum Unit: In this study specific reference will be made to the "curriculum unit" which the author has developed. This is the curriculum unit that has been used in the experimental part of this study. It consists of a mathematics unit involving word problems only, at the grade seven level.

Dropout: In this study "dropout" refers to any student who having once enrolled in school discontinues before graduation from grade twelve for reasons other than
1) transfer to another school, 2) physical injury or death,
3) the inaccessibility of schools for further education.

Native Student: In this study "native student" refers to any students, Indian or Metis, Treaty or Non-treaty, within the scope of this study that are of Indian descent.

Student: In this study "student" refers to any subject in this study who is registered in the schools in which the study is being conducted. More specifically this group of students consists of three categories, those that live on a reserve, those that do not live on a reserve but who have been long term residents in the community, and those who do not live on a reserve and are short term or recent residents of the community. In this last group would be all those residents who are not indigenous to the community.

VI. LIMITATIONS OF THE STUDY

There are a number of limitations to this study. The writer is aware of the restrictive nature and scope of his topic; this choice, however, has been deliberate. The nature and scope of the study imply that the results of the study need not reflect on any other grade level, any other school, any other subject, or any other area of mathematics beyond that used in this study.

1. This study was limited to the grade seven students, in the schools randomly selected for the study.

2. This study was limited to randomly selected schools located within the confines of Frontier School Division #48 of the Province of Manitoba.

3. This study was limited to the mathematics curriculum units developed and used in the study which dealt only with word or story problem types.

VII. LOCATION OF THE STUDY

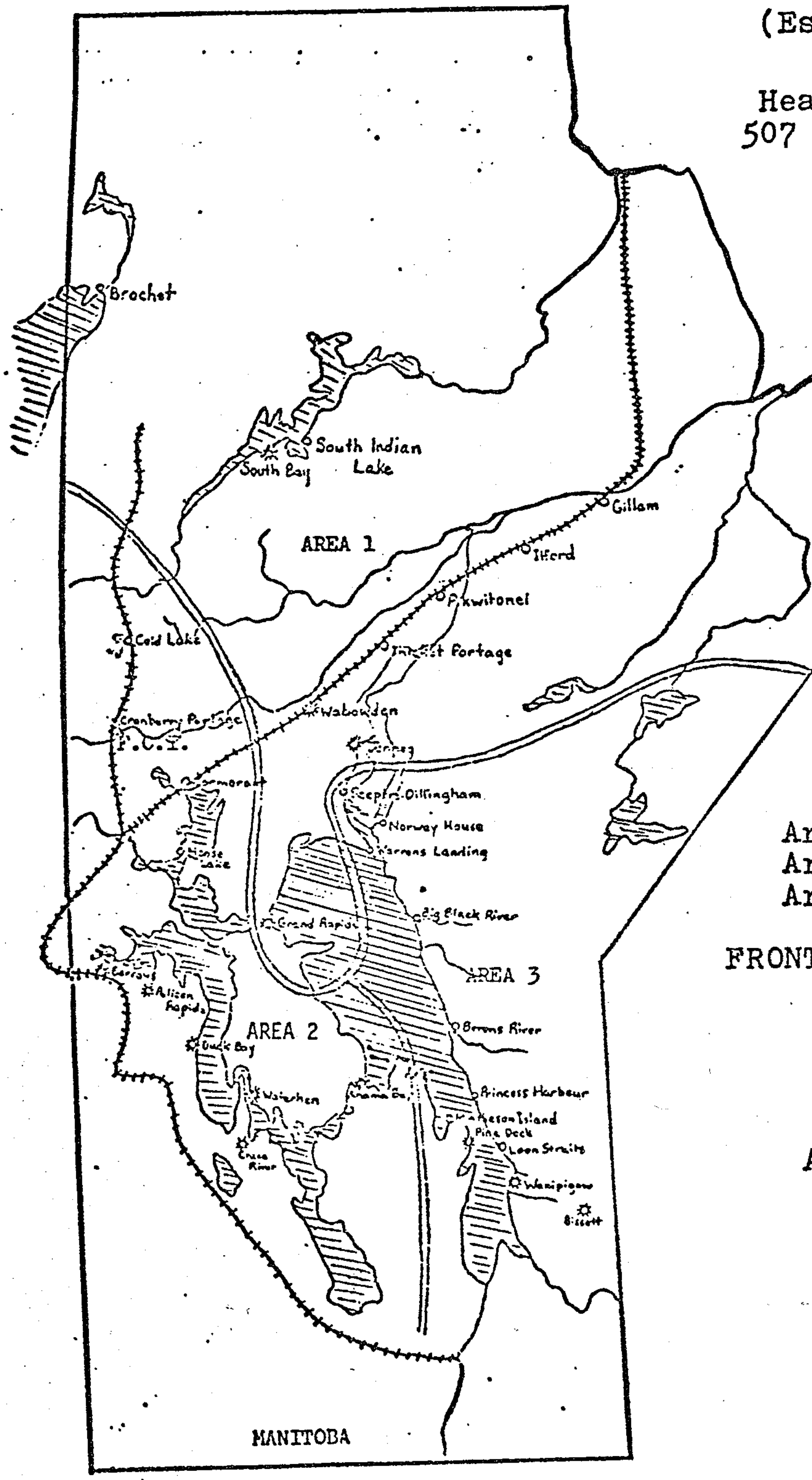
This study was conducted within Frontier School Division #48 in the Province of Manitoba. The Division was established in July, 1965. Prior to this date the schools now comprising the Division were administered in a variety of ways. The intention of the reorganization was to facilitate the coordination of efforts to improve education in isolated communities.

Many of the communities do not have a viable economic base. Most of the residents are of Native ancestry, either treaty or non treaty. The adults of the communities earn a livelihood by fishing, trapping, lumbering, employment with Manitoba Hydro, or gain employment with local businesses such as stories, motels and service stations. Unemployment is a continuing problem in many of these communities.

The isolated communities that comprise the Division are scattered over approximately two-thirds of the geographical area of the Province. They are located largely in the Canadian Shield country and range from the southern shores of Lake Winnipeg in the South-East of Manitoba to Brochet in the North-West corner of the province. Within the boundaries of this geographical area there are enclaves which are not part of Frontier School Division. These consist of large towns and cities which operate their own school systems such as The Pas, Flin Flon, Thompson, Leaf Rapids, Snow Lake, and Churchill. In addition, there are numerous Indian Reserves which operate schools under the authority of the Federal Department of Indian Affairs and Northern Development.

FRONTIER SCHOOL DIVISION #48
(Established July, 1965)

Head Offices Located at
507 - 1181 Portage Avenue
Winnipeg



Area 1 Office - Thompson
Area 2 Office - Dauphin
Area 3 Office - Winnipeg

FRONTIER COLLEGIATE - Cranberry Portage

Accessible by Road
Railway

Printed January, 1975

VIII. EXPERIMENTAL HYPOTHESIS

The following three hypothesis relate to Question One posed earlier in this chapter:

<u>Hypothesis 1</u>: There are no significant differences in the levels of achievement between students studying a culturally relevant mathematics curriculum unit and those studying a culturally nonrelevant mathematics curriculum unit.

<u>Symbolic Representation</u>

Ho: $u_1 - u_2 = 0$

Legend: Treatment groups
1. culturally relevant
2. culturally nonrelevant

<u>Hypothesis 2</u>: There are no significant differences in the levels of achievement between male or female students studying a culturally relevant mathematics curriculum unit and male or female students studying a culturally nonrelevant mathematics curriculum unit.

<u>Symbolic Representation</u>

$$Ho: \begin{Bmatrix} u_{1,3} \\ u_{1,4} \end{Bmatrix} - \begin{Bmatrix} u_{2,3} \\ u_{2,4} \end{Bmatrix} = 0$$

Legend: Treatment groups
1. culturally relevant
2. culturally nonrelevant

Sex Groups
3. male students
4. female students

<u>Hypothesis 3</u>: There are no significant differences between population groups of students studying a culturally relevant mathematics curriculum unit and population groups of students studying a culturally nonrelevant mathematics curriculum unit.

<u>Symbolic Representation</u>

$$\text{Ho:} \begin{Bmatrix} u_{1,5} \\ u_{1,6} \\ u_{1,7} \end{Bmatrix} - \begin{Bmatrix} u_{2,5} \\ u_{2,6} \\ u_{2,7} \end{Bmatrix} = 0$$

Legend: Treatment groups
1. culturally relevant
2. culturally nonrelevant

Population Groups
5. students resident on reserves
6. students resident off reserves and indiginous to the community
7. students resident off reserves and not indiginous to community

IX. ORGANIZATION OF THE THESIS

Presented in Chapter I was the statement of the need for the study. The importance of the study was followed by the purpose of the study. Questions to be answered, definitions of terms, and limitations, as well as the location of the study, were presented.

Chapter II includes an overview, a review of the literature related to this study, and a summary of the literature pertinent to the study.

In Chapter II the methods, procedures and design of the study are examined in detail. Specifically, the description of the population and selection of the sample, description of the treatments and questionnaires, the research design, and the procedures of the investigation are presented, as well as the methods for analysis of the data.

In Chapter IV the analysis of the data and reports of the findings are presented.

Finally in Chapter V are recorded a summary of the findings, conclusions based on the study, implications arising out of the study, and recommendations for future research.

CHAPTER II

A REVIEW OF RELATED RESEARCH AND LITERATURE

The research and literature describing studies in the area of mathematics and the Native student was found to be limited. If the scope of this review had been expanded to include all available research and literature on mathematics and the so called "disadvantaged" a dearth would still have been found to exist. Suydam (1971) reporting on research in this area said:

> All in all, research has given us limited guidance in knowing how to provide the most effective mathematics programs and instructions for disadvantaged students. Little of the knowledge we do have regarding such students comes from research conducted explicitly within the context of mathematics education. (Suydam, 1971. p.1)

In an attempt to establish the context for the present study this review considered literature related to education and the culturally different; mathematics and the culturally different; education for cultural awareness; the curriculum as a factor in failure for the Native student; the need for a different curriculum for the Native student.

The term "disadvantaged" was found to be used in many different ways, to suit many different situations. Suydam (1971) pointed out two categories of "disadvantaged" the "environmentally" disadvantaged and the "academically" disadvantaged. The environmentally disadvantaged included such cultural factors as socio-economic level or migrant status. Also included was the community or location within a community where the student lived, and the ethnic origin of the student. The academically disadvantaged included such factors as intellectual ability and achievement. This included the "low achiever" with an IQ of 75 to 90. It also included the "underachiever" who appeared to have the ability to achieve at a higher level but who failed to do so.

The writer recognized that the reasons for a student or a group of students being referred to as "disadvantaged" were many. In this review the literature pertaining to or speaking of the disadvantaged within a cultural context was considered. Literature relating to other categories of the disadvantaged was also referred to but only as it spoke to or had implications for the disadvantaged within a cultural context. Consequently, the writer used the term "culturally different" rather than "culturally disadvantaged".

I. LITERATURE RELATED TO EDUCATION AND THE CULTURALLY DIFFERENT

A cartoon published in the New Yorker (Howe, 1968) depicted what has happened to education for the "disadvantaged". The cartoon showed an Indian father reading a bedtime story to his son in the family teepee. He read:

> And just then, when it appeared that the battle was lost, from beyond the hills came the welcome sound of war whoops."

Textbooks used in schools tend to present anything involving

"Indians" only from a "white" point of view.

Forbes (1967) maintained that North American schools are monocultural. The very fact that the term "disadvantaged" was used implied that a certain group of people "do not fit." Forbes further maintained, the term "culturally different" should be used since this terminology would recognize the differences that exist. Forbes believed that thousands of American Indian children in government-run schools were becoming "no culture" people due to the fact that they were learning nothing about the positive aspects of Indian heritage and history. The Indian student had not positively identified with his own heritage and thus had difficulty identifying with the hostile dominant society. Forbes (1967) quoted a study by Max and Dermont on the Pine Ridge Sioux which stated that the last few years of an Indian student's schooling were particularly useless, and were psychologically destructive as demonstrated by the high dropout rate and the lack of responsiveness among pupils in late elementary and early high school. In the past this unresponsiveness had led educators to intensify the traditional approach and focus the blame for failure on the minority group. Society had insisted that the minority group must adjust, must conform, must change, while the schools and their programs were basically sound and needed no fundamental revision (Forbes, 1967).

Indian children in schools were forced to make a choice between their parents and their old ways and a new system in which they anticipated gaining employment. Monocultural schools were one of the causes of tensions that thwarted the avowed educational goals of the school and produced alumni who were unfitted for participation in either culture (Forbes, 1967).

In a Canadian study Hawthorn (1967) found that the national dropout rate for Indian students from Kindergarten to Grade Twelve was ninety-four percent and for Non Indian students was twelve percent. Kirkness (1973) projected a Manitoba based study to the 1974-75 school year and predicted ninety-one percent dropout on the basis of figures available at the time. Sealey (1972), reporting on Manitoba students who had already reached secondary school found that Metis students in Frontier Collegiate, Cranberry Portage, Manitoba had an attrition rate of sixty-six percent.

Fantini (1968) related the dropout rate to the level of achievement. In turn, achievement which was measured by the grade level achieved prior to leaving school, was related, among other things, to a curriculum with which the students could identify culturally.

Major, quoted by Forbes (1967) suggested that the idea of cultural deprivation was a term devised by the missionary urge of whites to remake Native people in their own image. Thus, "cultural deprivation" is posited to be an expression of Anglo-American racism based on the Indian being "backward" and "savage".

Max and Dermont (1966) contended that it made sense for the members of the community to determine what goes on in curriculum of the schools. They further contended that schools should make more vigorous efforts to bring out the rich heritage of folk cultures. The school curriculum should vary from region to region in order to reflect the rich diversity of life. Forbes (1967) on the same topic suggested that true education is therefore always cross-cultural in nature.

Banfield writing in "Education for the Disadvantaged Child", said:

> ...it is time to discard the currently operating definition of the 'disadvantaged' to remove onus for educational failure from the students and lodge it squarely on the educational institutions where it properly belongs... (Banfield, 1974, p. 15)

Baty (1967) stressed that our educational system must stop using the school as an assimilative tool but rather teach for cultural awareness. The school must be multi-ethnic since this would reflect the actual cultural diversity of society. Educators must begin to understand cultural gaps and perform experimentation to bridge these gaps.

Further, Baty (1967) stated that young people have been "shortchanged" by schools in the sense that they have not learned about human differences and what adjustments are necessary to live and work with people of different backgrounds. The minority groups, or the "disadvantaged", have had to adjust to the norms, values, and behaviors of the dominant society reflected within the schools, the curricula, and the teachers. Cultural diversity has been ignored. It is time that the schools, the curricula, and the teachers recognized the culture of children from minority groups and be influenced by it.

Hodgson in an interview reported in Indian-Ed argued:

> Too many white teachers have assumed that to teach Native children is like teaching white children. Many do not realize that the Native child is six years behind the white culture but far more wiser in his own culture than the white six year old. The expectations of the teachers are too high and too confusing. I often wonder what the reaction would be if we expected every white teacher to know our customs, values, morals, and ways of communicating, including non-verbal communication. (Hodgson, 1974, p.3)

Further in regard to the implications for teacher training Cavender (1971) and Sekaquaptewa (1970), established the inadequacy of the Teacher Training Programs for the teachers of Indian children. Some of their concerns were as follows: the need of a knowledge base for the teacher in language, history, values, culture, and curricula having as its source the Native culture; student teaching in Indian schools; the education of the adults to know about the school system and the training of teachers of their children.

II. LITERATURE RELATED TO MATHEMATICS AND THE CULTURALLY DIFFERENT

Most mathematics educators seem to agree with Hendrickson (1974) who argued that mathematics was a tool for problem solving that should be centred around problems that typify the way of life of the student. He did not exclude the way of life of the culturally different.

In December, 1968, Anderson reported that parents of first generation disadvantaged students felt that mathematics was the most important subject taught at school. At the same time he found that these so-called "disadvantaged" students scored much lower on mathematics tests than "advantaged" students.

Mayberry, writing in Education for the Disadvantaged stated:

> We say we are striving for relevancy and at the same time we are trying to prove to the world that algebraic abstraction can be taught to disadvantaged students. Yet, we have not taught them the basics of mathematics that they must master in order to survive successfully in their own environment.... Mathematics must be made a functional part of what the student has experienced. In this way, the disadvantaged child will have some basis for associating mathematics with his or her view of the real world.... We must make mathematics pertinent to the students' lifestyle. (Mayberry, 1973, p. 21)

In discussing the status of the environmentally disadvantaged, Suydam (1971) found that achievement was significantly lower than the national average in preschoolers and in Grade Six students in all mathematics-related activities and tests. She substantiated this finding by referring to research done by Montague (1964), Dunkley (1965), Johnson (1970), Cleveland (1962), and Pattison and Fielder (1969).

Again, Suydam and Weaver (1971), in investigating the effect of special mathematics programs for environmentally disadvantaged students, found that:

> ...special programs designed to provide special treatments and emphases for disadvantaged students result in higher achievement when compared with 'regular' programs which include no special provisions for such pupils. (Suydam and Weaver, 1971, p.3)

That special programs result in higher achievement was further substantiated by Dethmers (1969) in regard to "economic deprivation", and by Hankins (1969), who found that special programs significantly increased achievement. This was also substantiated by Castaneda (1968), in a mathematics program for Mexican Americans; by Lerch and Kelly (1966), working with slow learners in the seventh grade; by Dreyfuss (1969), working with regular classrooms; and finally by Liederman, Chinn and Dunkley (1966) in a pilot project undertaken to evaluate the learning of SMSG (School Mathematics Study Group) materials by culturally disadvantaged pupils.

Suydam concluded on the basis of these researches that among other things:

> ...social relevance appears to be more crucial to consider in the case of disadvantaged students; however little research has attended to this topic... It does little good to report that special programs for disadvantaged students are effective without also reporting in detail the specific nature of those programs. More evidence on 'ideas that work' as well as research is needed. (Suydam, 1971, pp6-7)

Almost all mathematics texts and curricula to date, concluded Mayberry, have dealt with the cognitive domain almost exclusively. He said, "...we need a balance between cognition and affection. Only then can we achieve relevancy". In the domain of affection a cross-cultural approach to the teaching of mathematics could be included. Mayberry represented his concept by the following model. (Mayberry, 1973, p.22)

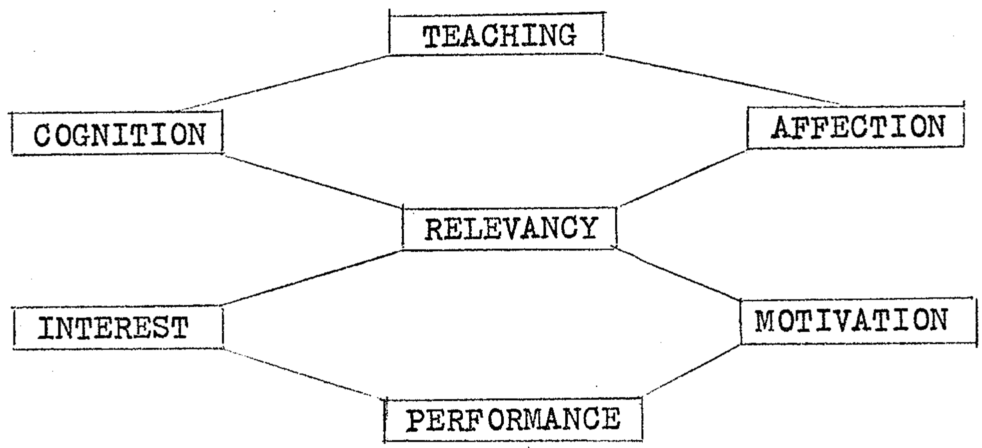


Figure 1

MAYBERRY'S MODEL

In order to achieve relevancy Hammersmith (1973) writing in The Northern Newsletter also contended that problems in mathematics must deal with the reality of the student's world and not the teacher's world. He suggested fur prices and marketing; fish prices and marketing; gasoline consumption and costs in the operation of outboards, skidoos and so on.

There have been some limited number of curriculum units in mathematics created for Native students.

Mewham (1971), reported on a grade three unit which was remotely related to mathematics. She had a bibliography on "The Indian". The bibliography included a list of books for children and a list of films and filmstrips on Indians and Indian Culture.

Stodola (1971) had a unit on "The Mathematical Contributions of the Mayas, Aztecs, and Incas". She included such things as number systems and calendar techniques.

Torguson (1971) had a curriculum unit on the Maya calendar. The unit was designed for use in schools serving both Native students and Anglo-American students.

Selby (1968) compiled a bibliography of materials related to Indian education available from the Institute for Northern Education, University of Saskatchewan. This bibliography was much like that of Suydam (1970), but did not include materials specifically related to mathematics education.

Durowich (1967), compiled a bibliography of one hundred and fifty-nine books and articles published between 1928 and 1967 in the area of Indian Education. This list did not contain a significant number of items directly related to mathematics education.

A final caution to the would be developer of curriculum materials in mathematics and all other subjects for the culturally different was given by Sealey (1972) when he stated:

> In the last decade the market has been flooded with materials concerning Indian Peoples - films, filmstrips, pictures and books. Most of these relate to the Indians of times past and are of a basically romantic nature which white children will accept in small quantities but to which modern Indians and Metis children find difficulty in relating. (Sealey, 1972, p.2)

Individual mathematics teachers have, no doubt, adapted materials which they hoped would improve instruction but the results have not been reported.

