THE EFFECT OF BI-MONTHLY STUDENT TEACHER CONFERENCES ON ATTITUDE TOWARD AND ACHIEVEMENT IN MATHEMATICS 100

A Thesis

Presented to

The Faculty of Graduate Studies

The University of Manitoba

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

by

Edward A. Melnyk

August, 1980

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A thesis 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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ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Dr. A. Murray McPherson, Chairman of the Thesis Committee for his friendship, encouragement, guidance and help during this study. The writer is also indebted to Dr. Dexter Harvey for his suggestions and his help with the analysis of the results. A special thanks is due Clare O'Neill for reviewing the work and for her suggested improvements.

I would also like to thank the students of my H100 mathematics class who formed the experimental group in this study. It was rewarding to work with them during and after the experiment.

Mrs. Joyce Anderson deserves a special thank you for the accuracy, efficiency and patience she demonstrated during the typing of the thesis.

Finally, my sincere appreciation to my wife and family, without whose support and encouragement my program would not have been completed.

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CHAPTER I

INTRODUCTION

For a number of years the writer has observed that adapting to the senior high school curriculum, especially mathematics, poses a problem for many students. The prime reason for this difficulty appears to be weak and/or undeveloped study habits. Many potentially good mathematics students give up on the more challenging mathematics courses because they have little idea of how to attack a course of study. As a result they choose courses in mathematics which are below their level of ability or choose not to study mathematics at all.

In an attempt to seek a solution to this problem the writer conducted an experiment which provided students with an opportunity to closely monitor their achievement and obtain advice on how they might improve their performance. The experiment was conducted with a group of incoming grade ten students and their mathematics teacher at a Winnipeg high school. The experiment also measured whether counselling students on their progress would influence their attitude toward mathematics.

Purpose

The purpose of this study was to determine whether student-teacher conferences have an effect on attitude toward and/or achievement in mathematics (Algebra) at the 100 level.

In other words, the researcher sought to assess the effects of direct student-teacher dialogue on student achievement in grade ten algebra and on student attitudes towards mathematics after such conferences. This assessment was continued for a period of four months beyond the period of instruction.

HYPOTHESES TESTED IN THE STUDY

A. Hypotheses relating to Attitude

HO: 1.1 There is no significant difference between the attitude measures of the control and experimental groups at the end of the 72 day experimental period.

HO: 1.2 There is no significant difference between the attitude measures of the control and experimental groups at the end of the 4 month follow-up.

HO: 1.3 There is no significant difference in the attitude scores of the experimental group between measures taken at pre-test and post-test times.

HO: 1.4 There is no significant difference in the attitude scores of the experimental group between measures taken at post-test and 4 month follow-up times.

HO: 1.5 There is no significant difference in the attitude scores of the experimental group between measures taken at pre-test and 4 month follow-up times.

HO: 1.6 There is no significant difference in the attitude scores of the control group between measures taken

at pre-test and post-test times.

HO: 1.7 There is no significant difference in the attitude scores of the control group between measures taken at post-test and 4 month follow-up times.

HO: 1.8 There is no significant difference in the attitude scores of the control group between measures taken at pre-test and 4 month follow-up times.

B. Hypotheses relating to Achievement

HO: 2.1 There is no significant difference between the achievement means of the experimental and control groups at the end of the 72-day experimental period.

HO: 2.2 There is no significant difference between the achievement means of the experimental and control groups at the 4 month follow-up times.

Note: Each hypothesis will be tested at the .05 level of significance.

In addition to the hypotheses to be tested the experiment suggests the following questions:

(1) Is the teacher-student conference most beneficial to students of a particular achievement level?

(2) What is the long term effect of the program on students? That is, does it affect their future choice of a mathematics program or does it affect their future achievement in a mathematics program?

In part these questions may be answered by the experiment,

but they should also be considered as worthwhile areas for future study.

Procedures

In order to assess the impact of student-teacher conferences on achievement and on attitude, the writer chose to employ a matched group technique of experimental research. Two groups consisting of twelve students each were selected by a matching process from two grade ten mathematics 100 classes. The matching was based on grade nine final standings and mathematical aptitude scores taken from students records (see Table 1). A diagnostic test of grade nine mathematics skills was used to check the matching. One group was randomly chosen as the experimental(conference) group: the second group became the control (non-conference) group.

During the seventy-two day experimental period each member of the conference group met with his mathematics instructor once each twelve school days. Conferences were held out of class time (before morning roll call or at lunch hour) and were a maximum of fiteen minutes duration. Discussion at the conferences centered on the students' progress in class work and on the results of testing since the previous conference. Also discussed were methods and facilities the students might use to improve his performance.

Conferences terminated with a summary of the important points raised and a commitment by the student to a particular

goal for the next twelve-day interval.

At the commencement of the experiment all students responded to an attitude scale designed to measure their attitudes towards mathematics. Students were re-tested with the same attitude scale after the 72 day experimental period and a final time after a four month follow-up period. Both experimental and control groups wrote an achievement test each twelve-day period on the work covered during that time. Tests were of thirty-five minutes duration. In addition, an accumulative test was given at the end of the seventy-two days. Achievement on these tests formed the basis for discussion with students in the conference groups. An additional achievement score was calculated at the end of the 4 month follow-up. All remaining students in the two classes, including those in the control group, received the usual help, advice, and encouragement in the regular classroom situation.

A comparison of the results of the achievement tests was made between the experimental and control groups at both 72 day and 4 month follow-up times. Comparison of change of attitude between the two groups was made at these same time intervals. Attitude change within each group was also calculated.

Importance of the Study

The problem addressed in this study is most severe in

many urban high schools today. Frequently students are counselled on the basis of their first term results in high school. If their achievement or attitude in mathematics classes is unsatisfactory they are guided into programs which are designed for students of lesser ability, with the result that work habits suffer due to lack of challenge. The writer believes that counselling should be done continuously in order to more adequately serve pupil needs.

Such a plan requires special consideration when teacher timetables are constructed. Time should be allowed for student teacher conferences, such as those conducted in the study.

While it would be desirable to have this option at all grade levels, the most benefit would be derived at the grade ten level, for at this level the incoming grade ten students develop work habits and attitudes that will help set the pattern of their high school academic career. This process would also be beneficial for the vocationally oriented student.

Limitations of the Study

The following factors could be considered to have affected the results of the study:

1. Students in the two groups were matched on the basis of their grade nine final mark in mathematics and their mathematical ability scores. Their final standing in grade nine mathematics is not standardized - the students come from

as many as twelve different teachers in three Junior High feeder schools with the corresponding variation in standards.

2. The validity and reliability of the achievement tests must be considered as limiting factors as they were teacher constructed.

3. Achievement tests for the two groups were not identical as it was not possible to test all the students together. As a result there was some transfer of information between members writing the parallel tests.

4. Students were not randomly assigned to the two groups.

Definitions

Achievement: For purposes of this study, achievement is defined as the ability to apply the concepts of the Algebra 100 course.

Achievement tests: Tests designed by the writer to examine the students' ability to apply the concepts in the Algebra 100 course.

Attitude: Beliefs about a subject, or prejudices favourable or unfavourable to it, that matter to an individual.

Conference: A 10-15 minute discussion between a student and his mathematics teacher, the purpose of which is to examine the students' progress in the course of study and how he might improve it. Conferences were non-tutorial in nature and were held outside of regular school hours.

Conference group: the experimental group.

Summary

Those of us who enjoy mathematics wish to share that enjoyment with as many students as possible. Many students exclude themselves from this enjoyment because they are uncertain about what is required for success in mathematics, or because they need a closer monitoring to ensure that they are following the path to success in mathematics.

The experiment will determine what effect a closer monitoring of students progress has on their achievement and attitude toward mathematics.

Organization of the Thesis

Chapter I contained a background to the study with the statement of purposes, hypothesis to be tested, the significance of the study, limitations and definitions. The chapter concluded with a summary.

A review of current research in the area of the present study is contained in the second chapter.

A detailed examination of the experimental design and procedures is presented in the third chapter.

The analysis of the data from the study and the summary tables are in chapter four.

The final chapter contains a summary of the study, conclusions from the data, and recommendations for future study.

CHAPTER II

REVIEW OF LITERATURE

Introduction

This chapter presents a review of literature under the following five headings:

1. The effect of student teacher conferences on achievement and attitude in mathematics.

2. The development and modification of attitude towards mathematics.

3. The effect of special programs on attitude towards mathematics.

4. The effect of attitude on achievement.

5. Teacher attitude and behaviour as a means of improving student attitude toward mathematics.

The chapter concludes with a summary of the important findings.

1. Review of Research relating to the Effect of Student-Teacher Conferences on Attitude and Achievement

A study entitled "Motivational Effect of Individual Conferences and Goal Setting on Performance and Attitudes in Arithmetic" (1968, Barbara J. Kennedy) was the only study found to have a similarity to the present experiment. The subjects of the study were 48 predominantly negro, low-socio-economic status, third and fourth graders from 3 arithmetic classes representing high, medium and low achievement. The children were randomly assigned to a control group, or to one of three experimental groups: (1) a group of students who

were told to do their best, (2) a group setting their own weekly goals, (3) a group in which the children's weekly goals were set by the teacher in conference with the student.

