

**PREFERENCE FOR TEACHER INSTRUCTION AND THE  
ACADEMIC PERFORMANCE OF EIGHTH AND NINTH GRADE  
MATHEMATICS STUDENTS WHEN PEER TUTORED**

**BY**

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in Partial Fulfillment of the Requirements  
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**Department of Curriculum: Mathematics and Natural Sciences  
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### Abstract

The interaction between eighth and ninth grade students' desire to be taught by adult teachers and their academic performance when peer tutored in a unit of mathematics was investigated. The experimental study used two intact classes of eighth grade mathematics and two intact classes of ninth grade mathematics. Prior to the onset of instruction, all subjects were surveyed, using an instrument designed for the purpose, to determine their preferred mode of receiving instruction, either from adult teachers or from students near their own age. One eighth grade class ( $n=20$ ) was taught, in groups of three, a unit of mathematics by peer tutors over five periods. The other class ( $n=21$ ) was taught the same material for five periods by their classroom teacher. Similarly, one class of ninth grade students ( $n=12$ ) was taught, in groups of three, a unit of mathematics by peer tutors over five periods. The other class ( $n=14$ ) was taught the same material over five periods by their classroom teacher. A sixth period, in which students wrote a unit test, was used to evaluate their academic performance during the unit. The hypothesis,  $H_0$ , is: there is no interaction between eighth and ninth grade students' preference for teacher instruction and their academic performance when peer tutored. At each grade level the hypothesis was tested using the interaction term in a two-by-two analysis of variance, with mode of instruction and students' preferred mode of receiving instruction as the treatments and levels respectively. The results indicated that at the eighth grade level the interaction term was not statistically significant ( $p < .05$ ). At the ninth grade level the interaction term was statistically significant ( $p < .05$ ).

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## Chapter One - Introduction

The National Council of Teachers of Mathematics (NCTM) *Standards* calls for a decrease in instruction by teacher exposition and, instead, the use of a variety of instructional formats, including small groups, individual explorations, peer instruction, whole class discussions, and project work. It also suggests that increased attention be given to active involvement of students in constructing and applying mathematical ideas (NCTM, 1989).

Peer tutoring has always been an informal component of classroom instruction. Considerable inter-student communication has often accompanied the working of exercises - tutoring in its most spontaneous and natural form. Tutoring has been referred to as peer teaching (J. Cohen, 1986; Kohler, 1985), peer education (Damon, 1984), partner learning, (Smith, 1977), peer learning (Damon, 1984), child-teach-child and *learning through teaching* (Bar-Eli & Raviv, 1982). It has been further classified into cross-age tutoring and peer tutoring (Hedin, 1987). It can be used to supplement teacher instruction or to supplant it. Whatever name researchers have used, peer tutoring refers to situations in which a student teaches other students, either peers or younger students.

There has been a dramatic rise in explicit interest in peer tutoring in recent years, accompanied by efforts to refine its techniques and expand its use. Numerous studies and reviews have identified many benefits of peer tutoring. Some researchers have claimed that it is an effective and efficient method of providing individualized instruction in different subject areas and to a variety of students, both regular program and special education (Alexander, 1986; Dineen,

Clark, & Risely, 1976; O'Connor, 1996; Miller, 1996; Bentz, 1996). Others have found that peer tutoring is an effective tool for improving school climate and morale (Hedin, 1987; Stofferahn, 1988; Gaustad, 1992). Some reviewers have presented peer tutoring as a means for mainstreaming (Maher, 1984; Roach, Paolucci-Whitcomb, Meyers, & Duncan, 1983).

Reviewers have agreed that using peer tutoring often results in cognitive benefits for the tutor and the tutee. Many studies found positive effects on the tutees' academic achievement (Cohen, Kulik, & Kulik, 1982; Devin-Sheehan, Feldman, & Allen, 1976; Hedin, 1987). Researchers and reviewers, though, were not in agreement on the issue of what affective gains result from peer tutoring. Allen (1976) reported an increase in self-esteem for both tutor and tutee. Britz (1989) found this not to be the case. Cohen et al. also concluded that the evidence does not support claims of increased self-esteem, although they reported an improvement in attitudes toward the subject being studied on the part of all participants. They also report that students with social and emotional problems also benefit from tutoring and from being tutored.

Considerable effort has been given to determining what makes peer tutoring effective. Damon (1984) suggested that tutoring produced the cognitive conflict required as a catalyst for change. Devin-Sheehan et al. (1976) believed that peer tutors and their tutees have similar 'cognitive frameworks' and therefore tutors may be able to present material in terms more easily understood by their classmates. J. Cohen (1986) suggested that an at-risk child may identify more easily with a peer, particularly one of the same social or ethnic background, than with an adult. Lippitt (1976) proposed that tutors who have struggled academically may be more patient

and understanding than those who haven't. He believes this empathy contributes greatly to low-achievers' effectiveness as cross-age tutors.

Many papers attempted to identify characteristics of tutors and tutees which mediate the efficacy of peer tutoring programs and studies. Low achievers benefit from being tutored (Fantuzzo, 1992; Bar-Eli & Raviv, 1982; Burton, 1986; Eisenberg, Fresko, & Carmeli, 1983) as well as from tutoring younger children (Bar-Eli & Raviv, 1982; Maher 1984). Although it is generally believed that tutoring is generally more effective in improving academic performance with same-sex pairings, there is little empirical data to support this assertion (Devin-Sheehan et al., 1976; Lamal, 1970). Devin-Sheehan et al. did report, though, that some studies have found that gender pairings do have an impact on affective variables such as the tone of the tutoring session and attitudes toward the tutors. Taken together, the literature suggests quite convincingly that tutoring and being tutored can be beneficial for a wide variety of students.

So far, researchers have not isolated the critical variables which mediate the efficacy of peer tutoring. Cohen et al. (1982) summarize their meta-analysis of peer tutoring studies with "... the meta-analysis raises some new questions about tutoring. It challenges other investigators and reviewers to identify the key variables underlying variation in tutoring outcomes.' (p. 247). This study will measure an obvious and possibly important variable which, although addressed tangentially, has not yet been studied directly. There are some students who, either by preference or by nature, do not like adults and do not like receiving instruction from them. It is commonly accepted that some students in their teens are especially prone to problems associated with interacting with authority figures, such as their

teachers. It is possible that these students, receiving large benefits from peer tutoring, could be responsible for the overall benefits reported by many researchers. The intent of this study is to find out if that is the case. If it is, then there are major implications for educators.

Numbers of researchers argue that under most circumstances peer tutoring is preferable to traditional instructional methods in producing academic outcomes and many teachers are beginning to use it explicitly in their classrooms. If only a portion of students are benefiting from it, then teachers should not be using peer tutoring so generally. School counselors might also benefit from the results of this study. If a student is performing poorly in a classroom primarily because of antipathy to teachers, then peer tutoring could be effective in helping that student find some success. Resource teachers might also benefit from the results of the proposed study. Despite their training, there may be circumstances in which they should encourage students with academic difficulties to be tutored by their peers or older students.

Peer tutoring has been shown to be an effective tool for increasing students' academic performance in mathematics. The present study will attempt to find out if some students do well under peer tutoring because they prefer instruction from peers rather than from adults. The hypothesis,  $H_0$ , to be tested is:

There is no interaction between eighth grade and ninth grade students' desire to be taught by teachers and their academic performance when peer tutored.