III. LITERATURE RELATED TO EDUCATION FOR CULTURAL AWARENESS

In writing about a multi-cultural curriculum, Sussna (1970) argued that the curriculum must reflect the difference and the sameness of people; that people are individual; that ethnic groups are both the same and different; and that only through intergroup communications can one's potential be reached.

Although Maubrich (1965) talked about "acculturation", he did so with a difference. He said that to bridge the gap between the teacher/school and child/family, educators must admit that problems exist; that each group should have an understanding of the other culture; that any search for solutions should be joint; and that all must recognize the value of differing cultural modes.

Education will be truly cultural awareness education only when teachers become acquainted with the other adults of the community, and when teacher training institutions conduct courses to prepare teachers for constructive attitudes towards dominant and minority cultures (Maubrich, 1965) and when increasing numbers of teachers will be content to remain in northern communities for longer periods of time (Wax and Walker, 1970).

Cooper and Norres (1970), in talking about the high dropout rate among pupils of Native descent, ascribed the same reasons as did Wax and Walker, but contended that other aspects of such a program were a) a curriculum which lacks relevance, b) a learning climate alien to the student, and c) inappropriate or invalid application of learning principles in regard to the Indian pupil. In a further comment on this last aspect, they stated that the school, with its alien environment, would not likely provide much in the way of positive reinforcement. It could be concluded that a non-culturally aware educational program could cause dropouts.

Das (1972) attempted to establish the existence of a relationship between cultures and cognitive growth. His argument was that environment was a major factor in cognitive growth with its basic patterns being communicated through culture. He concluded, "to be fully effective an educational experience must be relevant to the child's perceptions and cultural experience". (Das, 1972, p.8)

Sawyer (1973) contended that an objective of any educational system for Native students must be to get the young to understand their cultural heritage. He said:

> The individual ought to see himself in the tribal community, a community housing a tradition, which can be accepted or rejected, but not unless it is first understood. (Sawyer, 1973, p.23)

Further, he stated, "Education to be effective, must be intimately related to family and tribal goals and value systems." (Sawyer, 1973, p.23)

In his book The Unjust Society Cardinal (1969) pointed out several factors pertaining to "culture" and "education". He maintained that although Indians recognize that education is a major factor that can help "...strike off the shackles of poverty", the white man was using it as a tool for "...the implementation of his design of assimilation". (Cardinal, 1969, p.51) Cardinal felt that the question of education had to be rethought within the light of the needs of the Indian people. If education was to be a means of breaking off the "shackles of poverty" an entirely new pattern of authority must be initiated and education would have to be redefined to make it relevant to the needs and culture of the Indians of Canada. Education cannot operate in isolation from people.

Johnson (1968) reporting on the Rough Rock Navaho Demonstration School in Arizona wrote:

> The Rough Rock Navaho Demonstration School is guided by the philosophy that an Indian can, and should, be educated to retain his identity with his native values and culture while, at the same time, learn to master the Anglo culture...(Johnson; 1968, p.15)

In contrast to this W. C. Thomas, the first Indian to receive the directorship of Indian education in Alberta, suggested:

> When an Indian youngster reaches sixteen years of age, he is usually forced to make a choice between two ways of life - education which promises good things; or his parents and community. Frequently the Indian teenager will choose the latter and become a dropout, condemned to inferior or no employment at all... (Kanai News, 1971 p.

Continuing in this vein, McLeod (1964), in talking about the Canadian Mosaic, contended that culture is a "blueprint for living"; it is evolved over a long period of time; it contains the organic sum of ideas, attitudes, and skills, that are operative in the group. Thus, culture finds its primary expression in the family. It is because of this that educators of minorities must keep in mind that they are responsible for programs aimed at integrating the total community more fully with the larger society and the children with their community.

> When the culture, the values, and way of life of his (the Indian child) family are rejected and considered alien and undesirable by the broader society and the school, the reaction of the adolescent is to rebel against both cultures. Hence ... the school should cooperate with the families of its students, to instill in them a pride and positive identity with their own. (McLeod, 1964, p.59)

Since the key to success is the relevance of the school to the student and his culture, McLeod continued, by noting that "subject matter is relevant to the student when it has an idea or principle which tells him something about his own life". (McLeod, 1964, p.57)

Fantini and Weinstein agreed when they said that "...content which is most closely connected to the learner's reality will have the best possibility for engaging the learner". (Fantini and Weinstein; 1968, p.321).

Hence the best content with which to start when a teacher first faces his class is the content the child brings with him; what he knows, what he talks about, what he can teach the teacher - his culture! Later, this content could be related to less familiar content.

Finally Cardinal (1969) pleaded for consideration of cultural awareness in education when he said:

> In the old days the Indian people had their own system of education. It was designed to prepare the child for whatever way of life he was to lead... This education-to-a-purpose enabled the child gradually to become a functioning contributing part of his society. ...his identity was never a problem. His education had fitted him to his society; he knew who he was and how he related to the world and the people about him. (Cardinal, 1969, p.52)

IV. LITERATURE RELATED TO CURRICULUM AS A FACTOR IN FAILURE FOR THE NATIVE STUDENT

Young, writing in "The Northian Newsletter" stated:

> Indian children are being subjected to educational genocide by an insensitive archaic system, so that the Indian youngster perceives school as an alien institution which barely tolerates his physical presence, let alone looks after his spiritual and cultural needs.
>
> He attends schools where the value system, the beliefs, the curriculum and the whole thrust of the institution are culturally foreign and middle class. The teachers are white and the curriculum deals exclusively with white culture, traditions, and civilization. (Young, 1973, p.13)

From this it would be safe to suggest that the present system ignores the children, both in how they grow and in how they learn. This same shortcoming would be particularly harmful to the Indian child.

Purley (1970), in writing about a failure oriented Indian people, said that the first thing needed was to remove the inflexibility from the present curriculum and in its place put something in which there was a direct connection between what was being learned in school and what was happening outside of school.

Vineyard (1970) pointed out another reason for someone being "failure oriented". He contended that educators all gave lip service to local control of schools except when it came to Indian people. Indian parents were alienated and isolated from the opportunities to be involved in their children's education. This lack of involvement implied that those who were running the schools felt superior to the parents of the children in schools. In this regard Lee (1971) contended that no American community would stand for a government sponsored school program that completely ignored American history.

In writing about education in Northern Saskatchewan, Knill and Davis wrote:

> ...School in the North is presently - among other things - an agent for conditioning the child to failure, to a sense of inadequacy, a feeling of inferiority. The manifest or intended function of northern schools is, of course, training children for adult roles in modern Canadan society. But the latent function - the actual, unintended results - of the northern school effort is education of Metis-Indian children for failure. (Knill and Davis, 1967, p.229)

The failure rate in northern schools was phenomenally large; it exceeded by a factor of seven the Saskatoon Public Schools rate. (Knill and Davis, 1967). If these rates still hold, it would be reasonable to assume that Northern education is still "schooling for failure".

LaVallee (1967) said the reasons for this failure included the fact that not enough attention has been given to matters of extra-curricular activities, along with little preparation for responsible community and family life. The departments of education continued to concentrate their energies on treating the social structures themselves.

Fox (1971), reporting on an analysis of an American Indian Literature course impact on the self-image of senior high school American Indian students, found a strong positive correlation. She concluded that the curricula should be revised to reflect history, culture, and values of the Indian people the school serves.

V. LITERATURE RELATED TO THE NEED FOR A DIFFERENT CURRICULUM FOR NATIVE STUDENTS

With only a few exceptions, curriculum for the Native student in public schools was the same as provided for others. Often such a curriculum appeared to reject, to eliminate, or simply to ignore the Native heritage of the child. There were special needs among Native students that the ordinary school curriculum failed to meet. Recognition of these needs and programs to meet them were essential. (Havighurst, 1970).

The Association of Iroquois and Allied Indians (1972) proposed that a new self-awareness for the Indian is <u>needed</u>. The Association contended that a new approach to education of the Native student, and a general revision was <u>needed</u> within the present educational system. A new approach was necessary because the old system had caused absenteeism and an overwhelming feeling of alienation, with a sense of individual and group inferiority being a basic reason for the incredible high dropout rate. A new approach, the Association continued, should include, among many other things, revision of curriculum content to include the Nativeness of this country. The lack of Native culture in the curriculum according to the Association had negative effects on both the Indian and non-Indian student.

A Manitoba study by Goucher (1967) on the problem of dropouts among Indian and Metis students stated that students and teachers of Frontier School Division emphasized the need for curriculum adaptation or revision, particularly in the fields of English, Social Studies, Science, and Mathematics. Among reasons given for this need were reasons similar to the ones mentioned in the previous paragraph.

In this same vein Francis E. Dart argued:

> By the time a child enters primary school he already sees the world through a culture filter which will profoundly influence his response to a formal educational curriculum. We could often go further than we do towards providing a context of participation involving real questions that relate to the students' life and interests and local illustrations that require only locally available equipment. (Dart, 1973, Vol. 4, #8)

In developing a workable curriculum model and plan of instruction Tyler (1949) pointed out four fundamental questions that should be included in such a plan. They were:

1. What educational purposes should the school seek to attain?
2. What educational experiences can be provided that are likely to attain these purposes?

3. How can these educational experiences be effectively organized?
4. How can we determine whether these purposes are being attained? (Tyler, 1949, p.167)

He suggested that i) studying the student and ii) studying contemporary life were basic to answering these questions. In conclusion he emphasized that students were more likely to apply their learning if they could see the relationship between their learning and the situations they encountered in their everyday living.

Berger (1972) in an Alberta study found that the nine Indian families in his study placed the highest priorities on "culture" and "education" given a list of thirteen topics of concern.

Some action has been taken in the area of curriculum revision and development. The Department of Education of the Northwest Territories reported in Areturus:

> In October of this year, the Curriculum Division inaugurated a project to develop and produce reading materials suitable for use in northern classrooms. This project began with the production of the "Dogrib Storybook"...
>
> It is hoped that these books will help to develop the Indian child's pride in his culture and help him envisage the transition that his culture has undergone over the years... (Northwest Territories, Department of Education, 1971, Vol. 1, #3)

This same need for locally oriented materials could apply equally as well to other subjects, including mathematics.

Finally, Renaud (1971), reporting in The Northian on "Canada's Native Heritage": a total school project, said that the staff of St. John's School in Prince Albert, Saskatchewan, decided to experiment with an integrated thematic approach to "Canada's Native Heritage". The thrust of this approach was to organize as many activities as possible in various subjects and at all levels around the above stated theme. Renaud reported that the teachers found this easiest in Social Studies and Creative Arts, but after a while, looking at the world as it was in Indian times, it was also easy to discover countless opportunities for reading lessons as well as science, physical education, and arithmetic lessons.

VI. SUMMARY

This chapter reviewed literature related to education and the culturally different; mathematics and the culturally different; education for cultural awareness; curriculum as a factor in failure for the Native student; and the need for a different curriculum for the Native student.

The relatively low achievement and high dropout rate of Native students was pointed out. In turn this was related to a curriculum that was culturally non-relevant for the Native student. The need for culturally relevant material was pointed out. This need and the proposal that the filling of it would increase achievement and thus eventually lower the dropout rate was based largely on the educational philosophies of parents, teachers, and education administrators. It was pointed out that little real research has been done in the area of mathematics and the culturally different.

CHAPTER III

DESIGN OF THE STUDY

This chapter includes a discussion of the selection and a description of the sample used in the study. It further gives a description of the curriculum materials developed and used, as well as a description of the test instruments and questionnaires used. Following this, the experimental design and procedures of the investigation are described. In conclusion a description is given of how the data is to be analyzed followed by a summary of the chapter.

I. SELECTION AND DESCRIPTION OF THE SAMPLE

This study was conducted in Frontier School Division #48 in the Province of Manitoba. The Division was established in July, 1965. Prior to this date the schools now comprising the Division were administered primarily by a Special Schools Branch of the Department of Education of the Province of Manitoba but with a few being under the Department of Indian Affairs and Northern Development of the Government of Canada. The intention of the reorganization was to facilitate the coordination of efforts to improve education in isolated communities and to minimize duplication of educational facilities and services by the Province of Manitoba and the Government of Canada.

Frontier School Division has its head offices located in Winnipeg. At present the Division is divided into three Areas with regional offices in Thompson for Area 1, Dauphin for Area 2, and Winnipeg for Area 3. A map of the Division is included on page 9 showing the location of the Division, the Areas, and the thirty-three schools administered by the Division. These schools range in size from single classroom with one teacher to multi classroom with forty teachers. Following is a list of the schools by Area and by north-south direction.

<u>Area 1</u>

1. Brochet
2. South Indian Lake
3. South Bay
4. Gillam
5. Ilford
6. Pikwitonei
7. Thicket Portage
8. Wabowden
9. Jenpeg
10. Grand Rapids

<u>Area 2</u>

11. Cold Lake
12. Cranberry Portage Elementary
13. Frontier Collegiate, Cranberry Portage
14. Cormorant
15. Moose Lake
16. Barrows
17. Pelican Rapids
18. Duck Bay
19. Waterhen
20. Anama Bay
21. Crane River

<u>Area 3</u>

22. Sceptre Dillingham
23. Rossville, Norway House
24. Jack River, Norway House
25. Warrens Landing
26. Big Black River
27. Berens River
28. Princess Harbour
29. Matheson Island
30. Pine Dock
31. Loon Straits
32. Wanipigow
33. Bissett

Among the thirty-three schools in the Division there were twenty schools that had intact grade seven classes. The selection of ten schools for participation in this study, was done by the use of random numbers using Table D.2 in Kirk (1968, p.520).

The ten schools selected for participation were contacted by letter. One school selected for the control group was on a semester system and found it impossible to participate. This school was of considerable size and a further random selection of two schools was required to gain an equivalent number of subjects to use as the treatment group.

The final count of schools in the study was five in the treatment and six in the control. Following is a list of these schools by Area.

Area 1

1. Brochet
2. Wabowden
3. Grand Rapids

Area 2

4. Cormorant
5. Crane River
6. Duck Bay
7. Moose Lake
8. Pelican Rapids
9. Waterhen

Area 3

10. Berens River
11. Wanipigow

Most of the residents of the communities in Frontier School Division are of Indian ancestry. For the purposes of this study all the students of Indian ancestry are being referred to as Native students. More specifically, the Native students were divided into two groups - those living on reserves and those living off the reserves. Those living off the reserves could be referred to as Metis. These distinctions however do not hold in all cases.

Following is a breakdown showing the total number of students reported as taking part in the study and how they were placed into three population groupings.

TABLE 1

STUDENT POPULATION GROUPINGS

	No. of Students		
	Treatment	Control	%
1. Students Living on Reserves	30	35	37.14
2. Students Living off Reserves and Indigenous to Area	40	53	53.14
3. Students Living off Reserves and not Indigenous to Area	11	6	9.71
TOTAL	81	94	
	175		100

The students represented in the table above are only those that were used in the statistical analysis of the data. Only those students that wrote both a pretest and a posttest were included in the data reported in this study.

Table 2 shows the total number of students used in the analysis as compared to the total number reported as taking part. Of those randomly selected for the study only students who completed both pre and post tests were used in the analyses.

TABLE 2

SUBJECTS SELECTED AND SUBJECTS USED IN ANALYSIS

	Treatment	Control	Totals
Subjects writing both Pretest and Posttest (used in analysis)	81	94	175
Subjects not writing both Pretest and Posttest	25	18	43
Subjects Selected For Study (Reported as Taking Part)	106	112	218

As has been noted, the random selection for this study was a selection of schools and not a selection of individual subjects. This limitation to randomness is recognized and an appropriate computer program was used that took into account the fact that schools were nested within treatments. This is further explained in Section VI of this chapter in "Analysis of the Data".

II. DESCRIPTION OF THE MATERIALS

This study was conducted at the grade seven level using a unit on word problems. Since it is of an experimental nature a treatment and control situation was utilized. Thus, two units on word problems had to be developed - one unit to be like the materials in present authorized texts and a second unit mathematically identical but translated into a culturally relevant form for schools in Northern Manitoba.

The first unit (See Appendix E) used as the control unit. It was developed to reflect both the vocabulary, and level of mathematical difficulty as found in the mathematics textbooks authorized by the Manitoba Department of Education, for use at the Grade Seven level. In order to present an intact integrated unit and approach to work problem solving, the unit was developed as follows.

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involving single operations and continue on to more difficult problems and problems involving more than one operation.

5. Exercise IV — 12
Introduction: The set of fractions are introduced and become the background set for problems in this exercise.

Problems: This exercise also contains thirty (30) word problems with the level of difficulty advancing as in Exercise III.

6. Exercise V — 17
Ten additional problems.

The second unit (See Appendix D) used as the treatment unit was constructed to reflect the same vocabulary and mathematical levels as the first unit. In order to insure mathematical equivalence between the two units the introductions were constructed identical save for the examples. These were mathematically identical but worded in such a way that the treatment example reflects the culture of the student in northern Manitoba schools. The exercises were also mathematically identical in that the numeral, operations and equations utilized in each were the same. Again the only change is that the treatment exercises were reworded to reflect the culture of the student in northern Manitoba schools. Thus, there was an exercise for exercise and a problem for problem equivalence between the control and treatment units.

The treatment unit has one additional feature. Each of the Exercises III and IV are divided into two sections. Each of these sections begins with a non mathematical, culturally relevant paragraph(s) dealing specifically with different aspects of the culture of the student. These are Trapping, Transportation in the North, Tanning a Moosehide, and A Legend: Simon Gun-An-Noot. The problems in each section then relate specifically to the respective introductory paragraphs. (See Appendix D) The following is the table of contents showing that part of the unit only that varies from the first unit.

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In "Education of Indian and Metis", Kirkness (1973) gives several examples of what she termed culturally relevant curriculum and curriculum adaptations. One facet of her plea for relevance dealt with Mathematics. She writes:

> Work on relevant problems in mathematics.
> eg. One pound of fish costs $1.10. How much will 25 pounds cost?
> A skiddoo uses 1 gallon of gas for every 5 miles. How far will it go on 12 gallons?
> A skiff costs...
> A motor costs...
> One drum of gasoline costs...
> What is the total cost? (Kirkness, 1973, p.167)

A typical question from the grade seven mathematics course would read:

> A highway is 12 lanes wide in one section. This is three times its width when first constructed.

> How many lanes was the highway when first built? (Cadwell, et. al., 1965)

This problem changed to reflect cultural relevancy could read:

> In one section of his trapline, Alpheus has 12 beaver traps. This is three times the number he had when he first set up his trapline. How many beaver traps did he have at first?

In the above fashion each problem in the control unit has a corresponding problem in the treatment unit.

To further assure cultural relevance the completed curriculum unit used in the treatment was presented to two critics; the education coordinator of the Manitoba Indian Brotherhood and a member of the Faculty of Education, University of Manitoba teaching courses in Cross Cultural Education.

Thus, the cultural relevance referred to in regard to the treatment unit was arrived at through personal experience teaching in northern Manitoba; through the use of examples by Kirkness (1973), and through the communication with the above mentioned critics.

III. DESCRIPTION OF THE INSTRUMENTS

In this study there was one pretest, two posttests, a student questionnaire, and two teacher questionnaires. These will be discussed later in this section.

The pretest (See appendix F) consisted of ten word problems and was administered to all students taking part in the study. The test was validated by presenting it to two distinct groups of authorities for consideration. The first group consisted of mathematics teachers and the second was made up of members of the Faculty of Education, Department of Curriculum: Mathematics and Science, at the University of Manitoba. The pretest was prepared to reflect the word problem content of the texts and curriculum guides authorized by the Manitoba Department of Education for the grade seven level. Upon return of the completed pretests the papers were coded as to location and all scored by the writer. Each question had a value of three (3) points, making possible a maximum total of thirty (30) points. Full marks were granted for a correct answer together with the appropriate units. Two (2) points were awarded for answers which had correct numerical components but without the appropriate units. When the answer was incorrect, one (1) point was awarded when the mathematical expression from the word problem was correctly stated. No marks were awarded for partially correct expression or where no attempt had been made to answer the question.

The two posttests were constructed to be mathematically equivalent but culturally different. Each posttest consisted of ten word problems.

The first posttest (See Appendix H) was administered to the students in schools where the control unit had been taught. This test was prepared to reflect the content of the control unit. This test was validated in the same way as the pretest.

The second posttest (See Appendix G) was administered to the students in schools where the treatment unit had been taught. It was prepared to reflect the content of the treatment unit. This test was validated in the same way as the pretest and first posttest but in addition it was presented to a member of the Faculty of Education at the University of Manitoba, teaching courses in Cross-Cultural Education. This further authority was called upon to verify the cultural relevance of the test in regard to the treatment unit and the culture of students in schools in northern Manitoba.

The two posttests were constructed to be problem for problem mathematically equivalent. They differed only in the wording of the problem in that the first reflected the control unit and the second reflected the cultural relevance of the treatment unit. In both cases scoring of the tests was done by the writer and standardized as follows: Full points (3) were awarded an answer that was numerically correct and had the correct units attached. Two (2) points were awarded an answer that had correct numerical components but lacked the appropriate units. One (1) point was awarded for an incorrect answer but preceded by the correct mathematical expression from the word problem or evidence of the correct procedure used in solving the problem. The maximum marks possible on the posttests as on the pretest were thirty (30) points.

Prior to the commencement of the study the completed pretest and posttests were administered to two grade seven classes. One class a grade seven southern Manitoba class, the second a grade seven class in Frontier School Division that had been randomly left out of the participation in the proposed study.