The study ran for a period of 6 weeks and was designed to answer the following questions: What are the effects of individual conferences on the acquisition and retention of arithmetic skills? What are the effects of individual conferences on attitude change?

Results of the experiment were stated as: (1) children who attended conferences performed better than those who had not: (2) children with specific goals performed better than those who had self set goals: (3) high achievement students reflected positive attitude change while low achievers reflected negative attitude changes.

2.(a) Review of Research on When Attitudes are Developed

Prospective teachers enrolled in Education classes at the University of California provided Dutton (1954, p.28) with their personal experience that attitudes toward mathematics were developed at all grades. They recalled that the most crucial times for their attitude formation were grades three to six. The early junior high grades were also cited as important, with a rapid decline in attitude development experienced during the high school years.

A later study (1956, p.21) in which Dutton involved 459 junior high students in a similar survey, had attitude

development reaching maximums between grades three and seven, with peak growth occurring at grades five and seven. A marked decline in positive attitude was observed at the grade eight and grade nine level.

Studies by Smith (1964) and White (1964) point out that attitudes were developed throughout the grades, but that the intermediate grades four to six were most influential in developing attitudes towards mathematics. A study by Stright (1960, p.283) concluded that definite attitudes have been developed by the third grade.

2.(b) Review of Research on When Attitudes are Modified

A study by Francis (1970) found that younger children change more in their attitude during the year. A longitudinal study involving grade five and six students in 1960 and the same students in grades eleven and twelve (Anttonen, 1966, p.470) showed a low but significant (r.30) positive correlation between elementary attitude scores and secondary attitude scores. Malone and Fred (1954, p.607) found that attitudes were firmly developed by high school. Dutton's (1956, p.22) study revealed that pupils recognized changes in attitude (either favorable or unfavorable) during one or two years in the junior high school.

F.M. Roberts (1970, p.792) measured attitudes of 323 students and 112 teachers in three high schools. The rather small difference found between student scores and teacher

scores suggested that attitudes towards mathematics once adopted may be relatively stable over the years.

3. Research on Special Programs Designed to Improve Attitudes

This area of experimentation dominates the published literature. A small number of selected samples are described below.

Two studies by Martens and Johnson with elementary students attempted to determine the effect of homework on attitude and achievement. The 1972 study found a significant improvement in computational and problem solving skills with the homework-parental involvement groups. Neither study produced significant changes in attitude.

A study by J.A. Tupesis (1972) involving high school slow track geometry students in a homework-no homework situation found no significant difference between the groups in attitude. A two-year acceleration and enrichment program done with five high intelligence grade nine classes found no significant change in attitude between control and enrichment groups (Arends, 1964). An enrichment unit in probability and statistics with a grade nine general math group (Shulte, 1967) proved ineffective in improving either computational skills or attitudes toward mathematics.

Mathematics games as a means of improving attitudes and learning skills were used in a study by Burgess (1969).

The eight week experiment (control group having pencil and paper activity sheets) yielded significant changes in attitude favoring the games group and significant differences in achievement by the control group. A learning games and student teams study by Edwards and Devries (1972) found improved attitude toward mathematics classes but yielded no significant achievement difference.

A study on the effects of a modern mathematics program versus a traditional program on attitude and achievement (Ryan, 1967) found that the modern program had no significant effect on the attitudes of the eleventh grade students. This finding is borne out in studies by Stibal (1967) and Yasui (1967) who also compared attitudes towards a modern mathematics versus a traditional program.

Laboratory programs conducted by Smith (1973), and Simpson (1973), found no significant difference in student attitudes. A similar study by Gray (1973) found improved attitudes in a small number of cases, while Hollis (1972) found that with slow learners at the lower grade levels laboratory work facilitated a positive attitude towards mathematics - especially in a socially deprived area. A study by Koch (1973) which hypothesized that a lab, multi-sensory (use of visual, written and auditory materials), drill and practise approach would improve attitudes was not substantiated.

Desk calculators (when used to check answers to math

problems) improved attitude significantly in a six month study by Advani (1972) involving eighteen 12 to 15 year olds with learning difficulties and behavioural problems. Favorable attitudes towards mathematics were also obtained in a (printing) calculator study of low-achieving Miami high school students (Ellis and Corum, 1964).

Individualized instruction was found to promote increased attitude and achievement in a lower socio-economic area of New York City (Porter Elementary School Study, 1972). Although no significant increase was observed in achievement, an elementary school individualized program study by Meade and Griffin (1969) found a positive increase in teacher and student attitude.

A study on the effect of programmed instruction on improvement of attitude and achievement (Davis and Banning, 1968) did not significantly improve either but it was discovered that the pre-measured attitudes were the best predictors of final grades, with attitudes toward teachers being the single most important predictor variable.

A non-graded secondary school when compared with a graded one showed no significant difference between schools in attitudes towards mathematics (Steere, 1967). A continuous progress plan in grades four, five and six (Williams, 1973) yielded no significant difference in attitude when compared to a traditional program.

Studies involving grouping of low-achievers in grades three and four (Stern, 1971), discovery type teaching with low-achieving grade tens (Kleckner, 1968), and two-semester versus three-semester programs with weak grade nines (Posamentier, 1973) all failed to produce significant attitude changes.

4. Review of the Literature on Effect of Attitude on Achievement

"Obviously, the assessment of attitudes towards mathematics would be of less concern if attitudes were not thought to affect performance in some way." (Aiken, 1970, p.558).

The longitudinal study by Anttonen (1968) (mentioned under heading two of this chapter) stated that achievement was greater for students whose attitudes had remained favourable or had become favourable since grades five and six.

Neale (1969, pp.631-640) and Husen (1967, p.47) have reported that correlations between attitude and achievement are consistent between .20 and .40. Brown and Abell (1965, p.549) found that the correlation between pupil attitude toward a subject and achievement in that subject was higher for arithemtic than for spelling, reading, or language.

Social learning theory as analysed by Zimbardo, Ebbeson, and Maslach (1977) would link attitude and achievement in a reciprocal interaction. This interaction is explained as ..."the likelihood of a specific behaviour is

determined by the consequences the person expects will follow the performance of that behaviour. If the consequences are positive or rewarding, the behaviour is likely to recur. If they are negative or punishing, the behaviour is not likely to recur." (p.81).

In the view of this theory it appears that the best way to improve attitude is to improve achievement; and that the best way of maintaining a good attitude is to maintain achievement.

5. Research on the Effect of Teacher Behaviour and Attitude as a Means of Improving Student Attitude toward Mathematics

It is generally held that teacher attitude and effectiveness in a particular subject are important determinants of student attitudes and performance in that subject.

Poffenberger and Norton (1956, p.116) suggest that three major teacher qualities can affect the attitude of students: (1) the display of strong interest in the subject; (2) the indication of a desire to have the students understand the material; (3) the display of good control of the class without being overly strict.

Phillips (1969) claims that his study "lends support to authoritative opinion by providing evidence that the teacher's attitude toward arithmetic is significantly related to the student's attitude and achievement." (p.507).

Byars (1971) has claimed that ..."teachers who are

indirect, use student ideas more than an average amount, have more student talk than the average amount, have better achievement and attitudes toward mathematics" (p.14).

Aiken and Dreger (1961, p.7) found that mathematics attitudes are positively correlated with subjects' ratings of former mathematics teachers. Bassham, Murphy and Murphy (1964), state that "the sense of oneness in purpose between members of the group and between the teacher and the group is one of the most powerful factors in modifying attitude toward mastery." (p.7).

Tuloch (1957, pp.575-6) lists eight characteristics of teachers which lessen or remove unfavourable attitudes: (1) set individual goals to assure more possibility of success, (2) frequently judge the performance ability of each pupil and gear expectancy to make possible numerous rewards, (3) strive for interest by using puzzles, games, etc., (4) praise worthy accomplishments instantly and sincerely, (5) discover as much as possible how the child performs mathematical exercises, (6) teach for real understanding and evaluate understanding, (7) convey to the child in the best possible way your interest in him and your concern for his welfare, (8) avoid criticism and sarcasm.

O'Reilly (1975, p.17) claims that the psychological climate of a classroom has an effect on the learning and attitudes of the students. He suggests that the teachers

should develop techniques for improving this climate.

Torrance et al (1966) studied the attitudes of 127 grade six to grade twelve students and teachers who participated in a program to evaluate SMSG instructional materials. Teacher effectiveness was found to have a positive effect on student attitudes toward teachers, methods, and overall school climate.

It has been observed that students who do not do well in a subject may develop negative attitudes towards that subject. An investigation by Aiken and Dreger (1961) found that college men who disliked mathematics (as contrasted with those who liked mathematics) said that their previous mathematics teachers had been more impatient and hostile. College women who disliked mathematics (in contrast to those who liked mathematics) tended to view their mathematics teachers as more impatient, less caring, grim, brutal, dull, lacking in subject knowledge, and not knowing how to teach mathematics.

Summary

A search of published and unpublished material on the effect of student-teacher conferences on attitude and achievement in mathematics yielded only one study. Results of this study indicated that children setting specific goals (in conference with the teacher) performed better than those who had not.