### *Definition of Terms*

Peer tutoring refers in general to a situation in which a student tutor teaches another

student, either younger or the same age. In this study, "peer tutoring" refers to a situation in which a student tutor teaches three younger students new mathematics over five periods. This instruction supplants teacher instruction. "Teacher instruction" in general refers to traditional instructional techniques in which the teacher exercises a high level of control over the dissemination of knowledge and the activities in a classroom. In this study, "teacher instruction" refers to a situation in which classes of students are taught a unit of new mathematics by their regular classroom teacher over five periods. "Students' preference" for adult teacher instruction will refer in this study to students' rating on the Instructional Mode Preference Test (I.M.P.T.), a four-point scale which measures whether a student has a general preference for adult or peer instruction. The term "academic performance" refers in general to how well students learn the material that is taught to them. Operationally, in this study the term will refer to students' scores on the unit test.

## Chapter Two - The Research Literature

There is a very large literature concerning peer tutoring. The *ERIC* (Educational Resources Information Centre) database and *Comprehensive Dissertation Abstracts* collectively contain more than 600 titles relating to peer tutoring. Several major reviews of research on peer tutoring have been published (Cohen et al., 1982; Devin-Sheehan et al., 1976; Sharpley and Sharpley, 1981; Britz, 1989; Elson, 1976; Fitz-Gibbon, 1977). The Britz review focused exclusively on studies related to mathematics instruction.

### *Peer Tutoring Studies Relating to Mathematics Education*

Improving students' cognitive gains in mathematics has been the intent of many peer tutoring programs. Bar-Eli and Raviv (1982) studied the effect of a peer tutoring program involving 60 male subjects and controlled for sex and matched the subjects for schools and classes. The teacher-selected fifth and sixth grade tutors were paired randomly with second grade students. Tutors and tutees were underachievers in mathematics. Tutoring replaced instruction by the classroom teachers and was conducted three times a week for four months. Tutors met weekly with the tutees' teachers to discuss the week's planned lessons. Tutors were treated as younger colleagues by the teachers. At the end of approximately 40 lessons, both the tutors and tutees had improved significantly in mathematics on the Standard Achievement Tests. Furthermore, tutors had shown significant improvement overall in school, as evidenced by their teachers' marks in math.

Although no significant improvement was noted in the tutees' achievement mark awarded by the teachers, the authors suggested that since only three letter grades were used, the gain may not have been enough to affect the letter grade.

Furthermore, since the tutoring had been a substitute for classroom instruction, the teachers may have been subconsciously reluctant to record a higher mark for pupils who were absent from math classes three times a week and were taught by pupils instead.

Burton's study (1986) investigated the influence of a peer tutoring program on mathematics achievement through a comparison of pretest and post-test gains of college freshman enrolled in remedial mathematics classes with and without peer tutoring. Fifty freshman had been randomly selected from 163 students who had scored in the lower quartile of the math placement test. Half of the sample group was assigned tutors to supplement course instruction one hour three times per week; the control group received no additional assistance. The pretest showed no differences between the groups, whereas the post-test showed that the tutored group had made significant gains ( $p < .05$ ).

Sharpley, Irvine, and Sharpley (1983) examined the effectiveness of a cross-age tutoring program in mathematics in elementary school children. Fifty-one grade six and 25 grade five students tutored 51 third and 25 second grade students 30 minutes daily, four days weekly for five weeks, for a total of 10 hours. The tutoring program was used a substitute for two of the four hours of mathematics scheduled weekly. Results indicated that the operational mechanics achievement of tutors increased significantly over non-tutors, as did the achievement of tutees over non-tutees.

The Bar-Eli (1982), Burton (1986), and Sharpley, Irvine, and Sharpley (1983) studies typify the results of many studies which show that peer tutoring is an effective means to improve the academic performance of students in mathematics.

A number of peer tutoring studies addressed the effect of peer tutoring programs on attitudes toward subject matter and students with social and behavioural problems. The hypothesis of the present study concerns students' desire to be taught by adult teachers. It is reasonable to assume that students who are particularly loathe to receive instruction from adults will also have difficulty receiving instruction from them, and suffer from behavioral and possibly emotional problems. The research is therefore logically connected to that body of literature.

*Peer Tutoring Studies Relating to Students with Emotional and Behavioral Difficulties and Their Performance in Mathematics*

In 1982 Fogarty and Wang investigated the cross-age peer tutoring process in an attempt to determine to what extent it served as a motivating force toward more positive academic performance, attitude, and behavior measured by the completion rate of assigned tasks. The study was conducted in a university lab school where at least one-third of the students were children of faculty members. The 12 tutors were in grades seven to nine; the tutees were primary and intermediate students. Tutor training involved three 30-minute sessions. Tutor-tutee pairs were randomly assigned and met for thirty minutes twice per week for eight weeks. Task completion rates in mathematics for tutees were significantly higher than for those not tutored.

Franca (1990) investigated effects of a same-age tutoring procedure on academic and social behavior of eight behaviorally disordered middle school tutors and tutees. Results indicated increased scores on tutors' and tutees' math worksheets, improved attitudes toward math for both groups, and significantly improved social interactions between tutors and tutees. Hogan and Prater (1993) conducted a case study in which a 15 year old student classified as behaviorally disordered tutored a student with learning disabilities. The peer tutoring brought about improvements in the tutee's on-task and academic performance in mathematics but not in the tutor's disruptive behavior.

Powell, Weisenbaker, and Connor (1986) conducted a study of the effects of tutoring on several related variables on reading and mathematics achievement of low socioeconomic children. The three-year study involved 256 subjects in grades three to eight, 244 of whom were black, and 75% of whom were female. The tutors were predominantly white (80%). Tutoring sessions were conducted in two, one hour sessions twice weekly by trained volunteers to supplement regular classroom instruction. Among other benefits, there were decreased levels of absenteeism, although the results were not significant. There was no control group.

Maheady and Sainato (1985) examined the effects of peer tutoring upon the social interaction of students with varying social interaction skills, using a withdrawal ABAB design of 5-10-5-10 days and a four week follow-up. Six fifth-grade tutees who had been assessed by the Otis Lennon Test of Mental Ability as functioning in the low to high average range, but who were performing approximately two grades below average grade expectations in mathematics were

matched with six tutors working at grade level. Tutor training was conducted one hour daily for three days, in which tutors practiced role-play activities. Tutees improved in their social interactions and in their status in the class.

The above studies mirror the opinion of reviewers and other researchers who have found that peer tutoring is an effective tool for helping students with behavioral and emotional difficulties perform better socially in school. Since the present study concerns itself with a variable which is logically correlated to behavioral and emotional problems, it is expected that there will be an interaction between students' preference for adult instruction and their success when peer tutored.