The following table provided a breakdown of the number of students who scored points on each test item, and the points received. This is shown for the pretest and control posttest in testing obtained from these schools combined.

TABLE 3

PRETEST AND POSTTEST VALIDATION

Question #	Pretest No. of Students Obtaining Points	Pretest Total Points Obtained	Posttest* No. of Students Obtaining Points	Posttest* Total Points Obtained
1	52	109	45	98
2	48	111	47	112
3	50	105	41	83
4	15	40	45	114
5	38	83	27	55
6	53	113	38	80
7	45	115	34	73
8	47	92	28	68
9	32	66	22	43
10	19	49	19	37
TOTAL POSSIBLE (Each Question)	53	159	51	153

*POSTTEST in this case refers to the control posttest only.

As indicated by Table 3, the pretest and posttest both contained questions of varying degrees of difficulty. Since this was the intent the tests were considered acceptable for purposes relating to this study.

In the northern school the grade seven class, used to pilot the pretest and posttest for validation purposes, was divided into two equivalent ability groupings by the mathematics teacher. One of these subgroups received the control posttest and the other received the treatment posttest. The means were calculated for each subgroup. These are given in the following table.

TABLE 4

CONTROL AND TREATMENT POSTTEST VALIDATION

	% Means
Subgroup 1	51.52%
Subgroup 2	52.60%

Those scores further substantiate that the posttests were equivalent tests.

The student questionnaire (See Appendix J) administered following the completion of the posttest, will be reported on in a descriptive and detailed manner in Chapter IV. The intent of the questionnaire was to ascertain any differences in responses to the same questions by students in the control or treatment groups. An attempt was made to relate this questionnaire as specifically as possible to the experimental hypothesis. The questionnaire was of the multiple choice type concluded by several open ended questions. The data is recorded in Chapter IV with conclusions and suggestions regarding this record reported in Chapter V.

The teacher questionnaire (See Appendix K) was also administered immediately following the completion of the posttest. This was also of the multiple choice type with several open ended questions in conclusion. All teachers received the same questionnaire. Again, an attempt was made to relate the questionnaire as specifically as possible to the experimental hypothesis. The intent was to ascertain any differences in responses to the same questions by teachers in the control or treatment. The data is recorded in Chapter IV with conclusions and suggestions regarding this record reported in Chapter V.

An attempt was made at validation of the questionnaires. They were presented to fellow graduate students, Faculty of of Education Professors in the Department of Curriculum: Mathematics and Science, and a member of the Faculty of Education teaching courses in Cross Cultural Education, for scrutiny and suggestions. As a result several changes were made in the questionnaires.

The final questionnaire was prepared and sent to those teachers who had taught the control unit. They were sent a copy of the treatment unit and asked to respond in a comparative fashion regarding the treatment unit and the control unit. See Appendix L for the questionnaire, Chapter IV for a report and Chapter V for conclusions and suggestions regarding these comparisons.

IV. EXPERIMENTAL DESIGN

This study was conducted using a pretest-posttest comparison group design. As such, it is similar to the pretest-posttest control group design described by Campbell and Stanley (1972, p.13). Opportunities for randomization to treatment groups were present and were utilized in the study.

The design in Campbell and Stanley (1972) is Design 4. Diagrammatically, the design may be depicted as follows:

$$RO_1 \ X_c \ O_2$$

$$RO_3 \ X_T \ O_4$$

In this study the random selection was one of intact classrooms from the total population of grade seven classrooms in Frontier School Division. In regard to random selection of intact classrooms Campbell and Stanley contended that:

> The all purpose solutions to this (problems created by randomization of subjects) problem is to move the randomization to the classroom as a unit, and to construct experimental and control groups each constituted of numerous classrooms randomly assigned. (Campbell and Stanley, 1972, p.22)

They further stated that the tests of significance for the intact classroom randomization using their Design 4 should be ones that did not pool the students as though the students had been assigned at random. Instead they suggested the correct analysis would take into account the intact classrooms and the resulting larger error terms. They referred to Lindquist (1953, pp. 172-189) as providing the rationale and formulas for a correct analysis and further suggested a covariance analysis of the data which would use the pretest as the covariate. (Campbell and Stanley, 1972, pp.22-23).

Thus, because of the nesting effect caused by random selection of intact classrooms the general design for the study can be illustrated as follows:

$$
\begin{array}{c|ccccc|cccccc}
 & c_1 & c_2 & c_3 & c_4 & c_5 & & & & & & \\
\hline
a_1 & a_1c_1 & a_1c_2 & a_1c_3 & a_1c_4 & a_1c_5 & c_6 & c_7 & c_8 & c_9 & c_{10} & c_{11} \\
\hline
a_2 & & & & & & a_2c_6 & a_2c_7 & a_2c_8 & a_2c_9 & a_2c_{10} & a_2c_{11}
\end{array}
$$

Figure 2

NESTING DESIGN FOR THE STUDY

In this figure a_i $(i=1,2)$ represents the treatments and c_j $(j=1,2, \ldots 11)$ represents the intact classes chosen randomly for the study. In the study, classes (and in this case different schools and communities) one to five received the culturally relevant material and classes six to eleven received the control material comparable to the present authorized texts. This shows the nesting of classrooms within treatments. The independent variable groupings were treatment, school, population, and sex. The treatment variable contained the two categories of curriculum units, i) the culturally relevant unit and ii) the unit patterned after the present authorized texts. The school variable contained the eleven schools participating in the study. The population variable contained the three different categories of i) those students living on a reserve, ii) those students living off a reserve but indigenous to the community, and iii) those students living off a reserve who had recently moved into the community. The sex variable contained the categories of male and female. The dependent variable was the posttest with the pretest used as a covariate.

V. PROCEDURES OF THE INVESTIGATION

Access to Frontier School Division was arranged informally during the summer of 1974. On October 28, 1974 a letter from the Superintendent formally granted permission to use Frontier School Division and encouraged the principals and teachers to participate in the study. (See Appendix A). This letter was used as an enclosure in a letter of request for participation in the study mailed to the ten schools originally selected randomly for the study. (For all correspondence see Appendix A)

Of the ten schools originally contacted for participation, one school found it impossible to participate because it did not teach grade seven mathematics in the winter semester. Due to the size of this school two schools had to be randomly selected to replace it. In this way the five schools in the treatment and the six schools in the control contained approximately the same number of students.

The two curriculum units, the pretest, the two posttests and questionnaires were prepared and presented to the appropriate critics in the late fall and early winter of 1974. Early in January, 1975 the pretest and posttests were further administered for validation purposes to two grade seven classes not in the study.

On January 7, 1975 the selection of the schools was final and a letter was sent to the eleven principals and mathematics teachers confirming their offer to participate, indicating the date for the commencement of the study, and indicating that the writer would personally visit each school to answer any questions and present the materials to be used in the study.

Prior to the commencement of the study on January 28, 1975, each of the schools was visited. Care was taken to provide each of the principals and teachers with exactly the same information. The principals were informed of their role (See Appendix A) in the study and that the study was an experimental one. They were also told whether their school was a treatment or control school. The teachers were briefed on the crucial aspects pertaining to their instructional role in the study. They were not told that the study was an experimental one with treatment and control groups. In this way each of the eleven mathematics teachers could be given the same instructions. During this visit each school received:

1. A list of general instructions regarding the study. (See Appendix A)
2. A note to the teacher - complete with objectives and bibliography. (See Appendix B & C)
3. Enough copies of the pretest for each grade seven student. (See Appendix F)
4. Enough copies of the curriculum unit for each grade seven student and mathematics teacher. (See Appendix D & E).

Each school began the study on January 28, 1975 and continued for ten (10) mathematics periods each of forty to forty-five (40 - 45) minutes in length with no two periods on the same day. The posttest was administered on the day following the last of the ten periods of the instructional periods. Both the pretest and posttests were of 40 - 45 minutes and teacher questionnaires were completed following the completion of the posttest.

On February 4, 1975 each school principal was mailed a package containing:

1. Enough copies of the posttest for each student in grade seven mathematics.. (See Appendix G & H)
2. Enough copies of the student questionnaire for each student in the study (See Appendix J)
3. A copy of the teacher questionnaire. (See Appendix K)

4. A student information form on which were subsequently recorded students names, ages, place of residence. (See Appendix I)

These were required in the study as indicated in the previous paragraph.

By March 13, 1975, all pretests, posttests, questionnaires, and information sheets had been returned, corrected and coded for analysis by computer. On this date each of the teachers in the control schools was sent a copy of the treatment unit and was asked via a short questionnaire to respond in a comparative way between their control unit and the treatment unit. (See Appendix D and E)

By June 5, 1975 all computer analysis was completed and the responses to the questionnaires had been tabulated. At this time a letter (See Appendix A) was sent to each participating principal and teacher indicating very briefly some of the results of the study which might be of immediate interest to them.

VI. ANALYSIS OF THE DATA

The questionnaires were tabulated and are reported descriptively in Chapter IV.

The data from the experimental part of the study were analyzed using analysis of covariance. Treatment, school location, population and sex were used as independent variables. The posttest was the dependent variable and the pretest was used as the covariate. A rationale for the use of these statistics was provided under section IV of this chapter.

The computer program used for the statistical analysis was BMDP2V produced by the Health and Sciences Computing Facility, University of California, Los Angeles in 1973. The general description of this program indicates its strengths and limitations as follows:

> This program performs an analysis of variance or an analysis of covariance for a general repeated measures model. For each subject the trial factors (also called repeated measures factors, ie., factors for which each subject is measured at each level) must have a complete factorial structure with no missing observations. The group factors on the other hand may be crossed or nested; group indices are read as data and determine the nesting relationships without further specification. Unequal cell sizes are allowed but not empty cells. Within subject responses need not be independent, but between subject responses are assumed to be. All factors, except subjects, are assumed fixed. An orthogonal decomposition of the trial effects may be requested. Covariates may, but need not be, constant across trials. In essence, the program performs the analyses in Winer. (Health Sciences Computing Facility, 1973)
>
> The output using this program is:
>
> 1. Cell means and standard deviations for the dependent variable and covariate.
>
> 2. Due to the presence of a covariate, adjusted cell means and regression coefficients.
>
> 3. Design information including nesting relations.
>
> 4. Analysis of variance table consisting of sums of squares, degrees of freedom, mean squares, and F statistics with probability values associated with each.

Two separate computer runs were used since one run would have resulted in several empty cells which are not allowed in this program. The information generated regarding the experimental hypotheses are reported in Chapter IV.

VII. SUMMARY

This chapter included a discussion of the selection and a description of the sample used in the study. This was followed by a description of materials and instruments together with an explanation of the experimental design. The procedures of the investigation were outlined followed by an explanation of the analysis of the data which completed the chapter.

CHAPTER IV

ANALYSIS OF THE DATA

In this chapter the results of the analysis of the data are presented. These will include the data relating to the research questions raised in Chapter I. The first research question relates to the three experimental hypotheses also presented in Chapter I. In the following sections of this chapter the data relating to the remaining research questions will be reported in both a tabular and descriptive form. Within these sections the second and third questions relate to the information obtained from the completed student questionnaires. The fourth question relates to the information obtained from the questionnaires completed by the teachers participating in the study.

I. STUDENT ACHIEVEMENT

In this section are reported the analysis of the data regarding the experimental aspect of this study.

Research Question One: Do students at the Grade Seven level in mathematics using a culturally relevant curriculum unit show greater achievement than students using a culturally nonrelevant curriculum unit?

This research question is divided into three hypotheses each reported separately. In each case an analysis of covariance was used. The independent variables are treatment, school, place of residence (referred to as the population variable), and sex. The posttest is the dependent variable and the pretest is the covariate. In all cases an alpha ($\propto$) level of 0.05 will be required to reject the null hypothesis.

Hypothesis One: There are no significant differences in the levels of achievement between students studying a culturally relevant mathematics curriculum unit and those studying a culturally nonrelevant mathematics curriculum unit.

Ho: $u_1 - u_2 = 0$

Legend: Treatment groups
1. Culturally relevant
2. Culturally nonrelevant

Table 5 shows the cell means and standard deviations for the covariate and dependent variable as well as the adjusted cell means for the dependent variable. The independent variables for this case are treatment and location of school. In this case the schools are nested within treatments. Comparing the adjusted posttest means in Table 5 between treatments, the treatment schools scored noticeably higher than the control schools. It could be noted that some schools contributed more to this difference than others.

Figure 3 gives a graphical representation of the treatment-control comparison by schools. In it the schools for the treatment and the control are graphed separately from lowest adjusted group mean score to highest adjusted

TABLE 5

TREATMENT AND CONTROL CELL MEANS BY SCHOOLS

(Treatments = 2, Schools = 11, Subjects = 175)

	Schools	# of Students	Pretest Mean	Pretest S.D.	Posttest Mean	Posttest S. D.	Adjusted Mean (Posttest)
TREATMENT	1	15	5.33	4.86	2.93	2.87	4.58
	2	8	9.88	5.19	7.50	4.75	6.71
	3	17	7.18	5.21	6.76	3.91	7.42
	4	27	11.89	5.01	13.07	6.25	11.20
	5	14	7.64	5.76	12.36	5.31	12.78
CONTROL	6	7	6.86	3.72	4.00	3.27	4.83
	7	11	6.09	4.30	3.82	4.31	5.06
	8	12	7.25	4.65	4.75	3.25	5.37
	9	29	10.39	6.56	8.00	5.08	6.83
	10	13	6.38	2.81	6.38	2.69	7.47
	11	22	7.73	4.12	2.86	3.03	3.23

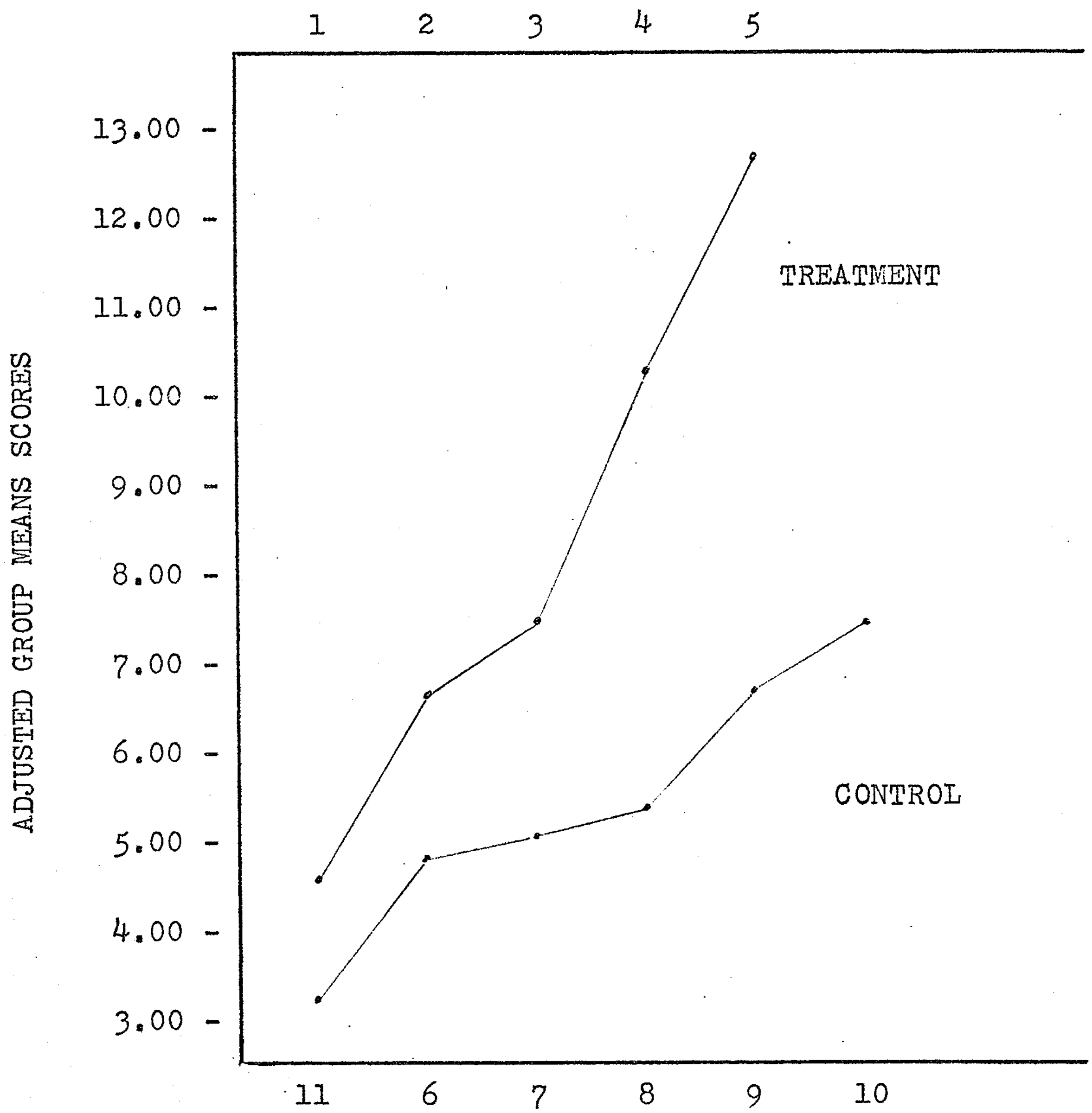

FIGURE 3

ADJUSTED POSTTEST MEANS FOR THE TREATMENT AND CONTROL GROUPS BY SCHOOLS

TABLE 6

ANALYSIS OF VARIANCE FOR POSTTEST

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F-Ratio	Prob. F Exceeded
Mean	294.38672	1	294.38672	24.16917	0.000
Treatments	340.77002	1	340.77002	27.97722	0.000
School Treatment	885.99976	9	98.44441	8.08229	0.000
Covariate	1285.14063	1	1285.14063	105.51009	0.000
Error	1985.38281	163	12.18026		

The pooled regression coefficient for the covariate is 0.53710.

The statistical method was ANCOVA.

As indicated by the data, all interactions between variables used in this analysis were significant beyond the p = 0.001 level.

group mean score.

The data for the analysis of variance for the dependent variable (adjusted posttest) is presented in Table 6. It shows that the F-ratio for the test of equality of the means for the two treatments is 27.07722. This ratio generates a p-value of less than 0.001, which is significant at the p = 0.001 level. Hence the decision was to reject the first null hypothesis. The F-ratios for the covariates, and the treatment-school location interactions also generate p-values significant at the p = 0.001 level.

<u>Hypothesis Two</u>: There are no significant differences in the levels of achievement between male or female students studying a culturally relevant mathematics curriculum unit and male or female students studying a culturally nonrelevant mathematics curriculum unit.

Ho: $$\left\{\begin{matrix} u_{1,3} \\ \\ u_{1,4} \end{matrix}\right\} - \left\{\begin{matrix} u_{2,3} \\ \\ u_{2,4} \end{matrix}\right\} = 0$$

Legend: Treatment Groups

1. culturally relevant
2. culturally nonrelevant

Sex Groups

3. male students
4. female students

Table 7 shows the cell means and standard deviations for the covariate and dependent variable as well as the adjusted cell means for the dependent variable. The independent variables for this case are treatment, location of school, and sex. The location of the school is again included since in this lies the nesting relation.

Figure 4 gives a graphical representation of the treatment-control comparison by schools and by sex. This again demonstrates the treatment-control differences but in addition shows there seems to be no apparent differences between sexes within treatments.