Crucial times for the development of attitude were found to be the latter elementary school grades and early Junior High school grades, though attitudes were developed at all grade levels. Grades eight and nine showed a marked decline in attitude formation, a decline which continued through the high school years. This finding could affect the outcome of the present study, since the subjects are being monitored at a time when attitude formation is at a lower level.

Attitude modification is more noticeable with younger children, although modification (both favourable and unfavourable) appears to be continuous in grade school. Stability of attitude increases toward the upper high school grades. In light of these findings it appears that attempting to alter attitudes of senior high school students involves a good measure of difficulty.

Numerous studies have been undertaken to assess the impact of special programs on change of attitude. Some of those cited in this chapter (laboratory approach, learning games approach, individualized programs, desk calculators) yielded significant positive attitude changes over the interval of the study.

The interest in attitude modification results from the feeling that attitudes toward mathematics affect achievement in mathematics. Studies indicate that students having

good achievement in mathematics usually have good attitudes towards that subject. On the other hand there is evidence that poor attitude and poor achievement are also mutually reinforcing.

Teacher attitude towards a subject, towards his students, and the climate he tries to maintain in a classroom have all been cited as determiners of student attitude towards a subject. Teachers who help each child to set his own goals, provide more opportunity for student talk, use student ideas more often, praise accomplishments, and show a genuine interest in their students are aiding the development and maintenance of a good attitude towards their subject area and themselves.

The intent of the study described herein is to determine if attitude and/or achievement can be significantly affected by student-teacher (goal setting) interviews. It is felt that a frequent assessment of student performance and the increase in rapport which results from conferences with the students will contribute to positive growth in both attitude and achievement.

CHAPTER III

EXPERIMENTAL DESIGN

The purpose of this chapter is to describe the study in detail. The school setting, the selection of subjects, the instrumentation, the student-teacher conferences, the hypotheses tested, and the treatment of data will be outlined.

The School Setting

The subjects in the experiment were selected from two Mathematics 100 classes at Kelvin High School in the Winnipeg School Division. The school operates classes in grades ten, eleven and twelve. The majority of the grade ten mathematics students are graduates of three junior high feeder schools: Earl Grey, J.B. Mitchell, and River Heights. There are approximately 860 students at Kelvin, with 285 of these in grade ten.

The school timetable is based on a six day cycle with eight periods per day. Each grade ten student has six mathematics periods per cycle; two of these are single periods (of 35 minutes duration), the remaining four classes are timetabled as two double periods.

Selection of Subjects

In the spring of 1979 timetable arrangements were made to enable the writer to teach two classes of Mathematics 100. In August when the junior high student records were

available for the incoming grade ten students, the grade nine mathematics scores were recorded for each member of the two class groups. Differential Aptitude Test scores were also recorded for those students who had written this test battery in junior high school. Using these two sets of measures a preliminary matching of subjects from the two class groups was done. Fifteen pairs of students were set up in this manner, the maximum number possible due to the availability of records.

On the second class day in September, a diagnostic test was administered to both classes. The test was constructed locally and included arithmetic and algebra skills that form the grade nine mathematics curriculum (see Appendix C). Results of the test were used to check the 15 matchings made earlier.

By the end of the first week several students on the original class lists had not reported to school or, because of program changes had transferred to other mathematics classes within the school. After making adjustments to the matched pairs to compensate for losses of students, the total number of pairs was reduced to ten. At the end of the first week in September the groups were finalized, and the experimental group randomly chosen.

TABLE 1

DATA USED TO MATCH STUDENTS IN CONTROL AND TREATMENT GROUPS

Subject	Grade 9 Final Standing	D.A.T. Score Verb Percentile	D.A.T. Score Num. Percentile	D.A.T. Score Av. Percentile	Diagnostic 50 + 50 = 100% Arith.	Diagnostic 50 + 50 = 100% Alg.	Diagnostic 50 + 50 = 100% Tot.
H_{33}	C	55	35	45	26	10	36
C_{31}	C	Not available			32½	14	46½
H_2	C	55	70	65	30	6	36
C_{18}	B^-	55	75	65	27	10	37
H_4	C	70	70	70	19	12	31
C_{27}	B	70	55	65	21½	6	27½
H_5	D	50	45	50	17	8	25
C_{10}	D	10	15	10	25	13	38
H_8	A			80	39	20	59
C_6	B	97	80	95	30	23	53
H_{10}	C	Not available			28	22	50
C_{12}	C	Not available			29	21	50
H_{11}	B			60	32	12	44
C_7	B	75	75	75	20	26	46
H_{12}	C	90	60	80	28	13	41
C_{17}	C^-	85	70	80	31	15	46
H_{18}	C	10	35	20	24	19	43
C_9	B^-	20	35	25	23	15	38
H_{22}	C	35	80	55	31	12	43
C_{22}	C	85	40	75	24	10	34

Note: H denotes experimental group
C denotes control group

The Experimental Group

At the beginning of the second week of school in September members of the experimental group attended a 30 minute meeting with their mathematics instructor. The purpose and format of the experiment were detailed to them at that time. Their involvement in the experiment was requested. The students were told that all information from interviews and any test results would be treated with confidence. They were to be provided with an opportunity to see the results of the experiment when it was completed.

Information relating to their match in the control group was not provided to members of the experimental group. Scheduling of conference times was also handled at this meeting.

The Control Group

Members of the control group were not notified of their involvement in the experiment. However,they may have received some indication that the experiment was in progress from their colleagues in the other class group.

Instrumentation

The following were considered to be the dependent variables for the experiment.

1. Algebra skills achievement tests (Appendix D)

Each twelve school days students in both class groups wrote an achievement test on the section of the algebra

course covered during that time period. Results of these tests formed the base for discussion at the subsequent student-teacher conference. During the experimental period, students in both class groups wrote five skills tests of the type described above, each test covering a 35 minute class period. At the end of the 12 cycle time period each student wrote an accumulative test on all the algebra skills covered during the experimental period. Test dates were set at least three days in advance. The accumulative test was planned (with student knowledge) for mid December and suitable review material and summaries were given to both classes.

2. Attitude (Post Test) scale

On the first day of class in September, students of both classes responded to an attitude scale (pre-test). Assurance was given that results of the test were not to be used in determining grades (see attitude scale in Appendix B).

The Mathematics Attitude Scale was developed in 1961 by Aiken and Dreger and was found to have a reliability of 0.94 for test-retest. The attitude scale is composed of twenty items: ten items represented positive attitudes toward math, and ten items represented negative attitudes. The scale was scored using the Likert method of summated ratings. The student reacted to each of the 20 items on

a five point scale indicating whether he strongly agreed, agreed, neither agreed nor disagreed, disagreed, or disagreed strongly. Values of one to five were assigned to a positive statement beginning with strong disagreement: a reversal of values was assigned for statements reflecting an unfavourable attitude. The maximum favourable score obtainable was 100, the maximum unfavourable score was 20, while a neutral score was 60.

The same attitude scale was administered at the end of the experiment (after 72 days) and a final time four months after the experimental period as a follow up.

Student-Teacher Conferences

The experimental treatment consisted of having each member of the experimental group meet with his/her mathematics instructor every twelve days at a pre-arranged time. Conferences were conducted before morning roll call, after noon dismissal, or before afternoon roll call and were of 10-15 minute duration.

Conferences examined progress during the previous twelve days and how that progress could be continued or improved upon. Also discussed was recent progress in the context of the years' work.

Each conference ended with a summary (of recent progress) and a commitment by the student for the next two cycles' work. (See conference schedule, Appendix E).

Hypotheses Tested in the Study

A. Hypotheses relating to Attitude

HO: 1.1 There is no significant difference between the attitude measures of the control and experimental groups at the end of the 72 day experimental period.

HO: 1.2 There is no significant difference between the attitude measures of the control and experimental groups at the end of the four month follow-up.

HO: 1.3 There is no significant difference in the attitude scores of the experimental group between measures taken at pre-test and post-test times.

HO: 1.4 There is no significant difference in the attitude scores of the experimental group between measures taken at post-test and 4 month follow-up times.

HO: 1.5 There is no significant difference in the attitude scores of the experimental group between measures taken at pre-test and 4 month follow-up times.

HO: 1.6 There is no significant difference in the attitude scores of the control group between measures taken at pre-test and post-test times.

HO: 1.7 There is no significant difference in the attitude scores of the control group between measures taken at post-test and 4 month follow-up times.

HO: 1.8 There is no significant difference in the attitude scores of the control group between measures

taken at pre-test and 4 month follow-up times.

B. Hypotheses relating to Achievement

HO: 2.1 There is no significant difference between the achievement means of the experimental and control groups at the end of the 72-day experimental period.

HO: 2.2 There is no significant difference between the achievement means of the experimental and control groups at the 4 month follow-up time.

Note: Each hypothesis will be tested at the .05 level of significance.

Treatment of the Data

Achievement Scores

The analysis used to test for significant differences in achievement was the t-test. The t-test is used to compare the means of two groups, and was used in this instance to test for significant differences between the means of the control and experimental groups at two different time intervals (72 days and 4 month follow-up).

Attitude Scores

An analysis of variance was run on the three attitude measures (pre-test, 72 days, 4 months) for each of the two groups. In addition the t-test was used to test for significant differences between control group and experimental group means at each of the three time intervals.