#### *Variables Mediating the Success of Peer Tutoring Programs*

Reviewers have categorized peer tutoring studies according to several variables and their effect in mediating the efficacy of peer tutoring programs. First, whether the peer tutoring supplemented teacher instruction or supplanted it. Devin-Sheehan et al. (1976) claimed that when the tutoring supplemented teacher instruction, any academic gains on the part of the tutee could be attributed to the extra instructional time. This conclusion, though, has been refuted by Pigott, Fantuzzo, and Clement (1986), Bar-Eli and Raviv (1982), Roach et al. (1986), and Sharpley, Irvine, and Sharpley (1983). The Bar-Eli and Raviv study used 60 male subjects and controlled for sex and matched the subjects for schools and classes. The teacher-selected fifth and sixth grade tutors were paired randomly with second grade students. Tutors and tutees were underachievers in mathematics. Tutors were treated as younger colleagues by the teachers. In this study 80% of the tutees

had received regular individual tutoring by *more or less skilled private teachers* for periods ranging from three to four months. Despite the individual attention and extra lessons, these students had not shown significant progress in mathematics. Yet, when these tutees were taught by underachieving peers, significant gains as measured by a standardized test were accrued by both tutors and tutees. The research literature suggests that whether tutoring supplements or supplants teacher instruction, benefits are realized by tutors and tutees.

Another variable which has been the focus of attention is that of tutor selection and training. Although the majority of peer tutoring studies used trained tutors, there is divided opinion among researchers and reviewers as to the importance of tutor training. Devin-Sheehan et al. (1976) found that the crucial element in the success of peer tutoring programs is some form of tutor training. They concluded that its form and content are not critical. The act of being trained seemed to be sufficient to induce better tutoring. They also found that tutors who were intrinsically motivated to tutor, as opposed to those who received an external incentive, were more effective. Britz (1989), who reviewed studies relating to mathematics, concluded that the evidence does not support the conclusion that tutor training is a critical factor in achievement gains in mathematics. Brandwein and DiVittis's study (1985) tested the effect of tutor training on the performance of tutees. They found that on four of ten items on a test, tutors who had participated in a training course could be differentiated from tutors who did not participate in any form of training. Trained tutors performed significantly better on those four items. However, areas related to mathematics showed no significant improvement. The authors concluded that more research was needed to determine the importance

of tutor training.

The length of peer tutoring programs has also been given attention by reviewers. The Devin-Sheehan (1976) meta-analysis indicated an inverse relationship between duration of tutoring and measured effects on achievement. The short duration of the present study, therefore, would not necessarily be expected to have a negative impact on the academic performance of the tutees. Fresko and Eisenberg's study (1985) involving 324 subjects determined the effect of two years of tutoring on mathematics and reading achievement. The socially disadvantaged tutees were enrolled in grades three to six; the tutors were university students who received rebates on their tuition fees. Other children in the classes made up the comparison group; a control group was also defined. When mathematics gains were measured over a two year period, findings indicated cognitive gains. However, they found that children who were tutored for two years did not achieve greater gains than students tutored for one year.

To summarize the variables affecting peer tutoring programs, it has been found that peer tutoring is effective whether the tutoring supplements or supplants teacher instruction. Tutor training has not been conclusively shown to have an impact on the effectiveness of peer tutoring programs, although there is research that suggests that some form of training is advisable. Peer tutoring programs of greater length do not necessarily produce greater cognitive gains than shorter programs.

When reviewing the research literature on a educational trend, there is the potential for what is commonly referred to as the 'small study bias'. That is, smaller studies whose results do not support the trend are more likely to be ignored

than larger, better funded research. This is a cogent concern with any peer tutoring research because many influential researchers have strongly associated their names and the names of their respective institutions to peer tutoring. Cohen et al. (1982) concluded that published studies related to peer tutoring were much more likely to report beneficial results, particularly in affective areas, than dissertations and unpublished papers.

In summary, peer tutoring, in which a student teaches younger or peer-aged students, has been used to improve the academic performance of students, particularly low-achievers, the handicapped, the at-risk, and those from lower socioeconomic backgrounds. Such programs have been used across all age levels and subject areas and the research literature indicates that such programs are generally beneficial for the tutors, tutees, and teachers who participate in them.

## Chapter Three - Method and Procedures

### *Comments from Reviewers on Research Design*

Reviewers of research in the area of peer tutoring, particularly Devin-Sheehan et al. (1976), have been quite critical of the design of many studies. Their most common objection was that a large number of studies fail to collect data rigorously. Even in programs that do collect data, there is often no control group. Another area of concern related to control groups is the method of selecting tutors and tutees. The researcher must beware of comparing an experimental group of volunteer tutors and/or tutees with a control group of non-volunteer tutors and/or tutees. The ideal method to avoid this situation is to use volunteer tutors and intact classes of tutees. This study was fortunate to have the opportunity to use intact classes. However, logistics at the school level demanded grouping each peer tutor with a group of three tutees. Almost all empirical studies in peer tutoring use peer tutor-tutee dyads and the author recognizes that this introduces a new variable into the study. Another variable that is frequently uncontrolled in peer tutoring research is friendship between tutor and tutee. Controlling for friendship between tutor and tutee was not possible in this study; the study occurred in a high school of 205 students, where there is substantial interpersonal dynamics among most of the students involved in the study.

### *Overview of the Study*

The experimental study used two intact classes of eighth grade mathematics and two intact classes of ninth grade mathematics. Using an instrument designed

for the purpose, the students in the four randomly-assigned classes were identified as having a preference for teacher or peer instruction. For a five-period unit from the mathematics curriculum, one of the classes from each grade level was randomly assigned to teacher instruction and the other to peer instruction.

Following the instruction, the students in all four classes wrote a teacher-constructed unit test. The hypothesis was tested using the interaction term in a two-by-two analysis of variance, with mode of instruction and students' expressed preferences as the treatments and levels respectively. Figure 1 illustrates the two-by-two analysis of variance design used at each grade level.

<u>Preferred Mode</u>	<u>Mode of Instruction Received</u>	
	Teacher	Peer Tutoring
Teacher		
Peer		

Figure 1. Two-by-two analysis of variance design for testing the interaction between eighth grade and ninth grade students' preference for adult instruction and their academic performance when peer tutored.

### *The Research Setting and Sample*

The study was conducted in a small secondary school in the lower mainland

of British Columbia. The culture is more diverse than in typical semi-urban settings. There are considerable numbers of artists, loggers, musicians, government employees, fishermen, and small business owners.

The school teaches 205 students in grades seven through twelve. The study used two intact classes of eighth grade mathematics and two intact classes of ninth grade mathematics. The peer-tutored eighth grade class comprised 20 students - the teacher-instructed class 21 students. The peer-tutored ninth grade class comprised 12 students - the teacher-instructed class 14 students. The students had been assigned to their classes randomly. The random assignment controlled for gender, ability level of learners, and the instructional preference mode variable under study.

#### *Administering the Instructional Mode Preference Test (I.M.P.T.)*

The research literature was not found to contain an instrument for determining students' preferred mode of receiving instruction. For the two possible modes, teacher instruction and peer instruction, the simplest way of determining students' preferred mode was to ask them. The researcher constructed the Instructional Mode Preference Test (I.M.P.T.) comprising four statements. Students place a check mark beside one of the following four statements with which they most agree.

- i) I prefer to be taught by a teacher whenever possible \_\_\_\_
- ii) I usually prefer to be taught by a teacher \_\_\_\_
- iii) I usually prefer to be taught by a student near my own age \_\_\_\_
- iv) I prefer to be taught by a student near my own age whenever possible\_

For the purposes of data analysis, the first two possible responses were taken to indicate a preference for teacher instruction and the latter two to indicate a preference for peer instruction.

The I.M.P.T. was administered to the classes involved in the study in early February 1998. Students absent from school that day completed the I.M.P.T. when they returned to school.