TABLE 7

TREATMENT AND CONTROL SCHOOL MEANS BY SEX

(Treatments = 2, Schools = 11, Sex = 2, Subjects = 175)

		School	No. of Students	Pretest Mean	Pretest S. D.	Posttest Mean	Posttest S.D.	Adjusted Mean (Posttest)
TREATMENT	Male	1	7	5.57	3.95	1.57	1.72	3.10
		2	5	12.60	4.51	10.60	2.30	8.34
		3	9	9.00	5.94	6.33	4.27	6.01
		4	10	14.00	5.40	14.50	6.65	11.01
		5	7	6.29	4.92	10.43	5.53	11.56
	Female	1	8	5.13	5.82	4.13	3.23	5.89
		2	3	5.33	2.08	2.33	2.08	3.99
		3	8	5.13	3.56	7.25	3.69	9.01
		4	17	10.12	5.59	12.24	6.05	11.31
		5	7	9.00	6.58	14.29	4.68	13.96
CONTROL	Male	6	4	8.00	3.56	3.25	2.63	3.47
		7	10	6.60	4.17	4.10	4.43	5.07
		8	8	7.25	5.01	5.13	2.90	5.75
		9	15	10.20	7.28	8.87	5.64	7.90
		10	8	6.38	3.11	5.75	2.87	6.84
		11	16	7.31	3.82	2.44	2.31	3.03
	Female	6	3	5.33	4.04	5.00	4.36	6.65
		7	1	1.00	0.00	1.00	0.00	4.98
		8	4	7.25	4.57	4.00	4.24	4.62
		9	14	11.00	5.94	7.07	4.43	5.68
		10	5	6.40	2.61	7.40	2.30	8.48
		11	6	8.83	5.04	4.00	4.52	3.77

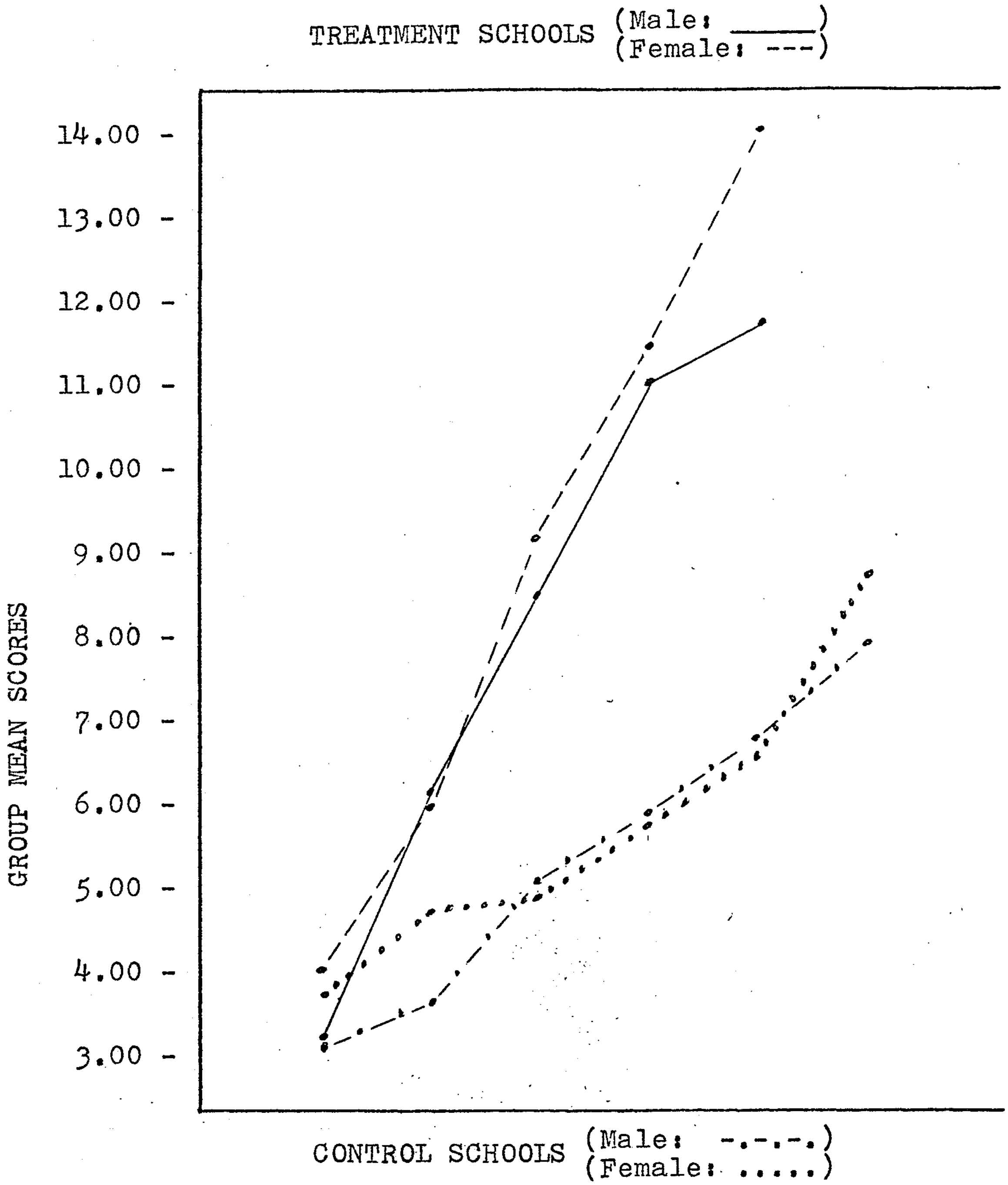

FIGURE 4

ADJUSTED POSTTEST MEANS FOR TREATMENT AND CONTROL SCHOOLS BY SEX

TABLE 8

ANALYSIS OF VARIANCE FOR POSTTEST

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F-Ratio	Prob. F. Exceeded
Sex	10.05005	1	10.05005	0.85127	0.358
Treatment Sex	1.64355	1	1.64355	0.13921	0.710
School Treatment Sex	155.84619	9	17.31624	1.46675	0.165
Error	1794.49561	152	11.80589		

Pooled regression coefficients for the covariate is 0.53775.

The statistical method is ANCOVA.

As indicated by the data, all interactions between variables that involved a by sex comparison are not statistically significant.

The data for the analysis of variance for the dependent variable (adjusted posttest) is presented in Table 8. It shows that the F-ratio for the test of equality of the means for the sex variable is 0.85127. This generates a p-value of 0.358. This main effect as well as the interactions were not significant. The decision was not to reject the second null hypothesis.

Hypothesis Three: There are no significant differences between population groups of students studying a culturally relevant mathematics curriculum unit and population groups of students studying a culturally nonrelevant mathematics curriculum unit.

$$\begin{Bmatrix} u_{1,5} \\ u_{1,6} \\ u_{1,7} \end{Bmatrix} - \begin{Bmatrix} u_{2,5} \\ u_{2,6} \\ u_{2,7} \end{Bmatrix} = 0$$

Legend: Treatment Groups

1. Culturally relevant
2. Culturally nonrelevant

Population Groups

5. Students resident on reserves
6. Students resident off reserves and indigenous to the community
7. Students resident off reserves and not indigenous to the community.

Table 9 shows the cell means and standard deviations for the covariate and dependent variable as well as the adjusted cell means for the dependent variable. The independent variable for this case are treatment and population groups. The location of the school is not included since such inclusion would have resulted in several empty cells and the program used did not allow for empty cells. Thus, this analysis does not take into account the nesting relation of schools within treatments. Comparing the adjusted means in Table 9 it could be noted that there was a noticeable difference in achievement between treatments but there do not seem to be any apparent differences between population groups within treatments.

TABLE 9

TREATMENT AND CONTROL CELL MEANS BY POPULATION

(Treatments = 2, Populations = 3, Subjects = 175)

	Population	No. of Students	Pretest Mean	Pretest S.D.	Posttest Mean	Posttest S.D.	Adjusted Mean (Posttest)
TREATMENT	1	30	5.63	5.03	7.03	6.03	8.72
	2	40	10.28	5.25	9.55	5.58	8.41
	3	11	11.73	7.16	13.82	7.12	11.80
CONTROL	1	35	6.83	4.16	4.46	3.57	5.42
	2	53	8.83	5.68	6.00	4.77	5.74
	3	6	9.17	4.17	5.17	4.49	4.70

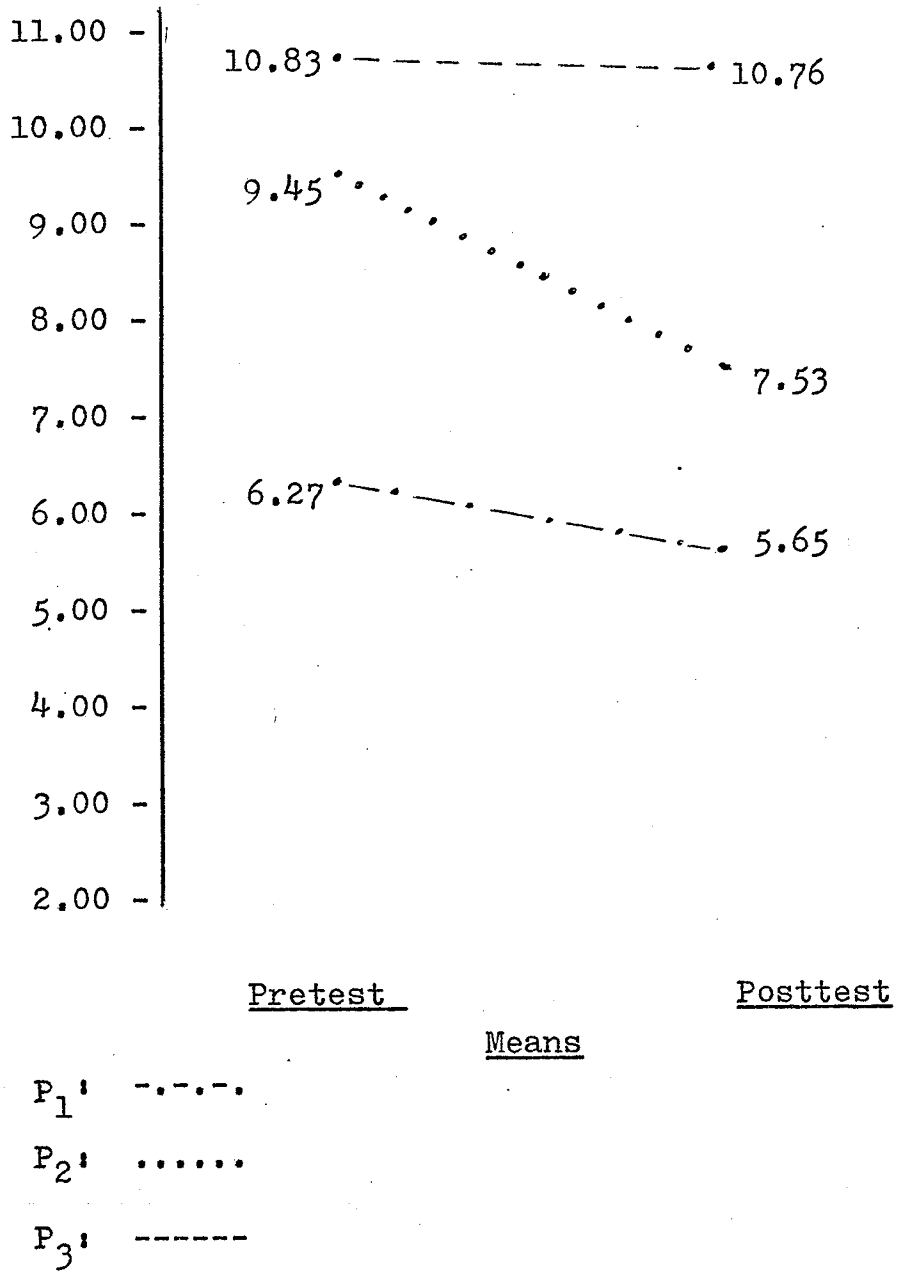

FIGURE 5

PRETEST AND POSTTEST MEAN SCORES
FOR THREE POPULATION GROUPINGS

TABLE 10

ANALYSIS OF VARIANCE FOR POSTTEST

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F-Ratio	Prob. F Exceeded
Mean	209.34009	1	209.34009	12.72471	0.000
Treatments	467.83862	1	467.83862	28.43750	0.000
Populations	19.28125	2	9.64063	0.58600	0.558
Treatment /Population	64.82690	2	32.41345	1.97025	0.143
Covariate	1730.05859	1	1730.05859	105.16138	0.000
Error	2763.84741	168	16.45146		

Pooled regression coefficients for the covariate is 0.60825.

The statistical method is ANCOVA.

As indicated by the data all interactions between variables that involve a by population comparison are not statistically significant.

Figure 5 shows the pretest used posttest performance of the three population groupings. The slopes of the lines confirm the lack of apparent differences between population groups.

The data for the analysis of variance for the dependent variable (adjusted posttest) is presented in Table 10. It shows that the F-ration for the test of equality of the means for the population variable is 0.58600. This generates a p-value of 0.558 which is not statistically significant. The F-ratio for the treatment by population comparison is 1.97025. This generates a p-value of 0.143 which is not statistically significant. The decision was not to reject the third null hypothesis.

In summary the results, relating to the three hypotheses within research question one, are presented in Table 11. Hypothesis One is rejected while Hypotheses Two and Three are not rejected.

TABLE 11

SUMMARY ANALYSIS OF VARIANCE RELATING TO THE EXPERIMENTAL HYPOTHESES WITH LEVEL AND DECISION

Hypothesis	Variables Tested	Level	Decision
1	Treatments	$p<0.001$	reject
	School/Treatment		reject
2	Sex	$p>0.05$	not reject
	Treatment/Sex		not reject
	School/Treatment /Sex		not reject
3	Populations	$p>0.05$	not reject
	Treatment /Population	$p>0.05$	not reject

II. STUDENT QUESTIONNAIRE

In this section is presented the tabulated data regarding the student responses to the questionnaire administered upon completion of the posttests. All students in both the treatment and control schools received the same questionnaire (See Appendix J). The data presented relates to Research Questions Two and Three.

Research Question Two: Do students enjoy mathematics more if a culturally relevant mathematics curriculum unit is used rather than a culturally nonrelevant mathematics curriculum unit?

Research Question Three: Do students see a greater value in mathematics if a culturally relevant mathematics curriculum unit is used rather than a culturally nonrelevant mathematics curriculum unit?

Items 2-13 of the questionnaire are presented with a treatment and control comparison by percentages. Items 14-16 are open ended. These are presented in an item by item, treatment and control, descriptive manner with responses presented that are representative of all student responses. The data relating to the student questionnaire is presented in Table 12. Summaries and conclusions regarding the questionnaire are presented in Chapter V.

TABLE 12

TREATMENT AND CONTROL COMPARATIVE RESPONSES

BY PERCENTAGE TO A STUDENT QUESTIONNAIRE

ITEM	QUESTION	TREATMENT (%)	CONTROL (%)
2.	What is your sex?		
	Male:	41.46	63.27
	Female:	58.54	36.73
3.	Your age as of January 1, 1975?		
	Eleven	-	4.44
	Twelve	36.25	22.22
	Thirteen	35.00	31.11
	Fourteen	17.50	30.00
	Fifteen	10.00	11.11
	Sixteen	1.25	1.11
4.	Where do you live?		
	a) Reserve	35.37	32.65
	b) Village	37.80	60.20
	c) Other	26.83	7.14
5.	How long have you lived here?		
	a) Always	53.66	76.29
	b) Five or more yrs.	30.49	16.49
	c) Less than five yrs.	15.85	7.22
6.	How many brothers and sisters do you have?		
	a) 0-4	33.33	15.31
	b) 5-9	54.32	58.16
	c) 10-up	12.35	26.53
7.	Did you like this unit on word problems?		
	a) All of it	25.30	23.00
	b) Most of it	36.14	28.00
	c) Some of it	31.33	39.00
	d) None of it	7.23	10.00
8.	Do you like mathematics?		
	a) All of the time	21.69	19.19
	b) Most of the time	38.55	42.42
	c) Some of the time	37.35	32.32
	d) Never	2.41	6.06

TABLE 12 (Con't)

ITEM	QUESTION	TREATMENT (%)	CONTROL(%)
9.	How many problems did you do in this unit on word problems?		
	a) More than those assigned	3.70	2.15
	b) All those assigned	25.93	27.96
	c) Most of those assigned	37.04	37.63
	d) Some of those assigned	32.10	30.11
	e) None	1.23	2.15
10.	Would you like more of your mathematics set up like this unit on word problems?		
	a) Yes (all of it)	26.83	28.28
	b) Yes (some of it)	59.76	50.51
	c) No (none)	13.41	20.21
11.	Did you show your parents or guardians what you were doing in this unit on word problems?		
	a) Yes	21.95	11.11
	b) No	78.05	88.89
12.	What subject do you like best in school?		
	a) Literature	13.41	26.04
	b) Mathematics	30.49	25.00
	c) Georgraphy/History	19.51	22.92
	d) Science	36.59	26.04
13.	What subject do you like least in school?		
	a) Literature	39.02	26.04
	b) Mathematics	8.54	16.67
	c) Geography/History	37.80	34.38
	d) Science	14.63	22.92

TABLE 12 (Con't)

14. What did you <u>like</u> about this unit on word problems?

i) Treatment Responses
- The short stories
- It was easy and fun.
- I liked it because it was different.
- I think it was easy.
- It helped me alot.
- It tested my skill.
- I liked the hard thinking.
- I liked all of it.
- It was a change in math.
- It taught me things I didn't know.

ii) Control Responses
- The first exercise.
- I like it all.
- I like it because it is good practice.
- I did not like any of it.
- I liked most of the problems.
- I like some of the problems.
- I liked the beginning of the book.
- It was easy and kind of fun.
- Nothing.
- They help you get ahead in school.

15. What did you learn about that you liked in this unit on word problems?

i) Treatment Responses
- I learned more math.
- I learned more than in our own books.
- About how to trap.
- I learnt nothing.
- How to do hard problems.
- Nothing.
- I learn how to read problems better.
- I learned alot more than in our own math book.
- I learned to do fractions better.
- I learned that word problems can be fun.

ii) Control Responses
- The meanings of words.
- I learned how to add and subtract.
- I learned more fractions.
- I learned how to do problems in steps
- I learned about fractions and liked it.
- Nothing.
- I learned to work them out easier.
- How to approach problems.
- How to do fractions on the operations.

TABLE 12 (Con't)

16. What did you <u>not like</u> about this unit on word problems?

i) Treatment Responses
- The questions were long and hard.
- The problems.
- It should have more stories.
- Nothing.
- The questions.
- There were too many fractions in the unit.
- The mixed up questions.
- Nothing, I liked them all.
- I did not like fractions.

ii) Control Responses
- It was too hard.
- Word problems, I guess.
- I didn't like the last part.
- I did not like fractions.
- They were too hard.
- Answering the questions.
- I liked all of it because I learned alot more.
- I didn't like the words I didn't understand.
- The hard ones.

III. TEACHER QUESTIONNAIRES

In this section is presented the tabulated data regarding the teacher responses to two questionnaires. The first was administered to all teachers involved in the study while the second only to those teachers within the control schools. The first was completed immediately following the teaching of the unit. The second was completed some weeks later when all the previously administered tests and questionnaires had been returned to the writer for correction and tabulation. These two questionnaires relate to research question four.

Research Question Four: Do teachers using a culturally relevant mathematics curriculum unit consider their unit to be more important in student enjoyment and achievement than do teachers using a culturally nonrelevant mathematics curriculum unit?

TEACHER QUESTIONNAIRE I
(See Appendix K)

Items 2-9 of this questionnaire are presented using a treatment and control comparison by percentages. Items 10-12 are open ended. These are presented in an item by item, treatment and control, descriptive manner. Each response for every teacher is reported. This data is presented in Table 13.

TABLE 13

TEACHER RESPONSE TO A QUESTIONNAIRE WITH A TREATMENT/CONTROL COMPARISON BY PERCENTAGE

ITEM	QUESTION	TREATMENT (%)	CONTROL (%)
2.	Teacher's Sex?		
	a) Male	100.00	100.00
	b) Female	-	-
3.	Number of years of teaching experience including the present yr.		
	a) 1-2	60.00	66.67
	b) 3-4	40.00	-
	c) 5-up	-	33.33
4.	Number of years of teaching experience in northern schools. (Frontier)?		
	a) 1-2	60.00	66.67
	b) 3-4	40.00	-
	c) 5-up	-	33.33
5.	How useful was this unit on word problems?		
	a) Very useful	-	16.67
	b) Fairly Useful	100.00	66.67
	c) a little useful	-	16.67
	d) Not useful at all	-	-
6.	How suitable was this unit for your students mathematically?		
	a) Very suitable	20.00	-
	b) Fairly	80.00	33.33
	c) A little	-	66.67
	d) Not at all	-	-
7.	How suitable was this unit for your students culturally?		
	a) Very suitable	20.00	-
	b) Fairly	60.00	16.67
	c) A little	20.00	33.33
	d) Not at all	-	50.00

TABLE 13 (Con't)

ITEM	QUESTION	TREATMENT (%)	CONTROL (%)
8.	Do you feel this was a good learning experience for your students?		
	a) Very much	-	-
	b) Fairly much	100.00	33.33
	c) A little	-	66.67
	d) Not at all	-	-
9.	Should more of our math be presented in this way?		
	a) Yes Much more)	80.00	40.00
	b) Yes (A little more)	20.00	60.00
	c) No	-	-

10. What did you like about this unit on word problems?

i) Treatment Responses
- The stories were beneficial in stimulating the interest of the students
- It was easy to relate to our present situation
- The introduction was useful.
- The unit was culturally appropriate.
- It was a challenge.

ii) Control Responses
- It was a challenge and made them read more carefully.
- Good introduction and problems carefully structured
- Step by step development
- The logical sequence.
- The idea of "N" representing the unknown was useful.
- The material presented in a step by step manner.

11. What did you dislike about this unit on word problems?

i) Treatment Responses
- The vocabulary was a little difficult.
- Problems presented were beyond the present math level of some of my students.
- Nothing
- Nothing
- Transformation from whole no. to fractions too quick.

ii) Control Responses
- This was ideal for students who want to learn.
- Too much emphasis on fractions.
- I was under the notion this was to help develop

TABLE 13 (Con't)

a unit for use with native students. If this is the case much work needs to be done.
- Problems not related to northern students.
- Problems quite similar to the present text.

12. Further Suggestions.

i) Treatment Responses
- Write a math book for Grade 7. You've made a good start.
- Seek Frontier employment. We could use much more of this type of material.
- I would suggest another booklet of this kind going from primary to junior high. Our present texts are not culturally relevant for my students. This causes difficulties.
- This unit rather than textbook.

ii) Control Responses
- Some problems had ridiculous remainders.
- Most of my grade seven class was below the grade seven level.
- Terms should be simple - rural oriented and names and places should have a familiar ring.
- This unit was too city oriented.
- The idea of word problems is great but they must be practical and relevant.

TEACHER QUESTIONNAIRE II
(See Appendix L)

This questionnaire was completed only by the teachers of the control schools. Each was sent a copy of the treatment mathematics unit and asked to compare it to the control unit they had used. The responses to the questionnaire are reported in the same manner as the first teacher questionnaire. Table 13 contains the data relating to this second teacher questionnaire.

Summaries and conclusions regarding the questionnaires are presented in Chapter V.