Summary

A sample of ten students from each of two grade ten mathematics 100 were selected and matched on the basis of grade nine achievement scores and differential aptitude scores. One group was designated the control group, the other the experimental group.

As the experimental treatment members of the experimental group attended individual conferences with their mathematics instructor each twelve school days. Conference time was used to discuss recent progress, to discuss means by which progress might be improved, and to set performance goals for the next twelve day period.

The dependent variables in the study were the achievement and attitude scores of the two groups. This chapter described the measuring instruments used. Hypotheses tested were cited and statistical treatments were described.

CHAPTER IV

ANALYSIS OF DATA

Chapter IV contains an analysis of the data generated by the study. Each hypothesis stated in Chapter I is tested; the test results are presented along with the supporting data.

The Analyses

A. Hypotheses Relating to Attitude

Hypotheses 1.1 and 1.2 were tested using the t-test.

HO: 1.1 There is no significant difference between the attitude measures of the control and experimental group at the end of the 72 day experimental period.

Table 2

Summary of Attitude Measures for Two Groups at 72 Days

No.	Control Group Mean	Experimental Group Mean	S.D. of Diff.	Calc. t.	D.F.
20	70.7	69.9	5.56	.144	18

Note: at .05 level, theoretical t = 1.734

As a result of the data in Table 2 , the null hypothesis was accepted.

HO: 1.2 There is no significant difference between the attitude measures of the control and experimental groups at the end of the four month follow-up.

Table 3

Summary of Attitude Measures for Two Groups at 4 Month Follow-up

No.	Control Group Mean	Experimental Group Mean	S.D. of Diff.	Calc. t.	D.F.
20	69.6	65.6	6.36	.629	18

Note: at .05 level, theoretical t = 1.734

As a result of the data in Table 3 , the null hypothesis was accepted.

Hypotheses 1.3, 1.4 and 1.5 were tested using an analysis of variance (see Table 4). As a result of the data in this table, the following decisions were made.

HO: 1.3 The null hypothesis that there would be no significant difference in attitude measures for the experimental group between pre-test and post test times was accepted.

HO: 1.4 The null hypothesis that there would be no significant difference in attitude measures for the experimental group between post-test and 4 month follow-up times was accepted.

HO: 1.5 The null hypothesis that there would be no significant difference in attitude change for the experimental group between pre-test and 4 month follow-up times was accepted.

Table 4

Analysis of Variance for Experimental Group
on Attitude Measures Across Three time Intervals

Source	D.F.	Sum of Squares	Mean Squares	F Ratio
Subjects	9	3678.581	408.731	1.71
Treatment	2	201.852	100.926	
Error	18	1060.813	58.93	
Total	29	4941.246		

Note: at the .05 level of significance F crit. = 4.41 for d.f. 2, 18.

Hypotheses 1.6, 1.7 and 1.8 were tested using an analysis of variance. Table 5 shows the results of this analysis. Table 6 gives the results of Duncan's Multiple Range Test, used to determine which of the means were significantly different.

HO: 1.6 The null hypothesis that there would be no significant difference in the attitude scores of the control group between measures at pre-test and post-test times was rejected. A significant difference was found (.05 level).

HO: 1.7 The null hypothesis that there would be no significant difference in the attitude scores of the control group between measures at post-test and 4 month follow-up time was accepted.

HO: 1.8 The null hypothesis that there would be no significant difference in the attitude scores of the control group between measures at pre-test and 4 month follow-up time was rejected. A significant difference was found (.05 level).

Table 5

Analysis of Variance for Control Group
on Attitude Measures Across Three time Intervals

Source	D.F.	Sum of Squares	Mean Squares	F Ratio
Subjects	9	5107.516	567.502	4.90*
Treatment	2	242.090	121.045	
Error	18	444.578	24.70	
Total	29	5794.184		

*Significant at the .05 level (F .05 = 4.41 for d.f. 2,18).

Table 6

Duncan's Multiple Range Test Applied to the Differences Between K = 3 Attitude means. The Analysis of Variance for the Control Group Attitude Measures across Three time Intervals is given in Table 5 .

Means	A Pre-test 64.20	B 4 mos. 69.60	C 72 days 70.70	Shortest Significant Ranges
64.20		5.40*	6.50*	$R_2 = 4.52$
69.60			1.10	$R_3 = 4.74$
	A	B	C	

* Significance at the .05 level

B. Hypotheses Relating to Achievement

Hypotheses 2.1 and 2.2 were tested using the t-test.

HO: 2.1 There is no significant difference between the achievement means of the experimental and control groups at the end of the 72-day experimental period.

Table 7

Summary of Achievement Measures for Two Groups at 72 Days

No.	Control Group Mean	Experimental Group Mean	S.D. of Diff.	Calc. t.	D.F.
20	71.8	67.5	5.13	.839	18

Note: at the .05 level, theoretical t = 1.734

As a result of the data in Table 7 the null hypothesis was accepted.

HO: 2.2 There is no significant difference between the achievement means of the experimental and control groups at the 4 month follow-up times.

Table 8

Summary of Achievement Measures for Two Groups at 4 month Follow-up

No.	Control Group Mean	Experimental Group Mean	S.D. of Diff.	Calc. t.	D.F.
20	63.4	57.9	5.72	.961	18

Note: at the .05 level, theoretical t = 1.734

As a result of the data in Table 8 , the null hypothesis was accepted.

Summary of the Findings of the Study

Analyses were conducted on the achievement and attitude ratings of two groups of students who received different treatment over the period of the experiment.

Findings on Attitude

No significant differences were found (t-test at the .05 level) between the experimental and control group attitude means at either of the three time intervals. A comparison of the three attitude means of the experimental group using an analysis of variance did not yield significant differences. However, significant F ratios were found when control group attitude means were compared. The significant differences were detected between pre-test and 72 day means, and between pre-test and 4 month follow-up means.

Findings on Achievement

No significant t values were found in the analyses used to determine if differences in achievement means existed.

Table 9

Comparison of Mean Attitude and Achievement Scores at pre-experimental, post-experimental, and 4 month follow-up Times

Group	Pre-Test	Post-Experimental	4 month Follow-up
Attitude control	64.2	70.7	69.6
Attitude experimental	63.7	69.9	65.6
Achievement control		71.8	63.4
Achievement experimental		67.5	57.9

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

As a result of the experimental data analysed, several conclusions can be drawn and recommendations made. In order to make these conclusions and recommendations more meaningful, a brief summary of the entire study will be presented at this point.

Summary of the Study

The purpose of this study was to determine whether student-teacher conferences had an effect on student achievement in the Mathematics 100 course and/or student attitude towards mathematics. Questions to be answered by the study were: (1) are there significant differences in achievement for students involved in the conferences as compared to students not involved in the conferences? (2) are there significant changes in attitude for the conference group or the control group at different time intervals?

A review of current literature revealed only one study that had been conducted to determine the effect of student-teacher goal setting conferences on achievement. Reports on any similar studies were unavailable from the usual sources.

The amount of literature dealing with attitude toward mathematics was plentiful and the following conclusions were evident:

(1) Attitudes are developed throughout all grades but predominantly grades four to eight; (2) attitudes can be modified more easily with younger children; (3) it becomes increasingly difficult to modify attitudes beyond the grade eight level; (4) positive attitudes towards a school subject were generally associated with good achievement in that subject; (5) improvement in attitude was facilitated by positive teacher attitude, positive parent attitude, and good classroom climate.

To conduct the current study a group of ten students was selected from each of two grade ten class units. Selection of the group was made by matching pairs of students on their grade nine final achievement scores, and verbal and numerical ability scores from a battery of differential aptitude tests. Matchings were further checked using results of a diagnostic test of grade nine mathematics skills.

One group of ten students was randomly designated as the experimental group. As the experimental treatment, members of the experimental group met with their mathematics teacher once each twelve school days for a 15 minute conference. Conferences were designed to examine recent student progress and to provide suggestions as to how he/she might improve that progress. The experiment ran for a period of 72 school days. During this time the experimental

group met with their instructor six times.

Members of the control group were unaware of their involvement in the experiment. They were treated as part of a regular teaching group. Progress reports, encouragement and suggestions for improvement were handled as an in-class matter.

Achievement (one of the dependant variables) was measured for all students by means of five 35 minute algebra skills tests. At the conclusion of the program all students wrote an accumulative test on all algebra skills covered during the experimental period. Four months after the experiment terminated an achievement score was calculated for that follow-up interval. The mean achievement scores for the experimental and control groups were compared using the t-test.

Attitude toward mathematics (the second dependant variable) was measured using a scale developed by Aiken and Dreger. The attitude scale was used as a pre-test, as a post-test, and at the end of a four month follow-up period. Using the analysis of variance, attitude scores were compared across these time intervals for each group. In addition the three attitude scores for the two groups were compared using the t-test.

The Findings

1. Achievement scores of the group which received the conferences and those of the control group did not differ significantly at either post experimental or 4 month follow-up times.

2. Attitude measures of the experimental group did not differ significantly across any of the three times: pre-test to post-test, post-test to 4 month follow-up, or pre-test to 4 month follow-up.

3. Attitude measures of the control group showed a significant difference between pre-test and post-test times. The difference in measures between pre-test and 4 month follow-up times was also significant for this group.