### *The Recruitment and Training of Peer Tutors*

Many studies, such as Bar-Eli & Raviv (1982), reported that students of widely varying ability levels and personality types can perform effectively as tutors. The researcher looked for qualities in potential tutors that would seem to enhance their ability to tutor successfully. They were selected according to their mathematical proficiency, reliability, and their perceived ability to interact with other students. The researcher, with assistance from staff members at the school, advertised for students in grades 10 through 12 who were interested in acting as peer tutors for the study. From those who expressed an interest, twelve were chosen. Devin-Sheehan et al. (1976) concluded, as indicated in Chapter One, that there is surprisingly little data showing that training of tutors, per se, has a beneficial effect on tutoring. There is evidence (Niedermeyer, 1970), though, that that training of tutors will result in more of the recommended behaviors (for example, praising, eliciting correct responses, and so on). The researcher incorporated this into the Peer Tutor Package (appendix C) so that tutors would adopt behaviors that are typically associated with effective instruction.

The researcher modeled for the tutors one technique of presenting a lesson

in mathematics. First, the main ideas and skills presented in any previous lessons were to be reviewed briefly. An introduction to the day's lesson would be given, which included several examples of why the concept or skill was important. Next, several examples of the skill would be presented, which tutors were instructed to have tutees write in their notebooks. A short assignment requiring approximately 10 minutes, providing students the opportunity to practice that skill, was to be assigned. The solutions to the questions would then be given and any difficulties discussed. The process would then be repeated for other skills taught in the lesson, followed by the homework assignment.

Tutors were instructed to interact with their tutees in a positive, friendly manner and to use praise and encouragement often. They were also instructed not to confront tutees in case of disciplinary concerns, but to get assistance from the classroom teacher or the researcher. Tutors were also instructed to stop at regular intervals and to review what had been covered during the lesson by asking questions of the tutees. The researcher met with the tutors to introduce them to the study, refresh their required mathematical skills, teach them the above-mentioned tutoring skills, and to lead them through the Peer Tutor Package (Appendix C).

### *The Instructional Phase*

Instruction commenced in mid-February 1998 and concluded with the unit tests. The peer-tutored group comprised a class of 20 eighth grade mathematics students and a class of 14 ninth grade mathematics students, and were taught by peer tutors in groups of three. The eighth grade classes learned basic fraction skills, and the ninth grade class learned basic exponent skills. Apart from some

very basic definitions and skills in the eighth grade unit on fractions, the material taught to all students in these units was new material. The researcher confirmed this by examining the relevant curricula and by interviewing the classroom teachers on the matter. The other two groups were taught by their regular classroom teachers. Peer tutors were assigned randomly to their tutees.

The researcher visited the classrooms each day while the peer tutored groups were being tutored to monitor procedures and to answer any technical questions that might have arisen. There were no situations in which the researcher needed to intervene or assist.

### *The Unit Tests*

The classroom teachers prepared the unit tests (Appendix D). The researcher provided feedback in terms of item validity, clarity, and potential scoring difficulties. Subjects who were absent for the test wrote it during the following two days. The classroom teachers graded the tests and reported the results to the researcher.

Since the classroom teachers had been thoroughly briefed concerning the intent of the study, there seemed to be little risk that they would be motivated to differentiate the two groups in scoring the tests.

## Chapter Four - Analysis of the Data

This chapter will discuss, for each grade level, the results of the I.M.P.T., the unit tests, and the two-by-two analysis of variance. Conclusions will be drawn from the results.

### *The Eighth Grade Group*

The results of the I.M.P.T. are presented in Table 1.

Table 1.

Cell Totals for the I.M.P.T. by Preferred Mode of Instruction and Mode Received.

<u>Preferred Mode</u>	<u>Mode of Instruction</u>		Total
	Peer Tutoring	Teacher	
Peer Tutoring	7	8	15
Teacher	13	13	26
Total	20	21	

The eighth grade mean scores on the unit test are presented in Table 2.

These scores are out of a possible 41 points.

Table 2.

*Mean Unit Test Scores for Eighth Grade Students Preferring Peer Instruction as Compared to Teacher Instruction for Those Peer Tutored and Teacher Taught.*

---

<u>Preferred Mode</u>	<u>Mode of Instruction</u>		Mean
	Peer Tutored	Teacher Taught	
Peer Tutoring	27.5	34.81	31.4
Teacher Instruction	32.62	33.5	33.06
Mean	30.83	34.16	

---

Table 3 summarizes the two-by-two analysis of variance for the eighth grade classes. The interaction term was found not to be significant,  $F(1, 40) = 1.04, p < .05$ . The null hypothesis will therefore not be rejected. There were no significant differences concerning the main effects.

Table 3

*Analysis of Variance Summary for Preferred Mode of Instruction of Eighth Grade Students and Type of Instruction Received*

---

<u>SOURCE</u>	<u>SS</u>	<u>dF</u>	<u>MS</u>	<u>F</u>
Between Preferred Mode	26.14	1	26.14	.27
Between Received Mode	103.26	1	103.26	1.06
Interaction	101.45	1	101.45	1.04
Error	3594.05	37	97.14	
Total	3824.9	40		

---

*The Ninth Grade Group*

The results of the I.M.P.T. are presented in Table 4

Table 4.

*Cell Totals For the I.M.P.T. By Preferred Mode and Mode Received.*

---

<u>Preferred Mode</u>	<u>Mode Received</u>	
	<u>Peer Tutoring</u>	<u>Teacher</u>
Peer Tutoring	6	6
Teacher	6	8

The mean scores on the unit test on exponents, out of 10 points, are

presented in Table 5.

Table 5

*Mean Unit Test Scores for Ninth Grade Students Preferring Peer Instruction as Compared to Teacher Instruction for Those Peer Tutored and Teacher Taught.*

<u>Preferred Mode</u>	<u>Mode of Instruction Received</u>		
	Peer Tutored	Teacher Taught	Mean
Peer Tutoring	9.33	6.17	7.75
Teacher	7.67	7.38	7.5
Mean	8.5	6.86	

Table 6 summarizes the two-by-two analysis of variance for the ninth grade classes. The interaction term of the two-by-two analysis of variance was found to be significant,  $F(1, 25) = 4.22, p < .05$ . This significant interaction is represented in Figure 2. The null hypothesis will therefore be rejected. Thus, those students who preferred to be tutored by their peers performed better when peer tutored. Those preferring teacher instruction performed more poorly with peer tutors than with their teachers. There is a significant main effect indicating the peer-tutored students performed better than the teacher-instructed students, but main effects were not the focus of the present study and therefore no conclusions will be drawn from this result.