TABLE 14

CONTROL TEACHER RESPONSES TO QUESTIONNAIRE ADMINISTERED UPON RECEIPT OF A TREATMENT UNIT

ITEM	QUESTION	RESPONSES (%)
5.	Would this unit be more suitable for your students than the one you used?	
	a) Much more suitable	100.00
	b) More suitable	-
	c) About the same	-
	d) Less suitable	-
6.	Would this unit be more suitable for your students in a cultural sense?	
	a) Much more suitable	66.67
	b) More suitable	33.33
	c) About the same	-
	d) Less Suitable	-
7.	Do you think they would enjoy the unit more?	
	a) Very much more	-
	b) Much more	66.67
	c) About the same	33.33
	d) Less	-
8.	Do you think their level of achievement would increase?	
	a) Very much more	-
	b) Much more	100.00
	c) About the same	-
	d) Less	-
9.	Should more of our mathematics be presented in this (culturally relevant) way?	
	a) Very much more	33.33
	b) Much more	33.33
	c) A little	33.33
	d) None	-
10.	What do you like about this culturally relevant unit? - It brings the problems into perspective with the local way of everyday life. - It should give the students a valid reason for studying mathematics, as well as making it easier to understand.	

TABLE 14 (Con't)

- More interesting.
- It brings the problems into a setting which the kids are familiar with.

11. What do you dislike about this unit?
    - It places too much emphasis on fractions.
    - Not enough emphasis on the metric system.
    - A key to the questions would make it more convenient to use.
    - Progress to hard.

12. Further comments.
    - I'm curious to see if relating math to the environment of the students does increase learning.
    - Were the pretest and posttest the same for both the control and treatment schools?

SUMMARY

In this chapter were presented the data relating to the analysis of covariance in which the posttest was the dependent variable; the pretest a covariate; and treatment, school location, population grouping, and sex were used as independent variables. Also presented were data relating to the student questionnaire and teacher questionnaires. This was presented by percentages in a comparative way between students or teachers in the treatment and students or teachers in the control. The summaries and conclusions regarding this data are presented in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A summary of the purpose and design of the study will be presented in this chapter together with a summary and discussion of the findings and conclusions. Also presented will be the implications for educational practice. In conclusion, suggestions for further study and research will be presented.

I. SUMMARY

Suggestions have been made by many educators concerning the need for curriculum materials that reflect the culture and environment of the student. In particular, it has been suggested that a reason for the high dropout rate and lower level of achievement experienced by native students when compared to non-native students in Canada, is the lack of a curriculum that takes into account the culture of the native student. This study, then, has been directed to the determination of the effect on achievement of the use of a culturally relevant mathematics curriculum unit. It has also been extended to include the reactions of students and teachers to such a unit of study.

More specifically, answers were sought to the following questions:

1. Do students at the grade seven level in mathematics using a culturally relevant mathematics curriculum unit show greater achievement than students using a culturally nonrelevant mathematics curriculum unit?
(This question was used for comparisons between treatments, between population groupings, and between sexes.)

2. Do students enjoy mathematics more if a culturally relevant mathematics curriculum unit is used rather than a culturally nonrelevant mathematics curriculum unit?

3. Do students see a greater value in mathematics if a culturally relevant mathematics curriculum unit is used rather than a culturally nonrelevant mathematics curriculum unit?

4. Do teachers using a culturally relevant mathematics curriculum unit consider their unit to be more important in student enjoyment and achievement than do teachers using a culturally nonrelevant mathematics curriculum unit?

Conclusions relating to the first question are made as a result of information obtained from the experimental part of the study. Conclusions relating to the remaining three questions are made as a result of information obtained from the questionnaires administered to students and teachers upon completion of the experimental part of the study.

For the experimental part of the study two curriculum units were developed on word problems at the grade seven level. One unit was constructed to reflect the vocabulary, level of difficulty, and types of problems found in the texts authorized for grade seven mathematics by the Department of Education, Province of Manitoba. The second unit was constructed to reflect the culture of students in northern Manitoba schools. The two units were constructed to be mathematically equivalent - the introduction was the same and each word problem in the first unit had a mathematically equivalent problem in the second unit. Eleven schools were randomly selected from within Frontier School Division #48, five as treatment schools which received the culturally relevant unit and six as control schools which received the first unit mentioned above. (See Appendix D and E for these two units)

All the students in both treatments wrote the same ten item word problem pretest on the same day. This was followed by ten mathematics instructional periods each of forty to forty-five minutes in length, during which time the two units were taught to their respective students. In the mathematics period following this ten day period a posttest was administered to all the students in the study. This again was a ten item word problem test. The test for the control schools was constructed to reflect the material in the control unit. The test for the treatment schools was constructed item for item mathematically equivalent to the control test but had each problem translated into culturally relevant terms reflecting the material in the treatment unit. (See Appendix F, G, and H for these three tests) These tests were all of forty-five minutes duration. Only those students who wrote both pretest and posttest were used in the statistical analysis of this experimental research. The final count was eighty-one (81) subjects in the treatment and ninety-four (94) subjects in the control.

The principals of the schools were privately told of the nature of the study. The instruction in each school was done by the teacher who normally taught grade seven mathematics. Teachers in both the treatment and control received the same instructions. (See Appendix A, Letter dated January, 1975)

The students participating in the study were divided into three population groupings. One group was comprised of those that lived on reserves, another consisted of those that lived off the reserves but were indigenous to the community, while the third group lived off the reserves and were not indigenous to the communities. With this information and additional information as to the sex of each student, an analysis of covariance was performed using treatment, school location, population grouping, and sex as independent variables. The posttest was the dependent variable with the pretest as the covariate. In this way the main effects between treatments, population groupings and sex could be compared.

The analysis of covariance was performed by computer program BMDP2V which took into account that the intact classes randomly selected were nested within treatments. The results indicated that there was a significant difference in achievement between treatments, but no significant differences between population groupings or between sexes.

Following the posttest the students in both the treatment and control completed the same questionnaire. This questionnaire related to questions two and three. The tabulated responses were compared between treatments by percentage. (See Appendix J for the student questionnaire) The subjective judgement of the writer is that the students did indeed enjoy mathematics more when it was culturally relevant.(See Section II if this Chapter) Although the students in the treatment group seemed to enjoy their unit more and seemed to have a more positive attitude toward the subject material it could not be said that they saw greater value in mathematics than students in the control group.

At the same time that the student questionnaire was being completed the teachers also filled out a questionnaire (See Appendix K). The questionnaire for all teachers in both the treatment and control groups was the same. Some weeks later the teachers in the control group received a copy of the treatment unit and were asked to compare it with the control unit, in a second questionnaire. (See Appendix L) The results of these two questionnaires relating to question four were tabulated and reported in the same manner as the student questionnaire. The responses indicated that teachers felt cultural relevance to be of importance. Almost without exception the teachers felt that culturally relevant curriculum material in mathematics would increase student enjoyment and achievement in mathematics.

II. FINDINGS AND CONCLUSIONS CONCERNING THE EFFECTS ON ACHIEVEMENT OF A CULTURALLY RELEVANT MATHEMATICS PROGRAM

In Chapter I the first research question, broken down into three experimental hypotheses was posed to clarify the first purpose of the study. That purpose was to determine the effects on achievement of a culturally relevant mathematics program. In this section of the chapter the findings and conclusions relating to these hypotheses are set forth.

1. Given a significant difference ($p<0.001$) between students studying a culturally relevant mathematics curriculum unit and students studying a culturally nonrelevant unit, it may be concluded that the use of relevant mathematics curriculum materials results in a significant increase in the level of achievement experienced by such students when compared to students studying a culturally nonrelevant unit.

2. Given no significant differences in the levels of achievement between male or female students studying a culturally relevant mathematics curriculum unit and male or female students studying a culturally nonrelevant mathematics curriculum unit it may be concluded that sex has no differential effect on the level of achievement experienced by students. More specifically, there were no significant differences between sexes studying a culturally relevant

unit or between sexes studying a culturally nonrelevant unit.

3. Given no significant differences in the levels of achievement between population groups of students studying a culturally relevant mathematics curriculum unit or population groups of students studying a culturally nonrelevant mathematics curriculum unit it may be concluded that a student's place of residence in a northern community has no differential effect on his/her level of achievement. At the same time a population group studying a culturally relevant unit showed a level of achievement significantly higher than the same population group studying a culturally nonrelevant unit.

4. Although the study indicates a significantly higher level of achievement for the students studying a culturally relevant mathematics curriculum unit when compared to students studying a culturally nonrelevant unit, it must be noted that the schools nested within treatments did have a differential effect in regard to this difference in levels of achievement. More specifically, some of the schools within the treatment contributed much to the difference in the level of achievement while others contributed much less. This same situation is again repeated within the control schools.

III. FINDINGS AND CONCLUSIONS CONCERNING THE STUDENT QUESTIONNAIRES

In Chapter I the second and third questions were posed to ascertain the attitudes of the students involved in the study, as they related to the material content and the subject matter of the study. In this section the findings and conclusions gleaned from the analysis of the student questionnaire, are set forth.

1. Students studying the culturally relevant mathematics curriculum unit seemed to enjoy mathematics somewhat more than students studying the culturally nonrelevant mathematics curriculum unit. More specifically, this difference in enjoyment can be seen in responses to such questions as "What subjects do you like best/least in school?" (#12,13) and "What did you like/learn/dislike about this unit on word problems?" (#14,15,16).

2. Although students studying the culturally relevant unit seemed to like mathematics more than other school subjects (#12,13) to a somewhat greater extent than students studying the nonrelevant unit, it is not apparent that there was any difference in the value either group placed on the value of mathematics. This can be seen in the responses of both groups to such questions as "How many problems did you do in this unit on word problems?" and "Would you like more of your mathematics set up like this unit on word problems?" (#9,10).

Any additional conclusions relating to the student will be left to the reader.

IV. FINDINGS AND CONCLUSIONS CONCERNING THE TEACHER QUESTIONNAIRES

In Chapter I the fourth question was posed to ascertain the attitudes and opinions of the teachers involved in the study relating to student enjoyment and achievement. In this section the findings and conclusions gleaned from the two teacher questionnaires are set forth.

1. The treatment teachers felt their unit was more suitable for their students mathematically than did the control teachers. (#I-6)

2. The treatment teachers felt their unit was more suitable for their students culturally than did the control teachers. (#I-7)

3. The treatment teachers felt their unit was a better learning experience for their students than did the control teachers. (#I-8)

4. Although both the treatment and the control teachers felt that more mathmatics should be presented in a manner such as this unit on word problems, this opinion was stated more strongly by the treatment teachers. (#I-9)

5. Control teachers received a copy of the treatment unit after the units had been taught and all stated that the treatment unit would be much more suitable for their students. (#II-5,6)

6. Control teachers received a copy of the treatment unit after the units had been taught and most stated that they felt students would enjoy the treatment unit much more than the control unit. (#II-7)

7. Control teachers were also unanimous in stating that they felt their student's level of achievement would be higher if the culturally relevant unit was used. (#II-8)

8. Again, these same teachers where unanimous in stating that more mathematics should be presented in a culturally relevant manner. (#II-9)

9. In view of the above findings and conclusions it can be stated that teachers feel that a culturally relevant mathematics curriculum unit is more important in both student enjoyment and achievement than a culturally nonrelevant mathematics curriculum unit.

V. DISCUSSION

Subject to the limitations stated, this study has shown that the use of a culturally relevant mathematics curriculum unit has a greater positive effect on the level of achievement attained by students than does a similar unit not taking into account the culture of the student. As noted in Chapter II many educators and educational critics of intercultural schools have suggested that the culture of the student should be considered in the development and presentation of the curriculum in such schools. This study has shown experimentally that in fact cultural relevance does play a significant role. If it is true, as these same critics propose, that a higher level of achievement is directly related to a lower dropout rate among students it could be concluded that a culturally relevant program would result in a lower dropout rate.

As noted in Chapter III there is one area in which the treatment and control units developed and used in this study do differ. The treatment unit had culturally significant, non-mathematical paragraphs of introduction for four of the exercises in the unit. It could be argued that the significantly higher increase in the level of achievement of the treatment subjects was due to these paragraphs rather than the cultural relevance within the problems themselves. This may be true but at the same time this possibility does not detract from the conclusions drawn since the paragraphs were culturally relevant, that cultural relevance does have a positive effect on achievement. Further studies could be suggested that would further isolate these variables.

VI. IMPLICATIONS FOR EDUCATION PRACTICE

The implications of the results of this study have pertinence for educators and publishers of texts and curriculum materials.

The difference found in the levels of achievement suggest that the development of culturally relevant currriculum materials and texts be made a matter of priority for intercultural schools. This work could be begun by teachers as they prepare for their daily classes, by administrators as they set priorities and select their faculties, and by departments of education as they plan curriculum and chose texts for these courses. In addition, publishers should be aware of the need and produce and publish materials that could be used in intercultural schools.

The development of such texts and materials should have input from all levels of communities serviced by these schools and educators teaching, planning, and administering education in such schools. In particular school boards responsible for such schools should consider the development of such materials of a major concern. In this regard, trained educators could be hired to facilitate the development of such cultural materials.

VII. RECOMMENDATIONS FOR FUTURE RESEARCH

From the viewpoint of this study there appear to be several suggestions for further research.

1. The study should be replicated in design with exception of the duration of the instructional time. It would be advantageous to lengthen this instructional time to be more representative of the total achievement for the courses of study.

2. This study should be replicated in design with the substitution of other topics in mathematics for the

"word problem" unit used in the present study.

3. This study should be replicated in design with the deletion of mathematics as the subject of research and replaced by units or courses representing other disciplines in the school curricula.

4. Other studies should be conducted to determine whether the introductory paragraphs to the exercise were the source of the significance of culturally relevant mathematics material.

5. Other studies should be conducted to determine the effects of culturally relevant materials on other minority and cultural groups than those represented in this study.

6. This study should be replicated in design with the exception of the grade level, to determine the effect on various levels other than that used in this study.

7. This same study should be repeated using a larger population for selection of the sample. In this way the conclusions would have more definite implications for a wider range of cross cultural schools.

8. This study should be replicated with the non-inclusion of Native students. The suggestion is to determine the effect of materials relevant to Northern Manitoba on southern Manitoba or urban students.

9. A similar study could be conducted which would take greater account of the student's attitudes in relation

to the material used in the study. This could be in the form of an expanded questionnaire analysed more specifically and rigorously.

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APPENDICES

APPENDIX A

LETTERS TO PRINCIPALS AND TEACHERS

FRONTIER SCHOOL DIVISION No. 48
DIVISION HEADQUARTERS
507 - 1181 PORTAGE AVENUE
WINNIPEG — MANITOBA
R3G OT3

October 28, 1974

Mr. G. Reimer

Dear Mr. Reimer:

We are pleased that you have decided to study, in the context of a Master's thesis, the effect of teaching Mathematics in culturally relevant terms, and that you wish to do the study in Frontier School Division.

I believe that principals and teachers will find your project interesting and useful and trust that you will receive their cooperation.

Yours sincerely,

A. Bergen
Field Superintendent

AB/ej

cc: Mr. K. Jasper
Mr. J. Zbitnew
Mr. D. Yeo
Mr. M. Effler
Mr. L. Heroux

The University of Manitoba
Faculty of Education

Department of Curriculum
Mathematics and Natural Sciences
Room 411

Winnipeg, Manitoba, Canada R3T 2N2

November 14, 1974

Dear Principal,

Enclosed please find a letter of personal introduction written by Mr. Abe Burgen, Superintendent of Frontier School Division.

During the past few years, teaching in Frontier School Division, I have become impressed with the need for curriculum materials whicn are culturally relevant for our students. I am at present working on a Masters Degree in Education at the University of Manitoba. My thesis topic involves the developing and testing of just such a curriculum unit in mathematics at the grade seven level. In this regard I will need the cooperation of a number of schools and teachers, and I am writing to invite your participation.

Your part would be the administration of a pretest and posttest. The cooperating teacher would be asked to teach a ten period (two week) unit in mathematics. The tentative dates for the study are January 28 to February 11, 1975. Your school has been chosen at random from those schools in Frontier School Division with grade seven classes large enough for the study.

Should you agree to participate in the study I will personally be in touch with you in the near future to explain the study more fully and answer any questions you may have regarding it.

Please show this letter to your grade seven mathematics teacher and then fill out the "permission granted" form and return it at your earliest convenience. Use the self-addressed stamped envelope enclosed for this purpose.

........2

Thank you for your time and consideration in this matter. If you have any questions don't hesitate to call me collect at the University (474-9076) or at home (

Thank you again.

Yours truly,

Gordon Reimer

GR/djp

cc: Mr. K. Jasper
Mr. A. Bergen
Mr. J. Zbitnew
Mr. D. Yeo
Mr. M. Effler
Mr. L. Heroux

PERMISSION FORM

DATE ______________________________

PERMISSION GRANTED Yes __________ No ____________

NAME OF SCHOOL ______________________________

ADDRESS OF SCHOOL ______________________________

NAME OF PRINCIPAL ______________________________

NAME OF TEACHER ______________________________

This is in response to a request by Gordon Reimer to conduct a study in Mathematics curriculum development in our school.

______________________ ______________________
Principal Teacher

UM

The University of Manitoba
Faculty of Education

Department of Curriculum
Mathematics and Natural Sciences

Winnipeg, Manitoba, Canada R3T 2N2

January 7, 1975

Dear Principal and Teacher,

Re: A Study in Mathematics Curriculum Development at the Grade Seven Level Conducted by Gordon Reimer

Let me first of all thank you for having consented to take part in my study in mathematics curriculum development. Without your cooperation in this way a study of this nature would be impossible.

During the month of January I will be in contact with you personally to explain the study more fully and to give you the materials to be used in the study. At that time I hope to be able to answer any remaining questions you might have regarding the study or your part in it.

Before coming to your school I will phone to make certain it is convenient for you. Should any other time be more convenient please feel free to tell me.

As previously indicated the dates for the study are still set for January 28th to February 12th, 1975.

I trust you will find your participation in this study worthwhile for yourselves and your students. It is my hope that there will also be some long range benefits for all of us that are teachers in cross cultural schools in Northern Manitoba.

If you have any questions before my visit don't hesitate to call me collect at the University (474-9076) or at home

Thank you again.

Yours truly,

Gordon Reimer

GR/djp

cc: Mr. K. Jasper
Mr. A. Bergen
Mr. J. Zbitnew
Mr. D. Yeo
Mr. M. Effler
Mr. L. Heroux

The University of Manitoba
Faculty of Education

Department of Curriculum
Mathematics and Natural Sciences

Winnipeg, Manitoba, Canada R3T 2N2

January 9, 1975

Dear Principal,

Enclosed please find a letter of personal introduction written by Mr. Abe Burgen, Superintendent of Frontier School Division.

During the past few years, teaching in Frontier School Division, I have become impressed with the need for curriculum materials which are culturally relevant for our students. I am at present working on a Masters Degree in Education at the University of Manitoba. My thesis topic involves the developing and testing of just such a curriculum unit in mathematics at the grade seven level. In this regard I will need the cooperation of a number of schools and teachers, and I am writing to invite your participation.

The pretest and posttests that are to be used in the study will have to be validated. To do this they will have to be administered to grade seven students in Frontier School Division who have been randomly omitted from the study. This testing would require approximately one and a half hours.

Should you agree to participate in this part of my study I will personally visit your school on the day of testing. In this way I could bring the materials required and at the same time answer any questions you may have in regard to the study.

Thank you for your consideration in this matter. I will be in touch with you by phone in a few days to get your reply and to arrange a time should you agree to participate.

Thank you again.

Yours truly,

Gordon Reimer

GR/djp

cc: Mr. K. Jasper
Mr. A. Bergen
Mr. J. Zbitnew
Mr. D. Yeo
Mr. M. Effler
Mr. L. Heroux

UM

The University of Manitoba
Faculty of Education

Department of Curriculum
Mathematics and Natural Sciences

Winnipeg, Manitoba, Canada R3T 2N2

January, 1975

Dear Principal and Teacher,

Re: A Study in Mathematics Curriculum Development at the Grade Seven Level Conducted by Gordon Reimer

Thank you for agreeing to participate in the above mentioned study. The reception and response you have given to the study is overwhelming. I trust you will find it a meaningful and productive experience.

Enclosed please find:

1. List of general instructions regarding the study.
2. A note to the Teacher.
3. Enough copies of the pretest for your grade seven students.
4. Enough copies of the curriculum unit, to be used in the study, for your grade seven students and teacher.
5. Student information form.

Following are the general instructions to be followed in conducting this study.

A) For the Principal

Your grade seven mathematics teacher will get all the materials except the posttests and questionnaires. These will be sent directly to you. Please give these to the teacher on the final day of the study. Your teacher will then administer both the posttest and student questionnaire, and fill out the teacher questionnaire. All of these should then be returned to me in one package.

B) For the Teacher

- Study the 'Note for the Teacher' carefully prior to commensing with the study.
- Look over the entire curriculum unit before you start teaching it.