4. The attitude measures for the two groups were compared at each of the three time intervals. No significant difference was found.

Conclusions

Experimental Group Achievement

Through personal experience and in the experience of colleagues it is perceived that students whose achievement in mathematics has been less than average are more tense, participate less, and are more withdrawn in mathematics classes. A worthwhile side effect of this study was to make students of the above mentioned group more relaxed and more willing to participate in their mathematics classes.

Further evidence of the meaningfulness of the experiment was provided by two students from the experimental group who requested (and were permitted) to continue the conferences for several weeks beyond the end of the experiment. They felt that the periodic detailed assessment gave them a better knowledge of their progress, and made them more enthusiastic in their quest for success.

As evidenced from Table 9, the mean achievement scores for the experimental group showed a large drop between the time of the termination of the 72 day experiment and the time of the 4 month follow-up. The following factors were noted to have contributed in some way to this drop: (1) students in the age group of the subjects are developing other interests and other directions for their energies: (2) the time of year during which the follow-up measurements were taken (January to April) is a time when students are somewhat less than enthusiastic about their studies: (3) the removal of the supportive measures that were introduced as part of the experimental program.

Experimental Group Attitude

The absence of a significant increase in attitude measures for the experimental group agrees with previous research which concludes that attitude is firmly developed before high school. The tendency for attitudes to remain stable once adopted, as cited by Anttonen, may also have

accounted for this outcome.

The small increase, though not significant might be attributed to the fact that the study provided conditions cited by Tulock as necessary for removing unfavourable attitudes. The conditions being: setting individual goals, frequent judging of performance, conveying interest and concern for the child's welfare, showing pleasure at success and improvement, and avoiding criticism and sarcasm.

Control Group Attitude

The significant difference in attitude for the control group (pre-test to post-test) is difficult to explain. The higher achievement measures in the group may have acted as a positive reinforcement for their attitudes. Maintaining this higher achievement level through to the 4 month follow-up time could serve to maintain the attitude level of the control group at the significantly higher level.

Relationship Between Attitude and Achievement in the Study

Highest achievement measures occur at the same time as the highest attitude measures for both experimental and control groups (see Table 9). This is in accord with Social Learning Theory which maintains that attitude and achievement are mutually reinforcing. In addition, this association between attitude and achievement was reported in studies by Anttonen (1968), Neale (1969), and Brown and Abel (1965).

Recommendations

It is possible to improve on several facets of the current study. Means for improvement (in the event of replication) are suggested in this section. Recommendations for the school are contained in a concluding section.

For Further Study

The writer suggests that the present study be replicated incorporating the following changes in design. The number of subjects in the study should be increased to at least twenty per group. This would allow for more meaningful results and enable the experimenter to determine if a particular level of student derives more benefit from the program.

Selection of subjects by matching should be avoided. Subjects should be randomly chosen and randomly assigned to the experimental and control groups. The experiment could be conducted as effectively by having membership in the groups cross class boundaries. Both groups should be taught by the same instructor as was the case in the present study.

Students in both groups should write a pre-test and post-test on algebra skills in addition to the pre and post attitude scale. This would allow a more accurate statistical assessment of the study. The analysis of covariance technique could be used to eliminate the possibi-

lity of having groups of unequal ability.

The time interval of the study was found to be satisfactory: the program was completed before the Christmas break, thus avoiding the possibility of a loss in continuity. The frequency and format of the student-teacher conferences seemed adequate.

For the School

Based on the findings of the study, the writer suggests that the following measures be taken in the next school year. First and most critical to the success of a program such as that conducted in this study, the school administration and all mathematics teachers must be convinced of the benefits of the program and must be supportive of it.

During the next school year three classes of grade ten mathematics (both levels represented) should be involved in the program. Although some personal time of staff members would be required, conference times could be almost completely scheduled during resource centre time (210 minutes per six day cycle for each member of the mathematics department.)

Parents of all students in the program would be contacted, the program explained to them, and a closer home-school contact would be instituted during the course of the year.

A regular assessment of the program would be conducted

during the year, and a decision as to the possible involvement of all grade ten classes, or possibly classes of other grades would be made during the spring term.

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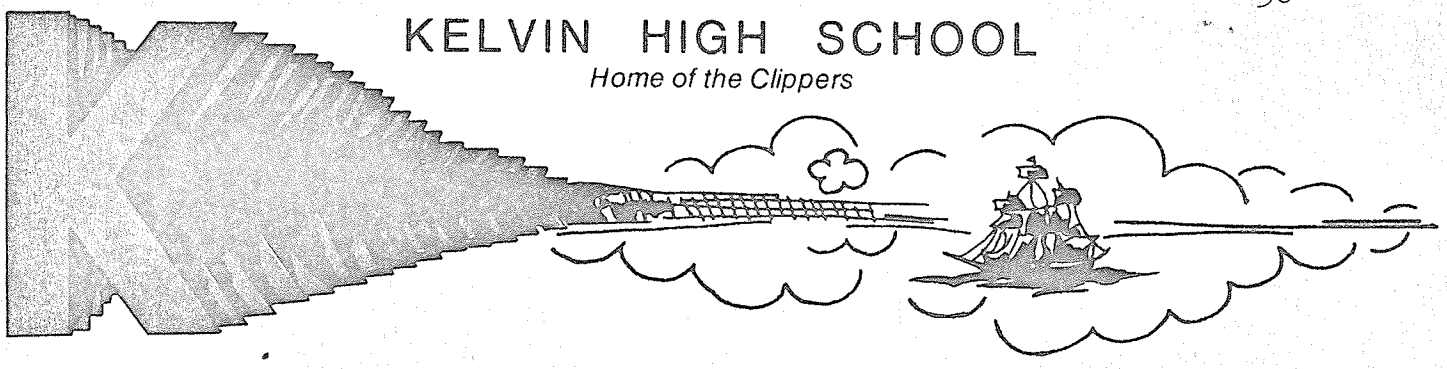
APPENDIX A

KELVIN HIGH SCHOOL

Home of the Clippers



G. H. Phillips, B.A., B.Ed.
Principal
P. E. G. Kallos, B.A., B.Ed.
Vice-Principal

March 19, 1979.

Miss V. G. Johnson,
Area 3 Superintendent.

Dear Miss Johnson:

In order to complete my M. Ed. program at the Faculty of Education it is necessary that I do a research paper commencing in the Fall of 1979. My project will involve two groups of Grade X Math 100 students--each group to contain 12 students. It would be beneficial if each group could be contained as part of a separate class. (It will not be necessary to create any special sized classes: Mr. Peter Kallos, our Vice-Principal, assures me that it is possible to timetable the students this way.)

In advance of this placement, I would like to pair up the 24 students based on their Grade IX Mathematics grades, and their I.Q. scores. For this it will be necessary to have access to their Junior High records. Miss Arnott of River Heights Junior High has indicated that she will cooperate should you give your approval.

The purpose of this experiment is to determine whether weekly counselling periods (of 10-minute duration) with each member of one group of students will have an effect on their attitude and/or achievement (and adjustment) in the High School Math program. The individual interviews will be scheduled during "spares" or out of class time. One group of 12 students is to act as the control group.

I request your permission to conduct this experiment at Kelvin and to have access to the Junior High records of students chosen for the program.

Respectfully yours,

Ed Melnyk,
Mathematics Department.

EM:hct

155 KINGSWAY AVENUE • WINNIPEG • MANITOBA • R3M 0G3 • TELEPHONE 474-1492

THE WINNIPEG SCHOOL DIVISION NO. 1
Superintendent's Department

March 23, 1979.

Mr. E. Melnyk,
Kelvin High School.

Dear Ed,

With reference to the experiment you would like to conduct with Grade X Maths classes, I would like you to know that I approve of the project.

However, one absolute requirement would be that you had the permission of the parents of the students involved to conduct this experiment, and permission to have access to the scores, etc. on their record cards for this purpose.

A discussion of your project with the group of parents might be a procedure used, as might a telephone conversation or a letter.

I wish you success with your research paper.

Yours sincerely,

Valdine G. Johnson,
(Acting) Superintendent,
Area III.

VGJ/as

APPENDIX B

MATHEMATICS ATTITUDE SCALE

General Instructions

This questionnaire contains a set of statements describing attitudes people have toward mathematics.

The questionnaire is NOT a test and it will not be used for grading purposes. It is designed to measure your own personal feelings toward mathematics.

Please read each statement carefully and answer by giving your first reaction to the item. Feel free to answer honestly and frankly as your answers will be kept confidential. Please answer all items.

How to Answer

Next to each statement are 5 blank spaces, each one representing a feeling toward the statement.

Sample	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Place a check ( ) mark in the space that most closely represents your feeling to the statement. Do not mark between the spaces.