Table 6

*Analysis of Variance Summary for Preferred Mode of Instruction of Ninth Grade Students and Type of Instruction Received*

---

<u>SOURCE</u>	<u>SS</u>	<u>dF</u>	<u>MS</u>	<u>F</u>
Between Preferred Mode	0.4	1	0.4	.13
Between Received Mode	17.44	1	17.44	5.69*
Interaction	12.94	1	12.94	4.22*
Error	67.38	22	3.06	
Total				

---

\* $p < .05$

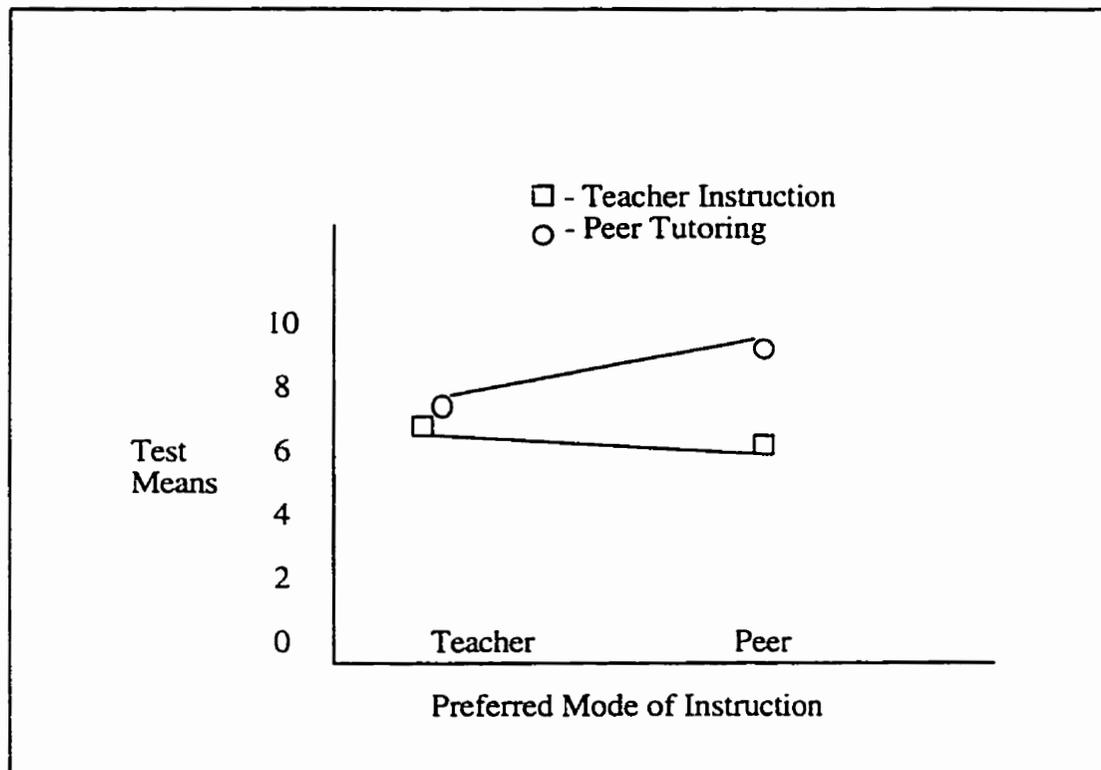


Figure 2. Unit Test Means for Mode of Instruction (Peer Taught and Teacher Taught) on Preferred Mode of Instruction (Teacher or Peer) for Ninth Grade Students.

### *Conclusions*

At the eighth grade level there is no interaction between students' desire for teacher instruction and their academic performance when peer tutored. At the ninth grade level there is a significant interaction between students' desire for teacher instruction and their academic performance when peer tutored. This result allows a rejection of the null hypothesis at that level. There is also a significant main effect at the ninth grade between mode of instruction, suggesting that the peer tutored class performed better than the teacher instructed class. However, this study did not intend to test hypotheses regarding main effects, and no conclusions will be drawn from this result.

## Chapter Five - Summary, Conclusions, and Recommendations

The intent of this study was to determine if students' preferences for adult instruction affect their academic performance when they are peer tutored in mathematics. The null hypothesis,  $H_0$ , is: There is no interaction between eighth and ninth grade students' desire to be taught by adult teachers and their academic performance when peer tutored. This experimental study used two intact, randomly assigned classes of eighth grade mathematics and two intact, randomly assigned classes of ninth grade mathematics. The randomization controlled for gender, ability level, and the variable under study - students' preferences for adult instruction. Using an instrument designed for the purpose, the students in the four randomly-assigned classes were identified as having a preference for teacher or peer instruction. For a five-period unit from the mathematics curriculum, one of the classes from each grade level was assigned to teacher instruction and the other to peer instruction in groups of three.

Following the instruction, the students in all four classes wrote a teacher-constructed unit test. The hypothesis was tested using the interaction term in a two-by-two analysis of variance, with mode of instruction and students' expressed preferences as the treatments and levels respectively. A separate two-by-two analysis of variance was used to analyze the results at each grade level.

For the eighth grade group the interaction term of the two-by-two analysis of variance was found not to be significant,  $F(1, 40) = 1.04, p > .05$ . The null hypothesis was therefore accepted, indicating no interaction between students' desire for teacher instruction and their academic performance when peer tutored.

For the ninth grade group the interaction term of the two-by-two analysis of variance was significant,  $F(1, 25) = 4.22, p < .05$ . The null hypothesis was therefore rejected, indicating an interaction between students' preference for teacher instruction and their academic performance when peer tutored. The statistical analysis suggests that there may be a significant main effect at the ninth grade level; that is, that the peer tutored students performed better than the teacher-instructed students. However, the present study did not focus on the main effects and no conclusion will be drawn from this result.

#### *Limitations of the Study*

There are three factors specific to the research site which could limit the generalizability of these results.

First, the experimental groups were not tutored in their typical classroom setting. J. Cohen (1986) suggests that '...the physical environment should inspire confidence, concentration, intimacy, and freedom.' (p. 184). Space was limited at the research site and it was necessary for the classroom teacher and researcher to distribute the groups in nearby locations around the school. Noise, interference from other students in the hallway, and so on, could have distracted the peer tutoring groups and interfered with their learning.

Second, the study was conducted in a small school. All students in this school are well known to each other. Since the peer tutors were assigned to their groups randomly, it is possible that peer tutors were matched with students with whom there was either strong friendship or equally strong animosity. This could affect the results.

Third, as noted in chapter three, it may not be possible to generalize results obtained in any one culture to schools in general. There is a considerable diversity in the socioeconomic status of the students attending this school. Families' incomes depend on fishing, logging, art, social assistance, and government employment. It is possible that results might differ in less diverse communities.

There are three factors which could, from a general standpoint, limit the generalizability of the study.

First, in the selection of tutors, the researcher and classroom teachers looked for peer tutors most likely to be successful. While research indicates that tutor selection is not a critical factor (Cohen, 1986; Bar-Eli & Raviv, 1982; Britz, 1989), the manner in which peer tutors were selected in the present study remains a possible limitation. There may be a risk in generalizing the results to tutors selected at random from the general population of students.

Second, it is possible that a Hawthorne effect occurred. That is, the students and teachers knew that they were participating in research and, therefore, may have changed their behavior.

Third, the analysis of variance accommodates varying sample sizes, but it becomes increasingly difficult to establish significant results as sample sizes decrease. That could account for the failure to find a significant interaction term in the eighth grade sample.

*Discussion*

The results of the study are mixed - a significant interaction effect was not found at the eighth grade level and one was found at the ninth grade level. A number of factors that could have mediated these outcomes.

As discussed in the previous section, classes were randomized, but sample sizes were small. Small sample sizes limit the power of statistical tests - this could explain the non-significant interaction at the eighth grade level.

Students' responses to the I.M.P.T. were not anonymous, since names had to be provided for data analysis purposes. It is possible that subjects may have been either overly enthusiastic or hesitant to express their feelings on the matter raised. For example, some students' may have felt that it would be disrespectful to express a desire for peer instruction over teacher instruction.