B) For the Teacher - Cont

- Teach the unit as you have been teaching your grade seven mathematics. You may assign homework but don't over emphazise it.
- Teach the unit for ten mathematics periods each being forty to forty five (40 - 45) minutes in length.
- Please begin the study on the day following the pretest which is set for January 28, 1975.
- Return the completed pretests to me as soon as the test is completed.
- If during the ten day study you have completed the unit before the ten days are used up please add problems of your own that are similar to the unit you are teaching.
- If you find you cannot finish within the ten days please assign only representative problems so that you can give your students some work in each of the exercises.
- Be sure to stress the 'method' of solving word problems. This will be taken into account in marking the posttest.
- I will correct the posttests after they have been returned. Should you desire grades for your students you may request them from me or get your own grade before sending back the posttests. Please do not write on the student's posttest.
- Ask the principal for the posttests and student questionnaires on the day of completion of the curriculum unit. I will send these directly to him.
- Please have the students fill out the questionnaires on the day following the posttest. Fill out your questionnaire at the same time.
- You may keep the curriculum materials for future use if you like. If you do not plan on using them at some future date please destroy them all.
- Please fill out the 'student list' form enclosed and indicate clearly the students name, age, sex, and place of residence.
- Return the posttests, questionnaires, and student list as soon as they are completed.

Thank you again for your participation in this study. Should you have any questions please do not hesitate to call me collect at the University (474-9076) or at home

Yours truly,

Gordon Reimer

GR/djp

The University of Manitoba
Faculty of Education

Department of Curriculum
Mathematics and Natural Sciences

Winnipeg, Manitoba, Canada R3T 2N2

February 4, 1975

Dear Principal and Teacher,

Re: A Study in Mathematics Curriculum Development at the Grade Seven Level Conducted by Gordon Reimer

Thank you for the tremendous reception I received from you when I visited your school last month. Your enthusiastic response to the material being used in this study was much appreciated. I trust this enthusiasm is continuing now as the unit is being taught in your school.

Enclosed please find the following:

a) Posttest - one copy for each student. Again it is important that as many of your students as possible write this posttest. It is a 40 minute test.

b) Student Questionnaire - one copy for each student. Please give this to the student after the posttest has been written.

c) Teacher Questionnaire - one only for your grade seven mathematics teacher. This questionnaire should be written by the teacher after the students have written their posttest.

d) Tabulation Sheets - enough to fill in the personal data required for each grade seven mathematics student.

Please forward all of these to me as soon as possible after they have been completed. A comprehensive report will be sent to you as soon as the results of this study are available.

Again, if you have any questions please call me collect at the university (474-9076) or at home

Thank you again.

Yours truly,

Gordon Reimer

GR/djp

cc: Mr. K. Jasper
Mr. A. Bergen
Mr. J. Zbitnew
Mr. D. Yeo
Mr. M. Effler
Mr. L. Heroux

UM

The University of Manitoba
Faculty of Education

Department of Curriculum
Mathematics and Natural Sciences

Winnipeg, Manitoba, Canada R3T 2N2

March 13, 1975

Dear Principal and Teacher,

Re: A Study in Mathematics Curriculum Development at the Grade Seven Level Conducted by Gordon Reimer

I am happy to be able to report that the tests and questionnaires relating to the above study are now all in my hands. I trust you found your participation in this study enjoyable and worthwhile both for yourselves and your students. Your comments and suggestions were very much appreciated.

The results are not yet available. As soon as they are I will send you a full report.

The study was an experimental one with a control unit and a treatment unit. Your school was a control school.

Enclosed please find a copy of the unit used in the treatment schools. As you will notice the treatment unit is exactly like the control unit you used except that the treatment unit has been translated into culturally relevant terms.

I would now like to prevail upon you just one more time. It would be of great value to me if you would look over this treatment unit and then answer a few questions. The questionnaire is also enclosed. Please return it to me in the enclosed self addressed stamped envelope.

Thank you again for participating in this study.

Yours truly,

Gordon Reimer

GR/djp

cc: Mr. K. Jasper
Mr. A. Bergen
Mr. J. Zbitnew
Mr. D. Yeo
Mr. M. Effler
Mr. L. Heroux

The University of Manitoba
Faculty of Education

Department of Curriculum
Mathematics and Natural Sciences

Winnipeg, Manitoba, Canada R3T 2N2

June 5, 1975

Dear Principal and Teacher,

Re: A Study in Mathematics Curriculum Development at the Grade Seven Level Conducted by Gordon Reimer

I am happy to be able to report that the data for this study has all been analysed and a preliminary report can be made to you in regard to the results of the study.

The study was an experimental one with a control and a treatment. The eleven schools taking part in the study were divided into these two groups. Five schools were in the treatment and six schools were in the control. The treatment schools received a curriculum unit exactly like the control schools except that the material in the unit was all translated into culturally relevant terms. The control schools received a unit based on the present authorized texts at the Grade Seven level.

The purpose of the study was to determine whether students using a culturally relevant mathematics curriculum unit would show greater achievement then students using a unit similar to present curriculum.

As would be expected no two schools showed exactly the same level of achievement. On the whole, however, the schools using the treatment unit did score significantly higher than the schools using the control unit.

Mr. Bergen has asked me to have a detailed report in the form of my thesis available to those schools that request one. These requests should be made directly to Mr. Bergen's office.

Thank you again for participating in this study. It was only because of your participation that the study turned out to be the success that it was. I trust you found the study meaningful and the results a challenge and encouragement for you and your school.

Thank you again.

Yours truly

Gordon Reimer

GR/djp

cc: Mr. K. Jasper
Mr. A. Bergen
Mr. J. Zbitnew
Mr. D. Yeo
Mr. M. Effler
Mr. L. Heroux

APPENDIX B

A NOTE TO TEACHERS
- TREATMENT

A UNIT

ON

WORD PROBLEMS

IN

GRADE SEVEN

MATHEMATICS

FOR

NORTHERN SCHOOLS

By Gordon Reimer
University of Manitoba
January, 1975

A Note to the Teacher

I Introduction

The following unit on 'Word Problems' is intended to complement the present Grade seven mathematics program. In part it has come about due to a concern voiced by many Junior High mathematics teachers that their students had great difficulty solving word problems. Many have suggested that more time spent on word problems would do more than act as a review. It would allow them more time to teach the methods used in solving word problems, both in setting up and solving the mathematical representations of the problems.

Many teachers are also concerned about the lack of relevance of mathematics to the life of our students in Northern and isolated communities. In this unit an attempt has been made to make mathematics culturally relevant for students in northern and isolated schools.

This unit is intended as a ten period unit which under usual circumstances will cover a ten day span of school time.

II Timetable

The following timetable is intended as a guide only. Please use it as you would any course outline. In general, however, do follow the order as shown below.

Timetable

	Days
1. Introduction	
Exercise I	1 - 2

Timetable

Exercise III and IV begin with simple single operation problems and move on to problems involving more than one operation and problems of greater difficulty.

III Objectives

This unit on 'Word Problems' in Mathematics at the Grade seven level should:

a) Help to develop basic computational skills in operations with whole numbers and positive fractions.

b) Help to develop the ability to determine the operation or operations required in a word problem.

c) Help to develop the ability to translate the word problem into an open sentence.

d) Help to develop the ability to solve open sentences by the inspection and the computational methods.

e) Help to develop the ability to relate and apply mathematics and mathematical skills to the real world. In particular the world in which the student lives.

f) Help to develop positive attitudes and appreciations with respect to mathematics.

g) Help to develop a greater level of achievement in word problems, in mathematics, and in school. This in turn should help to foster a better self concept through a sense of achievement.

References

1. Brumfiel, C. F., et. al. "Introduction to Mathematics, Addison-Wesley Pub. Co., Massachusetts, 19__.

2. Cadwell, J.D., et. al. Modern Mathematics - A Discovery Approach (Grade 7) Thomas Nelson and Sons, Toronto, 1966.

3. Cadwell, J. D., et. al. Modern Mathematics - A Discovery Approach (Grade 8) Thomas Nelson and Sons, Toronto, 1966.

4. Hanwell, A. P. et. al. Patterns In Arithmetic - 6, Holt, Rinehart and Winston, Toronto, 1965.

5. Lindsay, H. et. al. Trouble Shooting Mathematics Skills, Holt, Rinehart and Winston, Toronto, 1966.

6. McPherson, A. M. (chm) Grade VII Mathematics - Curriculum Guide, Department of Education, Winnipeg, 1967.

7. McSwain, E. T. et. al. Mathematics 7, Laidlaw Brothers, Illinois, 1963.

8. Stein, E. I. Refresher Mathematics, Allyn and Bacon Inc., Boston, 1965.

9. Spitzer, H. F. et. al. Mathematics 7, McGraw Hill Book Co., Toronto, 1968.

10. Spitzer, H. F. et. al. Mathematics 6, McGraw Hill Book Co., Toronto, 1968.

APPENDIX C

A NOTE TO TEACHERS
- CONTROL

A UNIT

ON

WORD PROBLEMS

IN

GRADE SEVEN

MATHEMATICS

By Gordon Reimer
University of Manitoba
January, 1975

A Note to the Teacher

I Introduction

The following unit on 'Word Problems' is intended to complement the present Grade seven mathematics program. In part it has come about due to a concern voiced by many Junior High mathematics teachers that their students had great difficulty solving word problems. Many have suggested that more time spent on word problems would do more than act as a review. It would allow them more time to teach the methods used in solving word problems, both in setting up and solving the mathematical representations of the problems.

This unit is intended as a ten period unit which under usual circumstances will cover a ten day span of school time.

II Timetable

The following timetable is intended as a guide only. Please use it as you would any course outline. In general, however, do follow the order as shown below.

Timetable

	Days
1. Introduction	
Exercise I	1 - 2
Exercise II	
2. Exercise III	
Introduction	
Problems	3 - 5

Timetable

	Days
3. Exercise IV	
Introduction	
Problems	6 - 8
4. Exercise V	9
5. Catch up or Review	10

Exercise III and IV begin with simple single operation problems and move on to problems involving more than one operation and problems of greater difficulty.

III Objectives

This unit on 'Word Problems' in Mathematics at the Grade seven level should:

a) Help to develop basic computational skills in operations with whole numbers and positive fractions.

b) Help to develop the ability to determine the operation or operations required in a word problem.

c) Help to develop the ability to translate the word problem into an open sentence.

d) Help to develop the ability to solve open sentences by the inspection and the computational methods.

e) Help to develop the ability to relate and apply mathematics and mathematical skills to the real world. In particular the world in which the student lives.

f) Help to develop positive attitudes and appreciations with respect to mathematics.

g) Help to develop a greater level of achievement in word problems, in mathematics, and in school. This in turn should help to foster a better self concept through a sense of achievement.

References

1. Brumfiel, C. F., et. al. "Introduction to Mathematics, Addison-Wesley Pub. Co., Massachusetts, 19__

2. Cadwell, J. D., et. al. Modern Mathematics - A Discovery Approach (Grade 7) Thomas Nelson and Sons, Toronto, 1966.

3. Cadwell, J. D., et. al. Modern Mathematics - A Discovery Approach (Grade 8) Thomas Nelson and Sons, Toronto, 1966.

4. Hanwell, A.P. et. al. Patterns In Arithmetic - 6, Holt, Rinehart and Winston, Toronto, 1965.

5. Lindsay, H. et. al. Trouble Shooting Mathematics Skills, Holt, Rinehart and Winston, Toronto, 1966.

6. McPherson, A. M. (chm) Grade VII Mathematics - Curriculum Guide, Department of Education, Winnipeg, 1967.

7. McSwain, E. T. et. al. Mathematics 7, Laidlaw Brothers, Illinois, 1963.

8. Stein, E. I. Refresher Mathematics, Allyn and Bacon Inc., Boston, 1965.

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10. Spitzer, H. F. et. al. Mathematics 6, McGraw Hill Book Co. Toronto, 1968.

APPENDIX D

A GRADE SEVEN UNIT ON WORD PROBLEMS - CULTURALLY RELEVANT

A UNIT

ON

WORD PROBLEMS

IN

GRADE SEVEN

MATHEMATICS

TABLE OF CONTENTS

Word Problems

I Introduction

Story Problems

In almost everything we do we run into questions or problems of one kind or another. Often we want to answer these questions or solve these problems and at times the solutions are hard to find. Many of our everyday questions involve mathematics. Finding the total number of beaver trapped or rabbits snared, or the number of beads needed to decorate a purse all deal with problems where you would have to know addition facts. If you were mixing gas and oil for a snowmobile you would have to know some multiplication and division facts to mix three gallons of gas correctly if your standard measure of oil was for five gallons of gas. We are all faced with problems that we would like to solve. Most of our problems that include mathematics can be written down into words or short stories. It is a very important skill to be able to solve these word or story problems. In the past you have solved problems of this type by guessing, by writing number sentences that tell the story in the problem, and most recently you have solved problems of this type by the use of what mathematicians call algebra. In algebra you let what you want to find be represented by some letter and then using this letter along with the numerical information you got in the word problem, you write the problem in the form of an open sentence. This open sentence now tells the story of the problem in mathematical terms and is called an equation. You then solved these open sentences by inspection or by calculation.

Story problems often involve the search for some missing number. In the problems the stories change but the mathematics remains the same. Thus, once you have translated (changed) the story problem into an open sentence (equation), you will discover that finding the answer or solution is quite easy. In this unit the solutions will be natural numbers, whole numbers, positive fractions, or decimal fractions in the case of problems involving money. It is often helpful to decide what kind of a number makes sense for a problem before you actually solve it.

II <u>Word Meanings</u>

In doing the problems in this unit it is important that you understand the question clearly before you try and find the answer. In this regard be sure that you clearly understand what each word means in the problem. So, read the problem carefully and if there is any word you don't know the meaning of look it up in the dictionary, ask you fellow students, or ask your teacher.

These words will fall into two catagories:

i) words that describe objects

ii) words that tell you what kind of arithmetic to use

III <u>Reconstructing a Problem</u>

Sometimes when a problem seems difficult even after you understand the meanings of all the words and you know what operation to use there are other things you can do to help you with the problem.

First, you could try rewriting the problem in your own words.

Second, you could draw a simple diagram or sketch that represents the problem.

Your teacher can help you with this.

IV Estimating Answers

In doing a word problem you sometimes get a ridiculous answer by making a very simple mistake. One way to make sure your answer is reasonable is to estimate your answer before you actually solve the open sentence.

For example, if your open sentence was $n = 1/4 \times 6\ 2/3$ your estimate would be $3 \times 7 = 21$. Thus, if you got 12 1/2 or 210 2/3 you would easily recognize that your answer was wrong.

V Steps in Solving a Word Problem

1. Read the problem carefully.
2. Decide what you want to find.
3. Use a letter such as n, x or y to represent what you want to find. (In mathematics this is called a variable).
4. Write an open sentence (equation) that tells the story of the problem.
5. Estimate your answer.
6. Solve the equation (use inspection or calculations).
7. Test your solution. (This could be done by comparing it to your estimate or by substitution)
8. Write your answer in the form of a sentence.

   Example: A box of pickerel and a box of white fish are on a scale that reads 187 lbs. The white fish box is taken off and the scale reads 89 lbs. How much does the box of white fish weigh?

Solution

a) Getting the equation

Let n represent the weight of the box of white fish.

Thus $n = 187 - 89$

b) Making an estimate

the estimate is: $190 - 90 = 100$

c) Solving the equation

$n = 187 - 89$

$n = 98$ lbs.

d) Checking your solution

check: $89 + 98 = 187$

e) The solution in final form

The box of white fish weighs 98 lbs.

VI Identifying Operations

No matter how complicated a word problem seems to be it will always require one of the four basic operations or some combination of them. As you know the operations are addition, subtraction, multiplication and division.

For each of the four operations there may be several words that can be used in a word problem related to that operation. The following chart shows some common words and which operations they are associated with.

OPERATION	WORDS
Addition	Combine, join, sum, add, total
Subtraction	Difference, minus, left over, less than, more than
Multiplication	Product, of, for, at, @, X
Division	Quotient, share, ratio, rate, compare, part, Average

In some cases the correct operation is not clearly stated by a key word but is implied in the word problem.

Example: Alpheus, his brothers and sister live five miles from school. If they travel to school by motorboat and it takes them two minutes for each mile, how long does it take them to get to school?

In this problem you will find no single word that will give you a clue to the operation required. The problem does however clearly indicate that you must multiply 5 by 2 since for each of the five miles they need two minutes.

Note: In this unit you will be asked to solve these word problems by the open sentence method using inspection or calculation.

Exercise I

In each of the following problems indicate 1) what operation you would use to solve the problem and 2) why you think that operation is the right one.

Example: A number is 5 less than 15.

Solution

i) the operation is subtraction

ii) the reason is: less than means subtract

Problems:

1. 25 added to a number.
2. A number is multiplied by 5.
3. The number of rabbit snares is increased by 1 doz.
4. The product of a number and 17.
5. A number of coins shared by three students.
6. 15 is taken away from a number.
7. The snowmobiles on their way fishing were joined by 5 more.
8. A certain number times 50.
9. One more than a certain number.
10. The sum of two consecutive numbers.
11. Three less than two times a number.
12. A certain number decreased by 17.
13. The difference between a number and 30.
14. The difference between 25, and a number decreased by 5.
15. Eight more than 10 times a number.
16. Six of a number plus 8.

17. Thirteen added to twice a certain number.

18. The cost of a certain number of hockey pucks if each cost 25¢.

19. Five more than half a certain number.

20. Three times, a number less six.

21. Three-quarters more than, five times a number.

22. The average of, a number and twelve.

23. Two-thirds less than the product of 3 and a number.

24. Six joined to the difference between a number and one-third of the number.

25. Twelve more than the total of a number and double the number.

Exercise II

In each of the problems in Exercise I let what you want to find be represented by a letter (variable, placeholder) and write an open expression for each one.

Example: To build a good fire John needs five more sticks of wood than be already had.

Solution:

Let n be the number of sticks of wood he already has.

Then, 'n + 5' representes the total number he needs for a good fire.

Answer: $n + 5$

Exercise III Introduction

In most of the word problems in this section your answers will be whole numbers. W = (0, 1, 2, 3, ...). In the problems dealing with money all your answers should show the usual two decimal places.

Exercise III a) Trapping

Trapping has been an important part of the life of the Native people of Canada. Long before the white man came the people of Canada trapped for food and for skins to be used in many different ways. After the arrival of the white man trapping became an important industry for many Canadians both old and new.

Did you know that traplines used to be measured in pipes? Yes, in pipes! A trapper on his trapline would stop to light his pipe about once every hour. The number of pipes he smoked while following his trapline became the size or length of his trapline. Thus a trapline could be '5 pipes,' '9 pipes' or even much more. After some time 'pipes' were given up as a measure of a trapline since travelling by canoe, on foot, or by snowshoes would result in different lengths all being called a 'pipe'.

Today trapping is still important to many people living in the North. It provides an income for many families and spending money for many young people.

Do you have a trapline?

Exercise III a) Problems

1. The number of muskrat traps Norris has plus 5 equals 18. How many muskrat traps does he have?
2. Norris' 10 beaver traps minus the number of beaver traps Alpheus has is 3. How many beaver traps does Alpheus have?
3. During the winter Peter catches twelve rabbits in each of his snares. If he catches 168 rabbits altogether, how many snares does he have?
4. Albert made a certain number of rabbit snares and divided them among his five friends. If each of his friends got 11 snares how many snares had Albert made?
5. Headley bought a bear trap for $10.00 and two muskrat traps for $3.00 each. How much did he spend?
6. One year the trappers in a northern community made a combined total of $210.000. If their average combined total in other years was $180,000, by how much did this year exceed the average?
7. Peter made twenty three dollars more than Edwin when they both sold their winters furs. If Edwin got $138.00 how much did Peter get?
8. A certain trapline was 18 pipes. This is three times the number that it was when first begun. How many pipes was it when first begun?

9. To make snares for her brother Diane buys 8 rolls of snare wire for 96 cents. If she uses up two rolls and returns the rest to the store, how much do the two rolls cost?

10. One winter Susie's father made $5500 trapping. If his expenses were 1/5 of his income, how much did he have left over?

11. Besides trapping many of the men in Peter's community belonged to a fishing co-op. If 31 of these men bought new skiffs, motors, and nets; and the total cost was $55,000.00; on the average how much did each man spend?

12. Peter and his friends formed a hockey team. One winter they played 38 games. If they lost 12 games and tied 4, how many games did they win?

13. If Jack trapped five times as many muskrat as Peter, and Peter trapped four, how many did Jack trap?

14. Mary's great grandfather measured his trapline in pipes. One year he found he needed to lengthen his trapline by 5 more pipes to make it as long as it was the year before. If the year before it was 37 pipes, how many pipes was his trapline this year?

15. To test Peter's ability in mathematics I asked him this question. The sum of four times the number of otter in your traps plus the 9 you have already is 21. How many otter are in your traps?

16. A trapper got 25 skins on one round of his trapline. If he had 7 beaver and 8 otter, how many mink did he have?

Exercise III b) Transportation in the North

Exercise III b) Transportation in the North

Many people consider transportation in the north a difficult task. Not so the people who live there. Their energy, stamina, and inventiveness has always given them a means of doing and going where they want with relative ease.

Because of the many lakes and rivers in the north the Indians invented the canoe. This was designed so well that it is used today both in transportation and sport.

In the winter a dog team was used to go about the business of fishing, trapping and moving the family where they wanted to go.

Today the snowmobile has largely replaced the dog team. When it was introduced the people in the north saw its value and it became a standard means of transportation long before snowmobiling became a widespread sport further south.

Do you use a snowmobile often?