NAME_____ RM. NO._____

ATTITUDE STATEMENT	Personal Feeling				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I approach mathematics with a feeling of hesitation resulting from a fear of not being able to do it					
2. I really like mathematics					
3. I am always under a terrific strain in mathematics classes					
4. Mathematics makes me feel secure and at the same time it is stimulating					
5. I have always been afraid of mathematics					
6. Mathematics is fascinating and fun					
7. When I hear the word "mathematics" I have a feeling of dislike					
8. I look forward to mathematics classes					

ATTITUDE STATEMENT	Personal Feeling				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
9. I have a sense of insecurity when attempting mathematics					
10. My mind goes blank, and I am unable to think clearly when working at mathematics					
11. The feeling I have toward mathematics is a good feeling					
12. Mathematics makes me feel as though I'm lost in a jungle of letters and diagrams and cannot find my way					
13. I feel at ease in mathematics					
14. It makes me nervous to even think about having to do a mathematics question					
15. Mathematics is one of my favorite subjects					
16. Mathematics makes me feel uncomfortable, restless, and irritable					

ATTITUDE STATEMENT	Personal Feeling				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
17. Mathematics is very interesting to me and I enjoy mathematics classes					
18. Mathematics is my most dreaded subject					
19. Mathematics is something which I enjoy a great deal					
20. I feel a definite positive reaction to mathematics					

APPENDIX C

lue

GRADE X - DIAGNOSTIC TEST PART A

1. 319 + 78 + 1468 + 3624 = _____
2. -24 + +345 = _____
3. 7.28 x 51.6 = _____
4. $2\frac{2}{3} \times 7\frac{4}{5}$ = _____
5. 9193 ÷ 317 = _____
6. +16 x -29 = _____
7. +15 - +18 = _____
8. Express .875 as a fraction (simplest) _____
9. -14 + -79 = _____
10. $6\frac{1}{2} \div 11\frac{2}{7}$ = _____
11. 217 x 593 = _____
12. Express $\frac{1}{16}$ as a decimal _____
13. +5 x +23 = _____
14. -36 ÷ +9 = _____
15. +15 + +279 = _____
16. 4.3 + 21.05 + .074 + 19 = _____
17. 22,348 - 14,879 = _____
18. Express $.\overline{4}$ as a fraction _____
19. -38 - -9 = _____
20. +49 ÷ -7 = _____
21. +37 + -19 = _____
22. 14.375 - 9.296 = _____
23. Express $\frac{1}{7}$ as a decimal _____
24. $2\frac{3}{8} - 1\frac{3}{4}$ = _____

25. $\frac{1}{2} - \frac{1}{3} + \frac{1}{4} =$ _____

26. $8.89 \div 4.68 =$ _____

27. Express $.\overline{138}$ as a simplest fraction _____

28. $-18 \times -7 =$ _____

29. $+29 - +37 =$ _____

30. $-43 \times +9 =$ _____

31. $+235 \div +47 =$ _____

32. $-144 \div -12 =$ _____

33. The quotient of any number and zero is _____

34. $-94 - +26$__ $=$ _____

35. Express .19999 as a simplest fraction _____

36. a) What number is $33\frac{1}{3}\%$ of 237? _____

3 b) 49% of what number is 147? _____

c) $17\frac{1}{2}$ is 50% of what number? _____

37. a) The sum of three consecutive odd numbers is 63. Find the numbers. _____

3 b) Nancy has $4.55 worth of quarters and dimes. If she has 35 coins altogether, how many more dimes than quarters does she have? _____

c) A student paid $37.80 for a calculator. The price included the 5% sales tax. What was the cost of the calculator? _____

GRADE X - DIAGNOSTIC TEST PART B

1. Solve the following equations:

   a) $7 - x = 16$ _____

   b) $-7(2 - 3x) = 0$ _____

   c) $4x + 8 = 36$ _____

   d) $4(2m - 3) = 12$ _____

   e) $-4(1 - x) = 3(3 - 2x)$ _____

   f) $2 - 4(x + 1) = -7(1 - x) - 1$ _____

2. Simplify each of the following expressions:

   a) $a^3b^2b^4a =$ _____

   b) $(xyx)^3 =$ _____

   c) $\left(\frac{-x}{y}\right)^2 =$ _____

   d) $[(-3)xt]^5 =$ _____

   e) $\frac{c^2m^3}{cm} =$ _____

   f) $(4a)(3ab)(-5a) =$ _____

   g) $8x + 9x^2 + 6x =$ _____

   h) $7 + 9c + 2 + 6c =$ _____

   i) $3x^2 + 5 + 2(x^2 + 3) =$ _____

   j) $16 + 5(3d + 2) =$ _____

   k) $(-2)(-5)(-6) =$ _____

   l) $(4m - 3n^2) - (5n^2 - 6m) =$ _____

   m) $\frac{a}{x} + \frac{3}{y} =$ _____

   n) $\frac{5a}{7} + \frac{3x}{4m} =$ _____

o) $\frac{1}{x} \div \frac{2}{y} =$ _____

p) $\frac{4n}{x} - \frac{2}{y} =$ _____

q) $\frac{6}{r} \div \frac{11}{t} =$ _____

r) $\frac{x + \frac{1}{3}}{y + \frac{1}{4}} =$ _____

s) $\frac{2x + 1}{6} - \frac{3x}{8} =$ _____

t) $\frac{6 - \frac{7}{r}}{3 + \frac{2}{r}} =$ _____

u) $\frac{5}{t} \times \frac{r}{-6} =$ _____

v) $\frac{4}{c-7} \div \frac{6}{t-2} =$ _____

APPENDIX D

ies:

1. Add:

$$\begin{array}{r} 7x^3 + 9x^2 - 5x + 3 \\ 4x^3 - 6x^2 + 8x - 5 \\ -2x^3 - 7x^2 + 9x - 12 \\ \hline \end{array}$$

2

2. Subtract:

$$\begin{array}{r} 11a + 6c - 4b - 3f + 5 \\ 6a - 7c - 4b + 3f + 9 \\ \hline \end{array}$$

11. Simplify by removing brackets and collecting like terms

1. $(3x^2 + 4x - 9) + (5x - 2x^2 + 4) + (6 - 8x - 3x^2)$

2. $(3a^2 - b + 11c + 1) - (3b - 2a^2 - 5 + 2b)$

3. $(2x - 7y - z) - (3z - 4y + 6x) + (x - y - 2z)$

4. $2(x^2 + 3x - 4) - 3(x - x^2 + 2) + 4(5 - 2x)$

5. $(x + 5)(x + 3) + (x + 6)(x - 6) + (x + 2)^2$

111. Name three ways of classifying polynomials and give one example for each classification:

1.

2.

3.

IV. Perform the following multiplications (express answer in simplest terms).

Marks		
1	1.	$(-8a^2bc)(7a^3bc^4m)$
1	2.	$(2xy)(-3x^2z)(4xyz^3)$
1	3.	$5abc\ (2ab - 3bc)$
2	4.	$-6m^2n(5mn^2 - 4m^2n^2 + 7m^2n^3)$
2	5.	$(3x + 7)(2x - 9)$
2	6.	$(7x - 6)(5x + 4)$
2	7.	$(2x - 5)^2$
2	8.	$(3x + 2)(2x^2 + 5x - 4)$
2	9.	$(a + b + c)(a - b + c)$

V. Perform the following divisions

Marks		
1	1.	$(27c^3d^2e) \div (-6cd^3e)$
2	2.	$(24x^2y^2 - 18x^2y + 3xy) \div (-3xy)$

NAME _____ RM. NO. _____

ues:
=2

1. (1) Add:

$$\begin{array}{r} 5a + 2b - 4c + 11 \\ 3a - 8b + 6c - 5 \\ -7a + 36 - 7c - 8 \\ \hline \end{array}$$

(2) Subtract:

$$\begin{array}{r} 6x^4 - 5x^3 + x^2 - 7x + 9 \\ 8x^4 - 5x^3 - x^2 + 3x - 4 \\ \hline \end{array}$$

11. Simplify by removing brackets and collecting like items.

2 (1) $(2x^2-7x+4) + (x-2-4x^2) + (6x^2-3x+9)$

2 (2) $(5a-2b+7c-6) - (5c-3a-4b+9)$

2 (3) $(5x+6y-3z) - (2y-7x+5z) + (z-x-y)$

2 (4) $2(x^2+6x-5) + 4(x-x^2-3) - 3(x^2+2x-7)$

2 (5) $(x+7)(x-7) + (x+8)(x+1) + (x+4)^2$

111. For the expression $6x^3y+2y^2$

(1) a. $6x^3y$ is called _____

b. 6 is called the _____

c. x^3y is called the _____

(2) For the expression x^3

a. x is called the _____

b. 3 is called the _____

NAME _____ 12

IV. Perform the following multiplications (express answer in simplest form)

1. $(9x^3y^2z)(-6xy^2z^3)$ 1. _____

2. $(3abc)(-4a^2c)(-5c^2b)$ 2. _____

3. $6xyz(3x^2z-2yz^3)$ 3. _____

4. $-4m^3n^2(2mn^2-5m^2n-6m^3n^3)$ 4. _____

5. $(5x+6)(3x+2)$ 5. _____

6. $(7x-5)(4x+9)$ 6. _____

7. $(3x+5)^2$ 7. _____

8. $(2x-5)(3x^2+4x-6)$ 8. _____

9. $(x+y-z)(x-y+z)$ 9. _____

V. Perform the following divisions:

1. $(36a^3bc^2) \div (-9ab^2cd)$ 1. _____

2. $(36x^3y-27x^2y^2+3xy) \div (-3xy)$ 2. _____

NAME _____

SECTION H: FACTOR COMPLETELY

_____
16

(1) $15c^2d - 10cd^2$

(2) $21xyz - 28x^2y^2z^2 + 7xz$

(3) $m^2 - 81$

(4) $3t^3 - 27$

(5) $a^2 - 13a + 36$

(6) $3c^2 + 15c + 18$

(7) $w^2 - 6w - 55$

(8) $3r^2 + 6r - 72$

lue: 2 marks each

NAME _____

SECTION C: FACTOR COMPLETELY

/16

(1) $21x^2y - 14xy^2$

(2) $15abc - 27a^2b^2 + 3ab$

(3) $t^2 - 64$

(4) $cd^3 - c^3d$

(5) $m^2 + 8m + 12$

(6) $2r^2 - 10r + 12$

(7) $t^2 - 7t - 18$

(8) $3w^2 + 3w - 18$

alue: 2 marks each

NAME _____

H_{10} ALBEGRA

FACTOR THE FOLLOWING COMPLETELY. BEWARE THE COMMON FACTOR.