The design of the I.M.P.T. warrants discussion. Although it was an elegant, simple, and easy-to-understand instrument, it did not explore the issue of preference for adult instruction in depth. Preference for instructional mode is a complex phenomenon and shedding light on it might require more in-depth analysis.

Personnel changes at the school could have had an effect on the outcomes. The ninth grade classes had been taught by three different teachers prior to the onset of the research, and the class had spent a considerable amount of time earlier in the year learning mathematics using a computer-mediated format. Several students commented that their mathematics class had an air of instability. If some students were frustrated by this instability, the onset of peer tutoring could have resulted in resentment (or relief) on their part. Some students may have been relieved because

interaction with their peers was a constant throughout the year. Others may have been frustrated because as soon as they had settled into one classroom culture, change was again thrust upon them. In either case, the results could have been affected.

The personalities of the classroom teachers in the study may have influenced the results. Depending on a teacher's rapport with a class of students, responses to the I.M.P.T. might be skewed in favour of peer tutoring or in favour of teacher instruction.

The benefits of peer tutoring are discussed in chapters one and two. Specifically, peer tutoring can be an effective tool for helping students with behavioral and emotional difficulties perform better socially and academically in school. It was discussed in chapter two how the present study is logically connected to the literature regarding such students. If students are loathe to receive instruction from adults, then it is likely that they will experience behavioral difficulties when they are taught by them, and possibly suffer from emotional disturbances as a result.

The results of the present study augment that research by addressing a previously unexplored variable that could mediate the effects of peer instruction. It provides sufficiently strong evidence that there is a relationship between students' preferences and academic performance when peer tutored to encourage refinements of the instruments, variations in such parameters in the selection of tutors, and extensions to other grade levels and subject areas.

### *Suggestions for Future Research*

Since the results of this study are mixed, replication studies are needed to shed more light on the extent to which preference for teacher instruction mediates academic performance in peer tutoring situations. Future studies should use tutor-tutee dyads, as is typical in this area of research. As well, there should be refinement in the measuring of students' desire for adult instruction. A more detailed instrument would be able to differentiate students' opinions of particular teachers from opinions of receiving instruction from adults in general.

Research is also needed to determine if the subject matter affects the variable under study. Future studies might also focus on specific qualities of adult instruction which could mediate the efficacy of peer tutoring. For example, there may be certain classroom management techniques, teacher behaviors, or teaching styles which could play a role in peer tutoring outcomes. Researchers might also consider affective outcomes related to students' desire for adult instruction. For example, as reported in chapter two, the results of research which studies the effect of peer tutoring on outcomes such as self-esteem are inconclusive. The interaction between students' preference for adult instruction and changes in self-esteem when peer tutored would seem to be worthy of study.

Since the results of this study are not conclusive, it may be some time before researchers determine the extent to which students' preferences for adult instruction mediate the efficacy of peer tutoring. In the meantime, classroom teachers can provide valuable input into the process by providing anecdotal case studies in which students who show a clear disdain for adult instruction are given the opportunity to learn under peer tutoring.

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**Appendix A - Consent Letters**

Dear Parents and Guardians;

In February I will be conducting an educational research project in the grades eight and nine mathematics classrooms at [REDACTED] as a requirement for my masters of education degree from the University of Manitoba. The study is about peer tutoring, a common teaching technique in which students teach other students. There is evidence that peer tutoring can be a very beneficial teaching technique, and the purpose of my study is to help explain why it is often so effective.

Before the study begins, I will very briefly ask students, in writing, about their thoughts regarding peer tutoring. During the study, students will be taught a short unit of mathematics from the regular curriculum over five periods. One class will be taught in the regular manner, and the other by peer tutors who will have been selected and trained by me. They will be tested during the sixth period. I will then analyze the results.

Parents may withdraw their child from the study at any time without any penalty whatsoever. While the data from your son or daughter would not be used, he or she would continue to receive instruction according to the study for the five periods, and the marks earned on the unit test will count toward the students' final mark in the course. Furthermore, all the data in this study are confidential. Results

### Appendix A - Consent Letters

from individual students will never be published - the performance of an individual student may only be reviewed by the classroom teacher, myself, or possibly my research supervisor. Any students who feel that they did not do well on the unit will have the opportunity to attend a make-up session where I will reteach any and all parts of the unit that students did not understand well. This research is being supervised by Dr. Lars Jansson at the Faculty of Education at the University of Manitoba. He can be reached at (204) 474-9039, or by writing to him at Faculty of Education, University of Manitoba, Winnipeg, Manitoba, R3T 2N2. After the study is completed, I will make the results available to everyone involved, including the students. Should any of the parties involved so wish, I will be glad to present my findings in person and answer any questions. If you have any questions or concerns in the meantime, please call me at Pender Harbour Secondary School at 883-2727, or write to me at Box 137, Garden Bay, BC, V0N 1S0.

If you agree to allow your child to participate in the study, would you please sign in the space indicated and have your son or daughter return this form to his or her mathematics teacher.

I agree to have my child participate in this study.

\_\_\_\_\_ (parent/guardian) \_\_\_\_\_

(date)

Appendix A - Consent Letters

Thank you for your consideration.

Cordially,

Glen MacPherson

## Appendix A - Consent Letters

Superintendent of Schools  
[REDACTED]

Box 137  
Garden Bay, BC  
V0N 1S0

Dear [REDACTED],

I am planning to conduct an educational research study in a high school in School District # [REDACTED] and I am hoping that you will allow this research to take place in your school district; the study is a requirement for masters of education degree from the University of Manitoba.

The purpose of the study is to see if there is a connection between students' desire to be taught by teachers and their success when peer tutored. The purpose of the study is not to compare peer tutoring with 'regular' instruction. I am trying to find out if a student's preference for receiving instruction from a teacher has an effect on his or her success when peer tutored. The study will use two intact classes of eighth grade mathematics and two intact classes of ninth grade mathematics. First, every student will be asked to choose, in writing, one of the four following statements which best reflects their feelings regarding receiving instruction.

i) I prefer to be taught by a teacher whenever possible.

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- ii) I usually prefer to be taught by a teacher.
- iii) I usually prefer to be taught by a student near my own age.
- iv) I prefer to be taught by a student near my own age whenever possible.

Two classes will be taught for five periods in the regular fashion, while two classes will be taught for five periods, in groups of three, by peer tutors, who have been screened and trained prior to the onset of instruction. These peer tutors will consist of students from older grades who are proficient in mathematics. They will be trained and selected by me. A sixth period will be used for evaluation. After the evaluation, statistical tests will be applied to the data to determine if there is an interaction between students' preference for teacher instruction and their success under peer tutoring.

Parents may withdraw their child from the study at any time without any penalty whatsoever. While the data from that student would not be used, he or she would continue to receive instruction according to the study. Furthermore, all the data in this study are confidential. Results from individual students will never be published - the performance of an individual student may only be reviewed by the classroom teacher, myself, or possibly my research supervisor. Any students who feel that they did not do well on the unit will have the opportunity to attend a make-up session where I will reteach any and all parts of the unit that were poorly understood. This research is being supervised by Dr. Lars Jansson at the Faculty

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of Education at the University of Manitoba. He can be reached at (204) 474-9039, or by writing to him at Faculty of Education, University of Manitoba, Winnipeg, Manitoba, R3T 2N2. After the study is completed, I will make the results available to everyone involved, including the students. Should any of the parties involved so wish, I will be glad to present my findings in person and answer any questions. If you have any questions or concerns in the meantime, please call me at Pender Harbour Secondary School at 883-2727, or write to me at Box 137, Garden Bay, BC, V0N 1S0.