Exercise III b) Problems

17. On a camping trip Mary and her father went through three short rapids all about the same length, with their canoe. If the total length of the three rapids was 650 ft. How long was each one?
18. In March Jerry decided that after school was out he wanted to fix his canoe. For each of the next three months he saved eight dollars. In June after school was out he found he had 37 dollars. How much did he have in March before he started saving to repair his canoe?
19. On the last day of a dog team trek from Norway House to Berens River each of the 42 dogs got their usual ration of 2 pieces of fish. If there were 11 pieces of fish left, how many pieces were there before the dogs were fed that day?
20. Two freighter canoes carried a combined weight of 1650 lbs. of freight. If one carried 250 lbs more than the other, how much did each cnaoe carry?
21. The total number of gallons of gas Eska's father used in his snowmobile for two weeks of fishing is divided by 4. The result equals two times the number of gallons used by her brother for the same time period. His brother used one gallon the first week and three gallons the second. How many gallons did Eska'a father use?
22. The distance from the beginning of one set of rapids to the end of a second set is 4800 ft. There is 3600 ft. of calm water in the middle and the rapids at each end are the same length. How long

is each set of rapids?

23. Robert hauled 40 cans of water with his snowmobile. He weighed 5 of them and their total weight was 300 lbs. At this rate what was the total weight of the 40 cans of water?

24. Many years ago on a 1636 mile round trip supply run from Brochet, Manitoba to Coppermine, N.W.T. and back a dog team covered 192 miles in three days. At this rate, how many days would be needed to complete the run?

25. Travelling by snowshoes Headley could cover 24 miles in one day. If this was nine more than three times as far as he hed to go to school, how far did he have to go to school?

26. If twice the distance to their summer camp was the same as 5 miles plus one times the distance, how far is it to their summer camp?

27. John's father has a motorboat and a canoe. He told John that the motorboat could travel as fast as the difference between 5 times the speed of the canoe and 18 miles per hour. If this was two times the speed of the canoe how fast could the canoe travel?

28. Albert's father still keeps several dogs which he has trained as a dog team. Albert is five years older than the oldest dog in his father's dog team. If Albert and the dog have a combined age of 27, how old is Albert?

29. Snowmobiles are replacing the dog teams in the North. In one village there are now 4 times as many snowmobiles as there were 5 years ago. If there would be 11 more snowmobiles the total would come to 47. How many snowmobiles were there five years ago?

30. By snowmobile it takes Jill's father two hours to get out to his winter fishing camp. He sets up another camp further up the lake. This new camp is three times as long from his home as the first one. How far is it from the first camp to the second one?

Exercise IV Introduction

In this exercise you will be working with word problems that deal with fractional numbers. Again, these problems will involve the operations of addition, subtraction, multiplication and division. The exercise will begin with problems involving one operation only and move on into more difficult problems and problems involving more than one operation.

What is a fraction?

You know what a fractured bone is. The word fraction has the same origin. It originally meant broken number. Nowadays the word fraction indicates the form of a numberal rather than a kind of number. Thus, a fraction is a numeral that has a numerator, or first part, and a denominator or a second part.

Three examples of how a fraction can be used are as follows:

a) Fraction: as part of a whole. If we have six oranges in a basket and we break them up into two groups, each new group will contain 1/2 as many oranges as the first group.

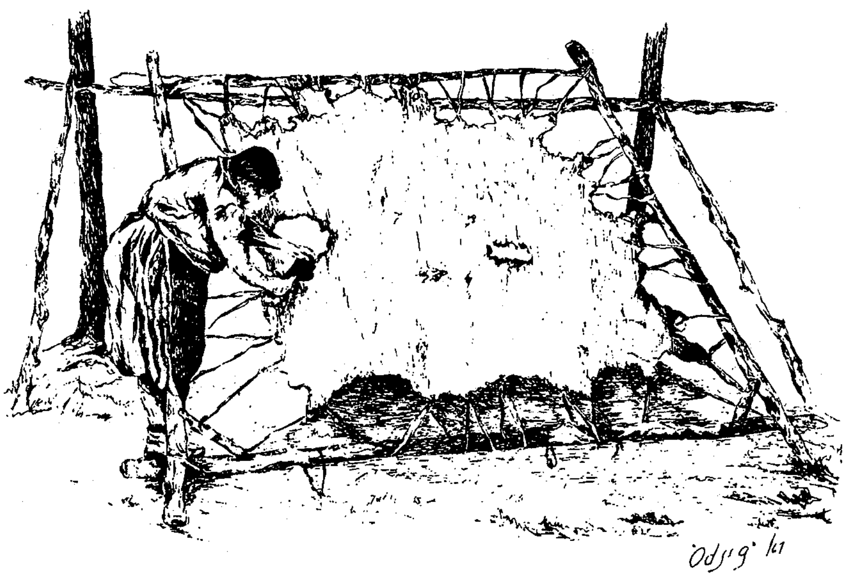
b) Fraction: as a comparison of like quantities. (Ratio) If Mary has 10 dollars and John has 15 dollars we can say Mary has 10/15 or 2/3 as many dollars as John. This is called a ratio and can be written in the form 2:3 or 2/3.

c) Fraction: as a comparison of unlike quantities. (Rate) Which is larger, $5 or 3 hours? We cannot say which is larger because dollars and hours are not the same units but we can say that 5/3 is the rate of pay in dollars per hour.

c) Thus if a snowmobile travelled 150 miles in 5 hours, we can say that the rate per hour is 150/3 or 30 m.p.h.

Again if a plant grows 9 inches in 12 weeks we can say it grows 9/12 or 3/4 of an inch per week.

Exercise IV a) Tanning a Moosehide



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THE TANNING OF A MOOSEHIDE

1. Cut out left over meat in the skin.
2. Cut out hair from the hide.

   (Above is done in the summer, with the skin draped over a stump.)
3. Cut holes around the edge of the entire skin.
4. Cut four poles and make a square bracket with the four corners tied together with a rope. (Must be very secure.)

5. The moosehide is stretched on this bracket during freezing temperatures.
6. Scraping is done on both sides during extreme frost.
7. The scraped skin is soaked many times until the water remains clear. The water must be lukewarm.
8. The skin is partially dried, and moose brains are spread on the entire surface of both sides.
9. The hide is then spread out close to the ceiling on strings or strips of wood for a minimum of one month.
10. Soak again for two days.
11. Wring it out with a pole against a tree.
12. Two people in rotation will pull the skin over a small fire for three to four hours until completely dry. It must be pulled in rotation around the skin. This part is a fun time much looked forward to by all, with tea and bannock served.
13. Sew the stomach portion and the hind end closed, and sew heavy canvas around the neck. The rear portion must be on top because it takes the most smoke to penetrate the tan.
14. Gather decayed wood.
15. Burn decayed wood in a pail with the least amount of kindling wood, so there will be no flames.
16. Pull canvas over pail.
17. Reverse the skin to tan both sides.

Our thanks to Mrs. Kathleen Mason, of St. Theresa Point, Island Lake, Manitoba for writing "The Tanning <u>of a Moosehide</u>" in Cree sylabics, and her son, Ed Wood for interpreting it for us in English.
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Exercise IV a) Problems

1. If moosehides before tanning are 11/15 of an inch thick together with the hair and there are 30 hides, how high would the pile be if the hides were piled on one pile?
2. In preparing a hide for tanning two lbs of fat and meat are scraped from the skin if 2/3 of this is fat, how much does the fat weigh?
3. If 8 1/3 lbs. of hair are scraped from one hide, how many lbs of hair would you get from 2 1/2 hides if the hides were approximately the same size?
4. In order to stretch the moosehide 50 cuts are made around the edge of the hide. If each cut is 2/5 of an inch long, what is the total length of all the 50 cuts?
5. The four corners of the square bracket are securely tied with lengths of rope. After one corner is tied the lengths of rope needed for the other three corners is 1 1/2 yards, 3/4 yard and 2 1/4 yards. How long was the rope if these three lengths were cut from one piece?
6. Mary and her brother Ed helped scrap the hide. If Mary scraped 2/5 of it and Ed scraped 1/3 of it, how much was left to be done?
7. Janet was hoping to get 2 1/2 squar feet of the tanned hide to make a purse. If she made the purse and a piece 2/3 of a square foot was left over, how much did she use?
8. The leather strips used to stretch the hide to the brackets are rolled up onto large spools. If on the average 3/30 of one spool is used for each strip, how many strips are there in 3 spools?

9. Each of the strips mentioned in problem 8 is on the average 3 1/2 ft. long. How many strips that long can be cut from a long strip 52 1/2 ft. long?

10. After tanning Mrs. Wood found that one of the hides she had tanned weighed 8 1/2 lbs. and the other 11 1/2 lbs. Find the total weight of the two hides.

11. If a 6 2/3 square foot piece of hide is to be cut into 4 pieces to make moccasins, how many sq. ft. is each piece?

12. On one hide Mary scraped 4 2/7 hours. If Ed worked on another hide for 3 1/4 times as long as Mary, how many hours did he work?

13. A large piece of canvas (see step 13 in Tanning) was used for several hides. If 1/5 of it was used for one hide 1/4 of it for another, and 1/3 of it for a third hide, how much of the canvas remained unused?

14. Mary and her brother Ed collected decayed wood (see step 14 in Tanning). Ed collected 3/4 of a dozen pails full and Mary collected 2/3 of a dozen pails full. How many pails full of decayed wood did they collect together?

15. A pole (see step 4 in Tanning) used to make a bracket was 5 1/2 ft. long. For tanning a smaller hide it only needed to be 4 3/4 ft. long. How much could be cut off?

Exercise IV b) A Legend: Simon Gun-an-noot

Simon Gun-an-noot was an Indian of the Kispiox tribe who lived in the central interior of British Columbia . Now, sixty five years after his death, a mountain and lake have been named in his honour. This was done by white men out of respect for a red man who made their law and their police look foolish!

Gun-an-noot and his brother-in-law Peter Hi-ma-dan were accused of murdering two no good white trappers and traders by the names of McIntosh and LeClair. A $1000 reward was offered for the fugitive's capture - Dead or alive!

For thirteen years many officers of the law and others made many journeys covering hundreds of miles into the bush trying to capture the fugatives and bring them to trial. None of them succeeded! One sergeant by the name of Otway Wilkie tells how he with his posse travelled a total of 1500 miles without once even catching sight of the wanted men. Gun-an-noot would creep close to their camp at night and listen to the posse talk of what it was like back home. Sometimes he would creep into camp at night and exchange furs he had trapped for salt and a few other supplies.

Many others tried to find him but no one ever even saw him.

After thirteen years the ones who were guilty of the murders confessed and Gun-an-noot came out of hiding.

Simon Gun-an-noot has become a legend and many old-timers continue to tell stories of his courage and stamina. He was a man with cleverness and endurance beyond belief. He is often called. "the forest phantom." (Based on an account of the actual incident by Thomas P. Kelley in "Run Indian Run")

Exercise IV b) Problems

16. One day while walking on the shore of a lake Gun-an-noot shot a wild goose that dressed out at 6 1/4 lbs. After roasting it whole, he and Peter ate it for supper. If each bite they took was 1/8 lb., how many bites did they take?

17. If Simon and Peter built a shelter out of snow and had to move 3135 cu. ft. of snow, how many gallons of snow did they clear if each cubic foot of snow is equivalent to 7 1/2 gallons?

18. A posse in search of Gun-an-noot and Hi-ma-dan travelled 1/8 of the distance to where they were hiding in one day. The next day they travelled another 1/6th of the way, followed by a third day in which they covered 1/4 of the way. On the fourth day before turning back and giving up the search they travelled 11/24 of the way to where Peter and Simon were hiding. How much further would the search party have had to travel to find Simon had he not moved on?

19. While hiding from a search party Simon only needed to travel 2/3 of a mile each day. If this search party was after him for 123 days, how many miles did Simon travel?

20. One night Gun-an-noot crept into the camp of some hunters and left a note for them. Each letter was 1/12 of an inch wide. If he wrote 5 lines and each one was 3 3/4 inches long, how many letters were there in his note?

21. At the time Simon fled into the bush he was 22 1/2 years old. If he was 5 1/2 years older than twice his nephew's age, how old was his nephew?

22. While camped on a cliff overlooking a valley Hi-ma-dan walked 2/3 of a mile to a lookout post. If he walked that distance four times each day, how much less than three miles did he walk each day?

23. Gun-an-noot had a trapline which took him 4 2/3 hours to cover in one round trip. If he increased this by making the trapline 1 3/4 times as large, how long was his new trapline in hours?

24. Peter and Simon took turns keeping a lookout for search parties. If Simon watched 5 1/2 hours and 3 1/3 hours on two shifts, how many hours did Peter watch if together their total time watching was 16 1/2 hours?

25. Running from a police officer the two men jumped over a creek that was 12 5/8 ft. wide. If Hi-ma-dan jumped 14 2/3 ft, by how much did he clear the creek?

26. Otway Wilkie and his posse searched for the two men for 33 days on one of their numerous searches. For two-thirds of these days they covered 6 miles on the average and for the rest of the days they covered 10 miles on the average. How many miles did they cover in the thirty-three days?

27. In one year the total number of miles covered by search teams was 1,295 miles. If this was 7/8 of as much as the miles covered in the record year, how many miles was the record?

28. One winter Gun-an-noot made himself a blanket out of 39 5/8 mink pelts. If Hi-ma-dan was a little smaller man and he made his out of 37 3/4 mink pelts, what was the difference in the number of mink pelts used?

29. If Peter discovered 14 cases of gun shells left behind by a search party, how many cases were still left unused if 3/8 of the cases were unused?

30. Suppose that during the thirteen years Gun-an-noot's searchers covered 16,440 miles. If 2/5 of this was during the first three years and 3/4 of that was by Otway Wilkie, how many miles did Wilkie cover in those first three years?

Exercise V Some Additional Problems

1. Marilyn wanted to buy a sweater for $4.98 and shoes for $7.29. She had earned $6.00 helping in the kitchen at the local tourist resort. How much more did she need?
2. The fishing co-op pays the fishermen $3.75 for each 10 lbs. of white fish. The co-op sold every 10 lbs for $4.98. The difference in the prices is used to cover wages for the fishing plant workers. How much money is paid to the workers on 65 such 10 lb. boxes of white fish?
3. Judy bought a pair of skates on sale for $10.00 at a local general store. What was the regular price if they had been reduced by one third?
4. The day after setting their nets Steve Wood and his father checked them and found 47 1/2 lbs of white fish in one net, 59 2/3 lbs. in another, and 64 1/3 lbs. in the third net. What was the average amount in pounds found in each net?
5. Travelling by boat across the lake one day to visit friends, Mary's father found that after travelling 1/3 of the distance to their friend's house they had used up 1/10 of the supply of fuel. How much of the fuel supply will be used up when they get to their friends place?
6. Jane wanted to help her brother mix the gas for their boat. If 3 cans of oil were to be used for 15 gallons of gas, how many cans of oil should she use to mix with 10 gallons of gas?
7. Two fire lookout towers were 200 ft. and 300 ft. high. If the 200 ft. tower casts a shadow of 300 ft.,what is the length of the

other shadow?

8. The men and women cleaning fish at the fish co-op could filet 975 fish in 3 hours. How many could they filet in 5 hours?

9. Mr. Wood and Mr. Mansesse want to set up a small tourist fishing and hunting camp together. Mr. Wood puts in \$2 for every \$3 Mr. Manssese puts in. This month Mr. Wood puts in \$75. How much does Mr. Manssese put in?

10. On a government map of Northern Manitoba each 1/6 inch represents 15 miles. If the distance from Wanipigow to Brochet is 5 5/6 inches on the map, what are the air miles between those two places?

APPENDIX E

A GRADE SEVEN UNIT ON WORD PROBLEMS - CULTURALLY NONRELEVANT

A UNIT

ON

WORD PROBLEMS

IN

GRADE SEVEN

MATHEMATICS

TABLE OF CONTENTS

Word Problems

I Introduction

Story Problems

An important skill in Mathematics is the ability to solve word or story problems. In the past you have solved problems of this type by guessing, by writing number sentences that tell the story in the problem, and most recently you have solved problems of this type by the use of what mathematicians call algebra. In algebra you let what you want to find be represented by some letter and then using this letter along with the numerical information you got in the word problem, you write the problem in the form of an open sentence. This open sentence now tells the story of the problem in mathematical terms and is called an equation. You then solved these open sentences by inspection or by calculation.

In this unit you will be asked to solve these word problems by the open sentence method using inspection or calculation.

Story problems often involve the search for some missing number. In the problems the stories change but the mathematics remains the same. Thus, once you have translated (changed) the story problem into an open sentence (equation), you will discover that finding the answer or solution is quite easy. In this unit the solutions will be natural numbers, whole numbers, positive fractions, or decimal fractions in the case of problems involving money. It is often helpful to decide what kind of a number makes sense for a problem before you actually solve it.

II Word Meanings

In doing the problems in this unit it is important that you understand the question clearly before you try and find the answer. In this regard be sure that you clearly understand what each word means in the problem. So, read the problem carefully and if there is any word you don't know the meaning of look it up in the dictionary, ask your fellow students, or ask you teacher.

These words will fall into two catagories:

i) words that describe objects

ii) words that tell you what kind of arithmetic to use

III Reconstructing a Problem

Sometimes when a problem seems difficult even after you understand the meanings of all the words and you know what operation to use there are other things you can do to help you with the problem.

First, you could try rewriting the problem in your own words.

Second, you could draw a simple diagram or sketch that represents the problem.

Your teacher can help you with this.

IV Estimating Answers

In doing a word problem you sometimes get a ridiculous answer by making a very simple mistake. One way to make sure your answer is reasonable is to estimate your answer before you actually solve the open sentence.

For example, if your open sentence was $n = 3\ 1/4 \times 6\ 2/3$ your estimate would be 3 X 7 = 21. Thus, if you got 12 1/2 or 210 2/3 you would easily recognize that your answer was wrong.

V Steps in Solving a Word Problem

1. Read the problem carefully.
2. Decide what you want to find.
3. Use a letter such as n, x or y to represent what you want to find. (In mathematics this is called a variable).
4. Write an open sentence (equation) that tells the story of the problem.
5. Estimate your answer.
6. Solve the equation (use inspection or calculations).
7. Test your solution. (This could be done by comparing it to your estimate or by substitution)
8. Write your answer in the form of a sentence.

Example: Bill and John are standing on a scale which reads 187 lbs. John steps off and the scale reads 89 lbs. How much does John weight?

Solution

a) Getting the equation

Let n represent John's weight

Thus n = 187 - 89

b) Making an estimate

the estimate is: 190 - 90 = 100

c) Solving the equation

$n = 187 - 89$

$n = 98$ lbs.

d) Checking your solution

check: $89 + 98 = 187$

e) The solution in final form

John weighs 98 lbs.

VI Identifying Operations

No matter how complicated a word problem seems to be it will always require one of the four basic operations or some combination of them. As you know the operations are addition, subtraction, multiplication and division.

For each of the four operations there may be several words that can be used in a word problem related to that operation. The following chart shows some common words and which operations they are associated with.

OPERATION	WORDS
Addition	Combine, join, sum, add, total
Subtraction	Difference, minus, left over, less than, more than
Multiplication	Product, of, for, at, @, X
Division	Quotient, share, ratio, rate, compare, part, Average

In some cases the correct operation is not clearly stated by a key word but is implied in the word problem.

Example: If John lives five blocks from school and it takes him two minutes to walk each block, how long does it take him to get to school?

In this problem you will find no single word that will give you a clue to the operation required. The problem does however clearly indisate that you must multiply 5 by 2 since for each of the five blocks he needs two minutes.

Exercise I

In each of the following problems indicate 1) what operation you would use to solve the problem and 2) why you think that operation is the right one.

Example: A number is 5 less than 15.

Solution

i) the operation is subtraction

ii) the reason is: less than means subtract

Problems:

1. 25 added to a number.
2. A number is multiplied by 5.
3. The number of tomatoes is increased by 1 doz.
4. The product of a number and 17.
5. A number of coins shared by three students.
6. 15 is taken away from a number.
7. The cars in a parking lot were joined by 20 more.
8. A certain number times 50.
9. One more than a certain number.
10. The sum of two consecutive numbers.
11. Three less than two times a number.
12. A certain number decreased by 17.
13. The difference between a number and 30.
14. The difference between 25, and a number decreased by 5.
15. Eight nore than 10 times a number.
16. Six of a number plus 8

17. Thirteen added to twice a certain number.
18. The cost of a certain number of articles if each cost 25¢.
19. Five more than half a certain number.
20. Three times, a number less six.
21. Three-quarters more than, five times a number.
22. The average of, a number and twelve.
23. Two-thirds less than the product of 3 and a Number.
24. Six joined to the difference between a number and one-third of the number.
25. Twelve more than the total of a number and double the number.

Exercise II

In each of the problems in Exercise I let what you want to find be represented by a letter (variable, placeholder) and write an open expression for each one.

Example:

Five less than a number.

Solution

i) let 'n' be the number

ii) 'less than' means subtraction

iii) thus the open expression is $\underline{n - 5}$.

Exercise III Introduction

In most of the word problems in this section your answers will be whole numbers. W = (0, 1, 2, 3, ...). In the problems dealing with money all your answers should show the usual two decimal places.