(1) $3w^2m + 21w^2m^2 - 12wm^2$

(2) $x^2 + 10x + 21$

(3) $c^2 - 3c - 28$

(4) $m^2 + m - 20$

(5) $x^3 - 25x$

(6) $2x^2 - 10x + 12$

(7) $x^3 - 27$

(8) $a^2b^2 - 121c^2$

(9) $3x^2 + 7x + 2$

(10) $3x^3 + 24$

(11) $6x^2 + 13x + 6$

(12) $9x^2 - 3x - 20$

(13) $15c^2 + 28c + 12$

(14) $.0016 - \frac{9d^2}{25}$

(15) $3a^2 - 2ab - 5b^2$

Value: 2 marks each

11 DIVIDE:

(1) $2a^2-3a-5 \overline{\big) 6a^3-5a^2-21a-10}$

Value: 2

(2) $5t-3 \overline{\big) 5t^3-2t^2+2t-3}$

Value: 3

NAME _____

C_{10} ALGEBRA

FACTOR THE FOLLOWING COMPLETELY. BEWARE THE COMMON FACTOR.

(1) $18x^2y - 15xy^2 - 3xy$

(2) $x^2 + 9x + 14$

(3) $m^2 - 2m - 48$

(4) $t^2 + t - 56$

(5) $a^3 - 36a$

(6) $2t^2 - 10t + 12$

(7) $c^3 - 64$

(9) $5w^2 + 7w + 2$

(10) $3n^3 + 24$

(11) $.0144 - \frac{25}{t^2}$

(12) $4x^2 - xy - 5y^2$

(13) $12a^2 + 28a + 15$

(14) $9w^2 + 3w - 20$

(15) $6x^2 + 13x + 6$

Value: 2 marks each

11 DIVIDE:

(1) $5x-3 \overline{)5x^3+2x^2+2x-3}$

Value: 3

(2) $2x^2-3x-5 \overline{)6x^3-5x^2-21x-10}$

Value: 2

NAME _____

RATIONAL EXPRESSIONS

Simplify by reducing to lowest terms:

lues		Values	
1	1. $\dfrac{-65m^3n^2t}{10Rm^2n}$	1	2. $\dfrac{x^2 - 4}{x^2 - 7x + 10}$
1	3. $\dfrac{2x^2 - 10x + 12}{2x^2 - 12x + 18}$	1	4. $\dfrac{3a^3b^2 - a^3b}{6ba - 2a}$
1	5. $\dfrac{6x^2 - 5x - 6}{9x^2 - 4}$	3	6. $\dfrac{x^3 - 27}{x^2 + x} \times \dfrac{2x^2 + 4x + 2}{2x^2 + 6x + 18}$
4	7. $\dfrac{x^2 - 7x + 12}{x^2 - 49} \times \dfrac{x^2 - 2x - 35}{x^2 - x - 12} \div \dfrac{x^2 + 2x - 15}{x^2 + 10x + 21}$		
3	8. $\dfrac{4x^2 + 8x + 3}{4x^2 - 1} \div \dfrac{4x^2 - 9}{6x^2 - 13x + 6}$		

5

NAME_____

RATIONAL EXPRESSIONS

Simplify by reducing to lowest terms:

alues		Values	
1	1. $\frac{10Rm^2n}{-65m^3n^2t}$	1	2. $\frac{x^2 - 7x + 10}{x^2 - 4}$
1	3. $\frac{2x^2 - 12x + 18}{2x^2 - 10x + 12}$	1	4. $\frac{6ba - 2a}{3a^3b^2 - a^3b}$
1	5. $\frac{9x^2 - 4}{6x^2 - 5x - 6}$	3	6. $\frac{x^2 + x}{x^3 - 27} \times \frac{2x^2 + 6x + 18}{2x^2 + 4x + 2}$
4	7. $\frac{x^2 - 49}{x^2 - 7x + 12} \times \frac{x^2 - x - 12}{x^2 - 2x - 35} \div \frac{x^2 + 10x + 21}{x^2 + 2x - 15}$		
3	8. $\frac{4x^2 - 1}{4x^2 + 8x + 3} \div \frac{6x^2 - 13x + 6}{4x^2 - 9}$		

5

Exponents

Name _____

I. Simplify each of the following: no answer to contain negative exponents. (1 mark each)

1. $x^3 \cdot x^5 =$

2. $x^9 \div x^4 =$

3. $x^{2a+b} \cdot x^{a-2b}$

4. $2^3 \cdot 2^5 \div 2^4 =$

5. $3^{-3} \cdot 3^5 =$

6. $(-x^3 y)^2 =$

7. $\dfrac{(-2m^2)^3}{(4t)^3} =$

8. $9^{\frac{1}{2}}$

9. $16m^3t^4$

10. $27^{\frac{2}{3}}$

11. $\dfrac{1}{8^{-\frac{4}{3}}}$

12. $\sqrt[3]{-125c^6} =$

13. $2^0 \cdot 4^{-1} =$

14. $10^{-2} \cdot 5^1 =$

15. $\left(\frac{x}{y}\right)^2 \cdot \left(\frac{y}{m}\right)^3 \cdot \left(\frac{m}{x}\right)^4 =$

16. $64^{\frac{5}{6}} =$

17. $5x^0 =$

18. $25^{-\frac{1}{2}} \cdot 2^3 =$

19. $\sqrt{\dfrac{(m+n)^4}{(c-d)^2}} =$

20. $\left[3(x^2y^5)^2\right]^0$

21. $8^2 \cdot 2^{-3} =$

22. $16^{-1} \cdot \dfrac{1}{4^{-2}}$

II. Write with all exponents positive (1 + 1 + 2 marks)

1. $3m^{-4}$

2. $\dfrac{R^2M^{-3}}{c^{-2}t^4}$

3. $\dfrac{2A^2B^{-3}}{3A^{-8}B^{-7}}$

Total value - 26

III Simplify each of the following:

Marks 1 each

1. $\sqrt{76}$ 2. $5\sqrt{72}$ 3. $7\sqrt{32}$ 4. $\sqrt{136}$

3 5. $2\sqrt{20} + 3\sqrt{27} - 4\sqrt{75} + 7\sqrt{125}$

2 6. $6\sqrt{40} - 2\sqrt{500} + 3\sqrt{60}$

1 7. $5\sqrt{3} \times 3\sqrt{21}$

2 8. $6\sqrt{6}\ (3\sqrt{2} + 2\sqrt{3} + 5\sqrt{6})$

2 9. $(3\sqrt{5} + 2\sqrt{3})(5\sqrt{6} - \sqrt{5})$

2 10. $(2\sqrt{3} + 5\sqrt{2})(2\sqrt{3} - 5\sqrt{2})$

Exponents

Name _____

1. Simplify each of the following: no answer to contain negative exponents (1 mark each)

1. $y^3 \cdot y^7 =$

2. $a^9 \div a^4 =$

3. $x^{3a+2b} \cdot x^{a-b} =$

4. $10^3 \cdot 10^5 \div 10^4 =$

5. $3^2 \cdot 2^3 =$

6. $3^{-2} \cdot 3^5 =$

7. $\left(\frac{-3a^2b^3}{4t}\right) =$

8. $9^{\frac{1}{2}} =$

9. $\sqrt{36W^{10}m^{12}} =$

10. $32^{\frac{4}{5}} =$

11. $\frac{1}{8^{-\frac{2}{3}}} =$

12. $2^{-3} \times 2^0 =$

13. $5^1 \times 10^{-2} =$

14. $\sqrt[3]{-125m^9} =$

15. $3x^0 =$

16. $\left(\frac{x}{y}\right)^2 \cdot \left(\frac{y}{m}\right)^3 \cdot \left(\frac{m}{x}\right)^4 =$