Your signature, as consent to allow the research to take place, would be much appreciated.

\_\_\_\_\_ (Superintendent or designate)

Thank you for your consideration.

Cordially,

Glen MacPherson

## Appendix A - Consent Letters

Principal  
[REDACTED]

Box 137  
Garden Bay, BC  
V0N 1S0

Dear [REDACTED]

I am planning to conduct an educational research study at [REDACTED] Secondary School in February and I am hoping that you will allow this research to take place in your school; the study is a requirement for masters of education degree from the University of Manitoba.

The purpose of the study is to see if there is a connection between students' desire to be taught by teachers and their success when peer tutored. The purpose of the study is not to compare peer tutoring with 'regular' instruction. I am trying to find out if a student's preference for receiving instruction from a teacher has an effect on his or her success when peer tutored.

The study will use two intact classes of eighth grade mathematics and two classes of intact grade nine mathematics. First, every student will be asked to choose, in writing, one of the four following statements which best reflects their feelings regarding receiving instruction.

i) I prefer to be taught by a teacher whenever possible.

### Appendix A - Consent Letters

- ii) I usually prefer to be taught by a teacher.
- iii) I usually prefer to be taught by a student near my own age.
- iv) I prefer to be taught by a student near my own age whenever possible.

Two classes will be taught for five periods in the regular fashion, while two classes will be taught for five periods, in groups of three, by peer tutors, who have been screened and trained prior to the onset of instruction. These peer tutors will consist of students from older grades who are proficient in mathematics. They will be selected and trained by me. A sixth period will be used for evaluation. After the evaluation, statistical tests will be applied to the data to determine if there is an interaction between students' preference for teacher instruction and their success under peer tutoring.

Parents may withdraw their child from the study at any time without any penalty whatsoever. While the data from that student would not be used, he or she would continue to receive instruction according to the study. Furthermore, all the data in this study are confidential. Results from individual students will never be published - the performance of an individual student may only be reviewed by the classroom teacher, myself, or possibly my research supervisor. Any students who feel that they did not do well on the unit will have the opportunity to attend a make-up session where I will reteach any and all parts of the material that were not well understood. This research is being supervised by Dr. Lars Jansson at the Faculty

## Appendix A - Consent Letters

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Your signature, as consent to allow the research to take place, would be much appreciated.

\_\_\_\_\_ (Principal or designate)

Thank you for your consideration.

Cordially,

Glen MacPherson

## Appendix A - Consent Letters

Dear Colleague;

I am planning to conduct an educational research study at [REDACTED] Secondary School in February and I am hoping that you will allow this research to take place in your classroom; the study is a requirement for masters of education degree from the University of Manitoba.

The purpose of the study is to see if there is a connection between students' desire to be taught by teachers and their success when peer tutored. The purpose of the study is not to compare peer tutoring with 'regular' instruction. I am trying to find out if a student's preference for receiving instruction from a teacher has an effect on his or her success when peer tutored.

The study will use two intact classes of eighth grade mathematics and two classes of intact grade nine mathematics. First, every student will be asked to choose, in writing, one of the four following statements which best reflects their feelings regarding receiving instruction.

- i) I prefer to be taught by a teacher whenever possible.
- ii) I usually prefer to be taught by a teacher.
- iii) I usually prefer to be taught by a student near my own age.
- iv) I prefer to be taught by a student near my own age whenever possible.

### Appendix A - Consent Letters

Two classes will be taught for five periods in the regular fashion, while two classes will be taught for five periods, in groups of three, by peer tutors, who have been screened and trained prior to the onset of instruction. These peer tutors will consist of students from older grades who are proficient in mathematics. They will be selected and trained by me. A sixth period will be used for evaluation. After the evaluation, statistical tests will be applied to the data to determine if there is an interaction between students' preference for teacher instruction and their success under peer tutoring.

Parents may withdraw their child from the study at any time without any penalty whatsoever. While the data from that student would not be used, he or she would continue to receive instruction according to the study. Furthermore, all the data in this study are confidential. Results from individual students will never be published - the performance of an individual student may only be reviewed by the classroom teacher, myself, or possibly my research supervisor. Any students who feel that they did not do well on the unit will have the opportunity to attend a make-up session where I will reteach any and all parts of the material that were not well understood. This research is being supervised by Dr. Lars Jansson at the Faculty of Education at the University of Manitoba. He can be reached at (204) 474-9039, or by writing to him at Faculty of Education, University of Manitoba, Winnipeg, Manitoba, R3T 2N2. After the study is completed, I will make the results available to everyone involved, including the students. Should any of the parties involved so

## Appendix A - Consent Letters

wish, I will be glad to present my findings in person and answer any questions. If you have any questions or concerns in the meantime, please call me at Pender Harbour Secondary School at 883-2727, or write to me at

Box 137, Garden Bay, BC, V0N 1S0.

Your signature, as consent to allow the research to take place, would be much appreciated.

\_\_\_\_\_ (Classroom Teacher)

Thank you for your consideration.

Cordially,

Glen MacPherson

## Appendix A - Consent Letters

Dear Colleague;

During late February I will be conducting an educational research project as a requirement for my masters degree from the University of Manitoba. The study involves peer tutoring, and \_\_\_\_\_ (student's name) has volunteered, and has been selected by me, to participate in the study as a peer tutor of mathematics. To act as a peer tutor, this student will need to be absent during five of your 'G' block classes.

While participating in the study should be a rewarding educational experience for this student, his or her other course work must not suffer as a result. Your cooperation in allowing the student to catch up on missed work, without penalty, would be greatly appreciated.

Your signature, as consent to release this student from your classes, is appreciated.

Cordially,

Glen MacPherson

Appendix A - Consent Letters

\_\_\_\_\_ (Staff Signature)

\_\_\_\_\_ (Date)

## Appendix A - Consent Letters

Dear Parents and Guardians;

In February I will be conducting an educational research project in the grades eight and nine mathematics classrooms at [REDACTED] Secondary School as a requirement for my masters degree from the University of Manitoba. The study involves peer tutoring, an increasingly common educational technique in which students teach other students.

Your son or daughter has volunteered, and has been selected by me, to participate in the study by acting as a peer tutor of mathematics. In this study, peer tutors will be teaching younger students, in groups of three, a short unit (five periods) of mathematics.

The peer tutors, who will be trained by me, will need to be released from their regular 'G' block classes during the study. They will need their 'G' block teacher's permission to participate. The peer tutors will not be penalized for missing classes and will have time to make up any work missed during the study.

This study is supervised by Dr. Lars Jansson and you may write him at University of Manitoba, Winnipeg, Manitoba, R3T 2N2 or call him at (204) 474-9039 for further information. Please feel free to call me at school (883-2727) for information.

## Appendix A - Consent Letters

I expect that this will be a rewarding personal and educational experience for your child and if you would like him or her to participate, your signature as consent would be appreciated.

Thank you,

Glen MacPherson

\_\_\_\_\_ (parent/guardian)

\_\_\_\_\_ (date)

**Appendix B - Instructional Mode Preference Test (I.M.P.T.)**

## Appendix B - Instructional Mode Preference Test (I.M.P.T.)

Name: \_\_\_\_\_

From the following four statements, place a check mark beside the one you agree with most.