Exercise III Problems

1. A certain number plus 5 equals 18. Find the number.
2. Ten minus a certain number is 3. Find the number.
3. Twelve times a number is 168. Find the number.
4. A certain number is divided by 5 and the result is 11. What is the number?
5. Fred bought a glove for 10 dollars and a ball and bat for 3 dollars each. How much did he spend?
6. A newspaper in a large city has a daily circulation of 180,000. The Saturday circulation is 210,000. By how much the Saturday circulation exceed the daily circulation?
7. John's bowling score was twenty three more than Ed's. If Ed's score was 138, what was John's score?
8. In a certain downtown city block there are 18 stores. This is three times the number that there were twenty years ago. How many stores were there in this block twenty years ago?
9. To make a cake Diane buys a dozen eggs for 96 cents. If she needs four eggs for her cake, how much do the eggs cost for it?
10. Peter's father bought a car for $5500 and sold it one year later. If his car depreciated by $\frac{1}{5}$ th, for how much did he sell the car?
11. In one month a used car dealer sold 31 cars for a total of $55,000. On the average how much did each buyer pay for his car?

12. A basketball team played 38 games during one season. If they lost 12 games and tied 4, how many games did they win?

13. If Jack has five times as many sticks of gum as Mary and Mary has four sticks, how many does Jack have?

14. Sir Winston Churchill found in 1935 that if he had 5 more cigars, he could complete his cigar collection. When complete, his collection would consist of 37 different cigars. How many cigars does Sir Winston now have?

15. The sum of four times a number and 9 is 21. Find the number.

16. Mr. Farmer has 25 head of livestock consisting of cows, horses and sheep. If he has 7 cows and 8 horses, how many sheep does he have?

17. Three houses were to be built in a new neighbourhood. If the total amount of land available is 650 ft. front footage, how much front footage will each house have?

18. In preparing for a bike tour Jerry saved eight dollars per month for three months. When he took out all of his money he had 37 dollars. How much did he have in the bank before he started saving for the tour?

19. On halloween Mrs. Jones gave two pieces of candy to each of the 42 children that called at her door. She had 11 pieces left over. How many did she have to start with?

20. Two cows have a combined weight of 1650 lbs. If one is 250 lbs heavier than the other how heavy is each of the cows?

21. A number divided by 4 equals two times the sum of one and three. Find the number.

22. The George Washington Bridge has two end spans of equal length and a center span. The overall length of the bridge is 4800 ft. If the center span is 3600 ft. How long are each of the end spans?

23. To get an idea of the weight of newspapers Bob wanted to deliver, he weighed 5 of the forty papers and found the five weighed three lbs. Using this rate, find the total weight of the 40 newspapers.

24. A train travelled 192 of its 1636 mile run in three hours. At this rate how many hours would be required to complete the run?

25. During a basketball game Joe scored nine more than three times as many points as Bill. If Joe scored 24 points how many did Bill score?

26. If twice a number is five more than the number, find the number.

27. The difference between 5 times a number and 18 is two times the number. Find the number.

28. Jill is five years older than her brother Doug. If their combined age is 27, how old is Jill?

29. Mr. Farmer has 4 times the number of cows he had 5 years ago. If he now buys 11 more cows he has a total 47 cows. How many did he have to begin with?

30. Mr. Farmer presently has 2 sections of land. He buys some more land and his total land area is 3 times as large. How much land did he buy?

Exercise IV Introduction

In this exercise you will be working with word problems that deal with fractional numbers. Again, these problems will involve the operations of addition, subtraction, multiplication and division. The exercise will begin with problems involving one operation only and move on into more difficult problems and problems involving more than one operation.

What is a fraction?

You know what a fractured bone is. The word fraction has the same origin. It originally meant broken number. Nowadays the word fraction indicates the form of a numeral rather than a kind of number. Thus, a fraction is a numeral that has a numerator, or first part, and a denominator or a second part.

Three examples of how a fraction can be used are as follows:

a) Fraction: as part of a whole. If we have six oranges in a basket and we break them up into two groups, each new group will contain $\frac{1}{2}$ as many oranges as the first group.

b) Fraction: as a comparison of like quantities. (Ratio) If Mary has 10 dollars and John has 15 dollars we can say Mary has $\frac{10}{15}$ or $\frac{2}{3}$ as many dollars as John. This is called a ratio and can be written in the form 2:3 or $\frac{2}{3}$.

c) Fraction: as a comparison of unlike quantities. (Rate) Which is larger, $5 or 3 hours? We cannot say which is larger because dollars and hours are not the same units but we can say that $\frac{5}{3}$ is the rate of pay in dollars per hour.

c) Thus if a car travelled 150 miles in 3 hours we can say that the rate per hour is $\frac{150}{3}$ or 50 M.P.H.

Again if a plant grows 9 inches in 12 weeks we can say it grows $\frac{9}{12}$ or $\frac{3}{4}$ of an inch per week.

Exercise IV Problems

1. If your mathematics textbook is $\frac{11}{15}$ of an inch thick and there are 30 students in your class, how high would the pile be if you piled your books on one pile?
2. Barry bought a two lb bag of putty to fix some broken windows. If he used $\frac{2}{3}$ of the bag, how much did he use?
3. If a gallon of water weighs $8\frac{1}{3}$ pounds how much do $2\frac{1}{2}$ gallons weigh?
4. A grocer bagged 50 bushels of potatoes. If each of the bags contained $\frac{3}{5}$ of a bushel, how many bags did he use?
5. Sue earned extra spending money by babysitting for her neighbours. She worked $1\frac{1}{2}$ hours on Monday, $\frac{3}{4}$ hour on Wednesday and $2\frac{1}{4}$ hours on Friday. How many hours did she babysit that week?
6. Jerry and Sam were working on a model airplane together. Jerry completed $\frac{2}{5}$ of the model one evening and Sam completed another $\frac{1}{3}$ of it the next night. How much was left to be done?
7. To make a cover for her bike Janet bought $2\frac{1}{2}$ yards of canvas material. After she was finished she had $\frac{2}{3}$ yds. left over. How much did she use?
8. A candy bar has $\frac{3}{30}$ of a lb of sugar in it. How many bars could be made from 3 lbs of sugar?
9. A small bag of nuts contains $3\frac{1}{2}$ oz. of nuts. How many bags could

9. be filled from a box containing 52 $\frac{1}{2}$ ozs?

10. Mrs. Petes baked two turkeys for Christmas dinner. One weighed 8 $\frac{1}{2}$ lbs. and the other 11 $\frac{1}{2}$ lbs. Find the total weight of the two turkeys.

11. Mr. Green gave his son a board 6 $\frac{2}{3}$ feet long. Jerry, his son wanted to cut it up into exactly 4 pieces each having the same length. How long was each piece?

12. What is the number that is 3 $\frac{1}{4}$ as large as 4 $\frac{2}{7}$?

13. Mr. Jones, the farmer, watered his livestock at a trough full of water. If the calf draws $\frac{1}{5}$, the cow $\frac{1}{4}$ and the horse $\frac{1}{3}$ of the trough, how much water was left in the trough?

14. John collected $\frac{3}{4}$ dozen refundable soft drink bottles. His sister Sue had collected $\frac{2}{3}$ of a dozen. How many bottles did they have together?

15. A piece of board is 5 $\frac{1}{2}$ inches long. How much must be sawed off in order to make the board 4 $\frac{3}{4}$ inches long?

16. A large block of cheese weighs 6 $\frac{1}{4}$ lbs. How many slices, each weighing $\frac{1}{8}$ lb can be cut from it?

17. A cylindrical tank holds 3135 cu. ft. of water. If 1 cu. ft. of water is equivalent to 7 $\frac{1}{2}$ gallons, how many gallons of water will the tank hold?

18. After Kathy baked her cake, she left it sitting on the table. Naturally at four o'clock her brother was very hungry and ate $\frac{1}{8}$ of it. Unfortunately that did not satisfy his hunger therefore he ate an additional $\frac{1}{6}$ of the cake. Her father came home at 5 o'clock and ate $\frac{1}{4}$ of the cake. Cathy and her mother ate $\frac{11}{24}$.

18. How much of the cake was gone?

19. If each building lot is to contain $\frac{2}{3}$ acre of land, how much land is needed for 123 building lots?

20. Each letter on a typewriter requires $\frac{1}{12}$ of an inch. How many letters can be typed on 5 lines if each line is $3\frac{3}{4}$ inches in length?

21. Jane's aunt is $5\frac{1}{2}$ years older than twice Jane's age. How old is Jane if her aunt is $22\frac{1}{2}$ years old?

22. Cheryl lives $\frac{2}{3}$ mile from the school building and walks the distance four times each day. How much less than three miles does she walk each day in going to and coming home from school?

23. John can build a bookshelf in $4\frac{2}{3}$ hours. At this same rate how long will it take him to build a shelf $1\frac{3}{4}$ times as large?

24. One day five girls decided to add their babysitting time. If Sue and Molly worked $5\frac{1}{2}$ and $3\frac{1}{3}$ hours respectively and altogether the five had worked $16\frac{1}{2}$ hours, how much had the other three worked together?

25. At a school track meet Viviane throw the shot put $14\frac{2}{5}$ ft. Her friend Wendy throw it $12\frac{5}{8}$ ft. How much farther did Viviane throw the shot ?

26. Students in a class at Central Union High were asked to bring leaves to school for a class project. Two-thirds of the class of 33 were boys. On the average the boys brought 6 leaves each and the girls 10 leaves each. How many leaves were brought to school by the whole class?

27. The school athletic association sold 1,295 student membership tickets. If $\frac{7}{8}$ of the school became members, what is the school enrollment?

28. A certain stock sold at 39 $\frac{5}{8}$ when the stock market opened for the day and at 37 $\frac{3}{4}$ when it closed. How many points did the stock lose?

29. The radiator of a certain car holds 14 quarts. If $\frac{3}{8}$ of this must be antifreeze and the balance water, how much antifreeze must be used?

30. In a city of 16,440 population $\frac{2}{5}$ of the population are under 20 years old. If $\frac{3}{4}$ of those less than 20 were students, how many people in the city less than 20 years old are students?

Exercise V Some Additional Problems

1. Marilyn bought a sweater for $4.98 and shoes for $7.29. She paid $6.00 and her mother paid the rest. How much did her mother pay?
2. Mr. Orchard paid $3.75 a bushel for 65 bushels of peaches. He sold them for $4.98 a bushel. How much more did he receive for the peaches than be paid for them?
3. Judy bought a pair of skates on sale for $10.00. What was the regular price of the skates if they were reduced by one third?
4. In the building of a skyscraper three cranes were used to lift the material to each advancing level. In one day crane one lifted $47 \frac{1}{2}$ tons, crane two lifted $59 \frac{2}{3}$ tons and crane three lifted $64 \frac{1}{3}$ tons. What was the average amount lifted by each crane on that day?
5. A rocket is on its way to Mars. When it has gone $\frac{1}{3}$ of the distance to Mars the astronants find that they have used up $\frac{1}{10}$ of the supply of fuel. How much fuel will the rocket have used up when it reaches Mars?
6. Jane's class at school sold pencils as a class project to earn money for a tour. If they sold 3 pencils for 15 cents, for how much would they sell 10 pencils?
7. Two buildings have heights of 200 ft. and 300 ft. If the 200 foot building casts a shadow of 300 ft, what is the length of the other shadow?
8. An airplane travels 975 miles in 3 hours. How far will it travel in 5 hours?

9. Mr. Jones and Mr. Williams are investing money regularly in their company's stock. Mr. Jones invests $2 for every $3 Mr. Williams invests. This month Mr. Jones invested $75. How much has Mr. Williams invested?

10. In a certain map $\frac{1}{6}$ inch represents 15 miles. How many miles are represented by $5\frac{5}{6}$ inches?

APPENDIX F

STUDENT PRETEST

January 28, 1975

Name: ______________

Grade Seven Mathematics Test

Word Problems

Students, keep in mind that partial marks will be awarded for work shown even if the final answer is not correct. Do as many of these problems as you can but don't worry if you can't do them all.

1. Twelve minus a certain number is 5. Find the number.

2. A football team played 27 games during a season. If they lost 11 games and won 5, how many games did they tie?

3. Ten times a number is five less than 95. What is the number?

4. Mona is 14 pounds lighter than her sister Jane. If their combined weight is 168 pounds, how much does Jane weigh?

5. If three gallons of paint cost \$17.31 what is the cost of seven gallons?

6. Susie worked 1 1/2 hours, 2 hours and 3 1/3 hours on her mathematics project. Altogether, how much time did she work?

7. It takes Peter 1/2 of an hour to peel ten pounds of potatoes. If he works 8 hours how many pounds of potatoes does he peel?

8. A number is added to 7 3/4. If the sum is 11 1/4 what is the number?

9. A farm made up of 160 acres was sold for $140 per acre. If Mr. Jones bought 5/8 of the farm, how much did he pay?

10. Two boys together worked 13 1/2 hours on a class project. If John worked 2 1/2 hours more than Jerry how much time did John work?

APPENDIX G

STUDENT POSTTEST
- TREATMENT

Name ______________

Grade Seven Mathematics Test

Word Problems

Students, keep in mind that partial marks will be awarded for work shown even if the final answer is not correct. Do as many of these problems as you can but don't worry if you can't do them all.

1. Three times the number of beaver traps John has now is twenty seven. How many does he have now?

2. Robert and his friend go trapping each winter. One winter they caught two muskrats in each of their twenty nine traps. At the end of the winter their father gave them seven more muskrat pelts. How many muskrat pelts did they have altogether?

3. The number of rabbits Peter snared divided by six is six more than five. How many rabbits did he snare?

4. Mary and her brother paddled their canoe down Grassy Creek. It took them two minutes to paddle around three bends in the creek. At this same rate how long did it take them to paddle around 33 bends in the creek?

5. One fall Peter and his father each shot a moose. The one Peter shot was 450 lbs. lighter than his father's. If the two moose had a combined weight of 1400 pounds, what was the weight of Peter's moose?

6. Helping his mother tan a moosehide Jerry scraped 1/3 of the hide one day after school and 2/5 of the hide the same evening. How much did he have left to scrape for the next day?

7. A leather strip used to stretch the moosehide to a frame was cut from a strip 13 2/7 ft. long. The piece left over was 9 1/7 ft. long. How much was cut off?

8. Mary and her brother dig seneca root for some extra money. It takes them 1/3 of a week to dig 51 pounds. If they worked 3 1/3 weeks, how many pounds of seneca root did they dig?

9. Travelling by boat it takes John 3 3/4 hours to get to his fathers fishing camp. This same distance only takes 7/8 as much time by snowmobile in winter. How long does it take by snowmobile?

10. In one week Donald filleted fish at the fish co-op for 27 2/3 hours. This was 6 2/3 hours more than two times the number of hours he worked the week before. How many hours did he spend filleting fish the week before?

APPENDIX H

STUDENT POSTTEST - CONTROL

Name: ______________

Grade Seven Mathematics Test

Word Problems

Students, keep in mind that partial marks will be awarded for work shown even if the final answer is not correct. Do as many of these problems as you can but don't worry if you can't do them all.

1. The product of three and a number is twenty seven. What is the number?

2. Bob and his sister sold lemonade during their summer holidays. One day they sold two glasses each to twenty nine people. At the end of the day they had seven glasses left over. How many glasses did they start with?

3. A number divided by six is six more than five. What is the number?

4. Jane peddled her bike for 33 city blocks. If it took her two minutes to peddle three blocks, how long did it take her to peddle the 33 blocks?

5. In a zoo in Jerry's city they have several yaks. The smallest is 450 lbs. lighter than the largest. If their combined weight is 1400 lbs, what is the weight of the smallest yak?

6. A farmer asks his son Jerry to water the cattle. If the water trough was 1/3 full and Jerry put in 2/5 of a trough of water, how much more did he have to add to fill the trough?

7. A number is subtracted from 13 2/7 and the difference is 9 1/7. What is the number?

8. Mary helps her teacher staple the school newspaper. It takes her 1/3 of an hour to staple 51 papers. If she works 3 1/3 hours, how many papers does she staple?

9. It takes Mary 3 3/4 hours to sew a pair of pants for her bother. To sew a pair for herself she needs only 7/8 as much time. How long does it take her to sew a pair for herself?

10. Sam mowed his neighbours lawn during one summer and spent 27 2/3 hours at this job. This was 6 2/3 hours more than two times the number of hours he spent on his own lawn. How many hours did he spend on his own lawn?

APPENDIX I

STUDENT INFORMATION SHEET

A UNIT ON WORD PROBLEMS
IN GRADE SEVEN MATHEMATICS

Name of School: ______________________________

Don't write in this area

				Where Student Lives			Marks	
No.	Name of Student	Age (1/1/75)	Sex M/F	Reserve	Village (Indigenous)	Village (Recent)	Pretest	Posttest
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								

APPENDIX J

STUDENT QUESTIONNAIRE

A Unit on Word Problems
In Grade Seven Mathematics

Student Questionnaire

NOTE: 1) Do not write your name on this questionnaire.

2) Please read the questions carefully before answering.

3) Please answer each question.

4) Answer the questions with a check mark ( ) or sentence, as required.

5) If you have any questions please raise your hand and ask your teacher.

Questionnaire

1. What is the name of your school? ____________________

2. Sex (check one) Male __________ Female __________

3. Your age as of January 1, 1975. ____________________

4. Where do you live? (check one)

   a) Reserve ______________

   b) Village ______________

   c) Other (specify) __________

5. How long have you lived here? (check one)

   a) Always ______________

   b) Five or more years ________

   c) Less than five years _______

6. How many brothers and sisters do you have? ______________

7. Did you like this unit on word problems? (check one)

   a) All of it ______________

   b) Most of it ______________

   c) Some of it ______________

   d) None of it ______________

8. Do you like mathematics? (check one)

   a) All of the time ____________

   b) Most of the time ____________

   c) Some of the time ____________

   d) Never ____________________

9. How many problems did you do in this unit on word problems? (check one)

   a) More than those assigned ______________

   b) All those assigned ____________________

   c) Most of those assigned ________________

   d) Some of those assigned ________________

   e) None __________________________________

10. Would you like more of your mathematics set up like this unit on word problems? (check one)

    a) Yes (all of it) _______________________

    b) Yes (some of it) ______________________

    c) No (none) _____________________________

11. Did you show your parents or guardians what you were doing in this unit on word problems? (check one)

    a) Yes ____________________

    b) No _____________________

12. What subject do you like best in school? (check one)

    a) Literature ______________

    b) Mathematics ______________

    c) Geography/History __________

    d) Science ______________

13. What subject do you like least in school? (check one)

    a) Literature ______________

    b) Mathematics ______________

    c) Geography/History __________

    d) Science ______________

14. What did you like about this unit on word problems?

    ____

    ____

15. What did you learn about that you liked in this unit on word problems?

    ____

    ____

16. What did you not like about this unit on word problems?

    ____

    ____

    ____

Thank you for answering this questionnaire.

APPENDIX K

TEACHER QUESTIONNAIRE - I
- TREATMENT AND CONTROL

A Unit on Word Problems
In Grade Seven Mathematics

Teacher Questionnaire

NOTE: Please read each question carefully and then answer each question with a check mark or sentence.

Questionnaire

1. The name of your school ____________________

2. Sex: Male __________ Female __________

3. Number of years of teaching experience including the present year. ____________________

4. Number of years of teaching experience in northern schools. (Frontier) ____________________

5. How useful was this unit on word problems? (check one)

    a) Very useful __________

    b) Fairly useful __________

    c) A little useful __________

    d) Not useful at all __________

6. How suitable was this unit for your students mathematically? (check one)

    a) Very suitable __________

    b) Fairly __________

    c) A little __________

    d) Not at all __________

7. How suitable was this unit for your students culturally? (check one)

    a) Very Suitable __________

    b) Fairly __________

    c) A little __________

    d) Not at all __________

8. Do you feel this was a good learning experience for your students? (check one)

   a) Very much ____________

   b) Fairly much ____________

   c) A little ____________

   d) Not at all ____________

9. Should more of our math be presented in this way?

   a) Yes ____________

   b) Much more ____________

   c) A little more ____________

   d) No ____________

10. What did you like about this unit on word problems?

____

____

____

11. What did you dislike about this unit on word problems?

____

____

____

12. Further suggestions.

____

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____

Thank you for answering this questionnaire and taking part in the study.

APPENDIX L

TEACHER QUESTIONNAIRE - II
- CONTROL ONLY

A Unit on Word Problems
In Grade Seven Mathematics

Teacher Questionnaire

NOTE: This short questionnaire is to be answered by those teachers of schools where the control unit was taught who have now received a copy of the treatment unit.

Questionnaire

1. The name of your school ______________________

2. Sex: Male ______________ Female ______________

3. Number of years of teaching experience including the present year. ______________________

4. Number of years of teaching experience in northern schools. (Frontier) ______________________

5. Would this unit be more suitable for your students than the one you used? (check one)
   a) Much more suitable ____________
   b) More suitable ____________
   c) About the same ____________
   d) Less suitable ____________

6. Would this unit be more suitable for your students in a cultural sense? (check one)
   a) Much more suitable ____________
   b) More suitable ____________
   c) About the same ____________
   d) Less suitable ____________

7. Do you think they would enjoy the unit more? (check one)
   a) Very much more ____________
   b) Much more ____________
   c) About the same ____________
   d) Less ____________

8. Do you think their level of achievement would increase? (check one)

    a) Very much more ______________

    b) Much more ______________

    c) About the same ______________

    d) Less ______________

9. Should more of our mathematics be presented in this (cultural relevant) way? (check one)

    a) Very much more ______________

    b) Much more ______________

    c) A little ______________

    d) None ______________

10. What do you like about this culturally relevant unit?

____

____

____

11. What do you dislike about this unit?

____

____

____

12. Further comments.

____

____

____

____

____

Thank you for answering this questionnaire and taking part in the study.