17. $64^{\frac{5}{2}} =$

18. $25^{-\frac{1}{2}} \cdot 2^3 =$

19. $\sqrt{\frac{(m+n)^4}{(c-d)^2}} =$

20. $\left[3^0 (x^2 y^5)^2\right]^0 =$

21. $8^2 \cdot 2^{-2} =$

22. $16^{-1} \cdot \frac{1}{4^{-2}} \cdot 16^0 =$

II. Write with all exponents positive (1 + 1 + 2 marks)

1. $5w^{-3}$

2. $\frac{t^2 r^{-3}}{m^{-1} w} =$

3. $\frac{3x^{-5} y^2}{2x^{-2} y^{-6}} =$

Total value - 26

III Simplify each of the following:

rks 5	1. $\sqrt{84}$ 2. $5\sqrt{72}$ 3. $\sqrt{132}$ 4. $7\sqrt{56}$
3	5. $3\sqrt{45} + 4\sqrt{50} - 7\sqrt{18} + 3\sqrt{125}$
2	6. $5\sqrt{40} + 2\sqrt{60} - 8\sqrt{300}$
1	7. $7\sqrt{6} \times 5\sqrt{12}$
2	8. $6\sqrt{6}\,(3\sqrt{2} + 2\sqrt{3} - 2\sqrt{6})$
2	9. $(3\sqrt{5} + 2\sqrt{3})(5\sqrt{10} - \sqrt{3})$
2	10. $(5\sqrt{3} + 3\sqrt{5})(5\sqrt{3} - 3\sqrt{5})$

Pre Christmas Cumulative

Name _____

I. Simplify each of the following:

irks

Add.1.
$$\begin{array}{r} 2a + 8b + 4c - 9 \\ 3a - 7b - 2c + 6 \\ \underline{-a - 2b + c - 4} \end{array}$$

Sub.2.
$$\begin{array}{r} 5x - 7y + 8z - 4p + 2F \\ \underline{3x + 7y - 3z - 4p + 6f} \end{array}$$

3. $(5x^2 - 2x - 4) - 2(x - x^2 - 3) + 4(3x - 7 - x^2)$

4. $(x + 5)(x + 8) + (x - 6)(x - 3) + (x + 9)(x - 4)$

5. $(x + 5)(x - 5) + (x + 4)^2 - (x - 1)^2 - (x - 3)^2$

6. Divide $(24x^3y^2 + 18xy^3 - 12x^2y^2 + 30\,xy) \div 6xy$

7. $(x^3 + 3x^2 - 5x - 14) \div (x + 2)$

8. Factor Completely

a) $p^3r - pr^3$

b) $c^3 + 64$

c) $x^2 - 400$

d) $x^2 + x - 42$

e) $8x^2 + 6x - 5$

f) $6x^2 - 7x - 3$

Marks

9. Solve each of the following equations - show all steps

a) $5(r - 2) = 6(r - 3)$

b) $9m - (11 - 3m) = 25$

2

c) $\frac{4}{9}y - 1 = \frac{7}{9}y - \frac{16}{3}$

d) $\frac{x - 2}{3} = \frac{7 - x}{2}$

4

e) $\frac{5y^2 - 4y}{5} - \frac{17}{2} = \frac{10y^2 + 9y}{10}$

4

10. Simplify

a) $c^3 \times c^8$

f) $5^{-2} \times 5^0 \times \frac{1}{5}$

b) $(-3n^2t)^3$

g) $3^{-3} \times \frac{1}{2^{-4}}$

9

c) $(3w^o r^3)^o$

h) $4 \quad 81n^8t^{12}$

d) $2^5 \times 2^2 \quad 2^4$

i) Remove negative exponents

$$\frac{3r^{-2}m}{4c^{-1}w^{-3}}$$

Marks

11. Simplify:

1 a) $3\sqrt{27}$

2 b) $6\sqrt{50} - 2\sqrt{18} + 4\sqrt{40}$

3 c) $5\sqrt{6}\,(3\sqrt{3} + 2\sqrt{2} + 6\sqrt{6})$

3 d) $(5\sqrt{3} + 2\sqrt{2})(5\sqrt{3} + 2\sqrt{2})$

12. Reduce to lowest terms (simplify)

1 a) $\dfrac{x^2 - 7x + 12}{x^2 - 5x + 6}$

3 b) $\dfrac{x^2 + 7x}{x^3 - 8} \times \dfrac{x^2 - 4}{2x^2 + 18x + 28} \div \dfrac{x + 5}{2x^2 + 4x + 8}$

NAME _____

Pre Christmas Cumulative

es: 1. Simplify each of the following:

2 (1) Add:
$$\begin{array}{r} 3x + 5y - 6z + 4 \\ 7x - 2y + 8z - 7 \\ x + y - 9z - 2 \\ \hline \end{array}$$

(2) Subtract:
$$\begin{array}{r} 5a - 4b + 6d + e - 3f \\ 7z + 4b - 6d - 7e - 3f \\ \hline \end{array}$$

1 (3) $(3x^2 - 4x + 6) - 2(x - x^2 - 7) + 4(3 - x^2 - 2x)$

1 (4) $(x + 6)(x + 2) + (x - 5)(x - 2) + (x + 8)(x - 1)$

2 (5) $(x - 4)(x + 4) + (x + 3)^2 - (x - 1)^2 - (x - 5)^2$

3 (6) Divide: $21a^3b^2 + 35a^2b - 7a^2b^2 + 14ab$ by $-7ab$

2 (7) $(x^3 + 3x^2 - 5x - 14) \div (x + 2)$

12 (8) Factor Completely (2marks each)

(a) $3x^2y - 12xy^2 + 18x^2y^2$

(b) $x^2 - 400$

(c) $n^3 + 125$

(d) $6x^2 - 7x - 3$

(e) $8x^2 + 6x - 5$

(f) $2t^2 - 10t + 12$

24

NAME _____

es: (9) Solve each of the following equations - show all steps

2 (a) $7(k - 2) = 5(2k - 4)$

(b) $9 - 2(24 - 1) = 31$

4 (c) $\frac{x+7}{4} = \frac{4-x}{7}$

(d) $\frac{4}{9}y - 1 = \frac{7}{9}y - \frac{16}{3}$

4 (e) $\frac{10a^2 + 9a}{10} = \frac{5a^2 - 4a}{5} - \frac{17}{2}$

(10) Simplify:

(a) $c^3 \times c^8$

(b) $(-3n^2t)^3$

(c) $(3W^0R^3)^0$

(d) $2^5 \times 2^2 \div 2^4$

(e) $\left(\frac{-2Rx^3}{5PW}\right)^2$

(f) $5^{-2} \times 5^0 \times \frac{1}{5}$

(g) $3^{-3} \times \frac{1}{2^{-4}}$

(h) $\sqrt[4]{81n^8t^{12}}$

(i) Remove negative exponents

$\frac{3R^{-2}M}{4C^{-1}W^{-3}}$

NAME _____

es: 11. Simplify:

(a) $3\sqrt{27}$

(b) $6\sqrt{50} - 2\sqrt{18} + 4\sqrt{40}$

(c) $5\sqrt{6}\,(3\sqrt{3} + 2\sqrt{2} + 6\sqrt{6})$

(d) $(5\sqrt{3} + 2\sqrt{2})(5\sqrt{3} + 2\sqrt{2})$

12. Reduce to lowest terms (simplify)

(a) $\dfrac{x^2 - 7x + 12}{x^2 - 5x + 6}$

(b) $\dfrac{x^2 + 7x}{x^3 - 8} \times \dfrac{x^2 - 4}{2x^2 + 18x + 28} \div \dfrac{x + 5}{2x^2 + 4x + 8}$

APPENDIX E

INTERVIEW SCHEDULE

Date _____ Time _____ Subject Number _____ Interview No. ___

1. Review of progress in last two weeks:

   a. student report -

   b. teacher report -

2. Recent progress in the context of the year's work:

3. What will be done in order to continue and improve progress?

   a. student suggestions -

   b. teacher suggestions -

4. Special areas of concern:

   a. organization of study time -

   b. test preparation -

   c. source of remedial work -

5. Summary:

   Where is student at and what goals have been set for the next 12-day period?

APPENDIX F

RESULTS OF ACHIEVEMENT MEASURES AT POST EXPERIMENTAL AND 4 MONTH FOLLOW-UP TIMES (AS PERCENTAGES)

Subject	Post Experimental	4 Month Follow-Up
H_{33}	64	61
C_{31}	72	42
H_2	77	69
C_{18}	95	82
H_4	37	40
C_{27}	74	73
H_5	61	41
C_{10}	69	57
H_8	76	75
C_6	78	84
H_{10}	79	67
C_{12}	68	60
H_{11}	63	49
C_7	75	70
H_{12}	73	65
C_{17}	65	57
H_{18}	79	53
C_9	63	60
H_{22}	66	59
C_{22}	59	49

Note: H denotes experimental group
C denotes control group

APPENDIX G

RESULTS OF ATTITUDE SCALE ADMINISTRATION

Subject	Pre-Test	Post-Test	4 Month Follow-Up
H_{33}	64	60	51
C_{31}	68	72	71
H_2	91	88	82
C_{18}	87	96	97
H_4	71	60	46
C_{27}	60	62	60
H_5	52	67	70
C_{10}	56	66	76
H_8	78	85	88
C_6	82	88	77
H_{10}	41	65	63
C_{12}	47	56	48
H_{11}	51	63	58
C_7	50	67	72
H_{12}	63	64	69
C_{17}	80	80	78
H_{18}	72	83	75
C_9	62	68	69
H_{22}	54	64	54
C_{22}	50	52	48

Note: H denotes experimental group
C denotes control group