1. I prefer to be taught by a teacher whenever possible. \_\_\_\_\_
2. I usually prefer to be taught by a teacher . \_\_\_\_\_
3. I usually prefer to be taught by someone near my own age . \_\_\_\_\_
4. I prefer to be taught by someone near my own age whenever possible. \_\_\_\_\_

## Appendix C - Peer Tutor Package

Dear Peer Tutor,

First I would like to thank you and congratulate you for agreeing to participate in this research project; none of this work would be possible without your efforts. I hope that you find the experience a valuable one. Your classroom teacher and I are always available to give you assistance or answer technical questions during the study, so please do not hesitate to seek our help when you need it.

### General Information

There are a few things you can do to make the peer tutoring experience as beneficial as possible for you and the students with whom you will be working. If you don't already know them, we recommend that you learn the students' names as soon as possible, and to use those names regularly. Also, try to maintain a positive atmosphere throughout the session - you might find that a friendly joke or comment at the right time can make things go smoothly. If you experience frustration along the way, do your best not to show it. If, however, you experience hostility from a student, or if a student is refusing to cooperate with you, please call your teacher or me over right away and we will deal with the situation. You have our full support.

### Entering Skills

## Appendix C - Peer Tutor Package

In order for the students you will be tutoring to succeed in this unit, there are some basic skills which they must know. Those skills are:

### *For Peer Tutors of Grade Eights*

- . basic numerical operations (add, multiply, subtract, divide)
- . integer skills (For example, working with negative numbers)

### *For Peer Tutors of Grade Nines*

- . basic numerical operations (add, subtract, multiply, divide)
- . exponent notation
- . using the exponent laws for multiplication, division, power rule, and negative exponent rule, and the zero exponent rule.
- . using a calculator to simplify expressions involving exponents

Although you could review these skills as the need arises, we suggest you take a few minutes to quickly review them with the students. You may find that all of your tutees can perform these skills without any difficulty. Once you are satisfied that the students are comfortable with those skills, it is time to begin the first lesson.

## Appendix C - Peer Tutor Package

### *Peer Tutors of Grade Eights*

Lesson One - Meaning of fractions, writing fractions, and writing fractions that represent pictures. Assignment from text.

Lesson Two - Review of previous lesson. Equivalent fractions (renaming).  
Assignment from text.

Lesson Three -Review of previous lesson. Comparing fractions. Finding common denominators. Assignment from text.

Lesson Four - Review of previous lesson. Adding and subtracting fractions.  
Assignment from text.

Lesson Five - Improper fractions and mixed numerals. Applied problems.  
Assignment and review for unit test.

### *Peer Tutors of Grade Nines*

Lesson One - Introduction to exponent notation. Writing expressions using exponents and evaluating expressions involving exponents. Assignment from text.

### Appendix C - Peer Tutor Package

Lesson Two - The product rule. The quotient rule. Simplifying expressions using these rules. Assignment from text.

Lesson Three - The power rule and zero exponent rule. Simplifying expressions using these rules. Assignment from text.

Lesson Four - Simplifying, and substituting values for variables in, more complex expressions involving all the above rules.

Lesson Five - Applied problems, and review for the unit test.

**Appendix D - Unit Tests**

## Appendix D - Unit Tests

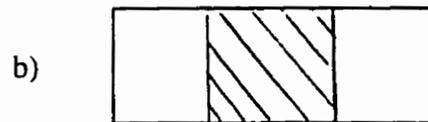
*Eighth Grade Unit Test*

Mathematics 8 Rational Numbers - Part One

NAME: \_\_\_\_\_

Show your work where appropriate.

1. Name a fraction which can represent the following pictures.



2. For each of the following fractions, write two equivalent fractions.

a)  $\frac{1}{2}$

c)  $\frac{2}{3}$

d)  $\frac{4}{5}$

e)  $\frac{2}{7}$

## Appendix D - Unit Tests

3. Fill in the blanks to make a true statement.

a)  $\frac{2}{3} = \frac{6}{\square}$

b)  $\frac{3}{15} = \frac{1}{\square}$

c)  $\frac{4}{\square} = \frac{8}{24}$

d)  $\frac{10}{50} = \frac{\square}{60}$

e)  $\frac{\square}{5} = \frac{1}{8}$

f)  $\frac{0}{4} = \frac{\square}{10}$

4. Change each of the following to improper fractions.

a)  $1 \frac{1}{2}$

b)  $3 \frac{3}{4}$

c)  $2 \frac{7}{8}$

d)  $5 \frac{2}{3}$

e)  $12 \frac{1}{5}$

f)  $5 \frac{5}{6}$

5. Change each of the following to mixed numerals.

a)  $\frac{22}{3}$

b)  $\frac{13}{5}$

c)  $\frac{17}{6}$

d)  $\frac{13}{2}$

e)  $\frac{6}{5}$

f)  $\frac{19}{3}$

6. Add the following fractions. Answers should be mixed numerals in lowest terms.

a)  $\frac{1}{2} + \frac{1}{4}$

b)  $\frac{3}{5} + \frac{4}{6}$

c)  $\frac{2}{3} + \frac{5}{4}$

d)  $3\frac{1}{2} + 1\frac{1}{4}$

e)  $4\frac{2}{3} + 6\frac{3}{4}$

f)  $6\frac{1}{2} + 7\frac{1}{7}$

7. Jake plays hockey for two and a half hours. He then plays piano for one and three quarter hours. He then sleeps for seven and one half hours. How many hours total does Jake spend on these activities?

## Appendix D - Unit Tests

## Grade Nine Test

## Simplifying and Evaluating Exponential Expressions

Name:

Score = \_\_\_\_/10

Date:

1. Express using only positive exponents (3x.5=1.5 marks)

a)  $9x^{-3}y^2$

c)  $16a^{-1}$

b)  $-2a^{-3}cd^{-1}$

2. Simplify and Express Using Only Positive Exponents (3x.5=1.5 marks)

a) 
$$\frac{3c^5d^3(6c^{-2}d^4)}{2c^8d^{-3}}$$

c) 
$$\frac{25d^6b^3}{d^6b^2}$$

b) 
$$\frac{12h^2a^{-2}g^5j^3}{-3h^5ag^{-2}j}$$

## Appendix D - Unit Tests

3. Determine the value of W. (1 mark)

$$\frac{-100c^W d^7}{20c^2 d^4} = -5c^8 d^3 \qquad W =$$

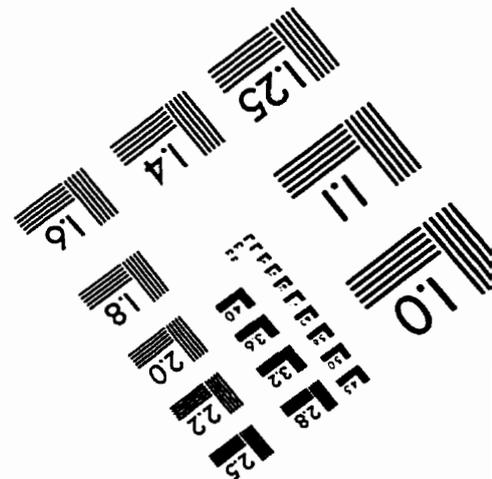
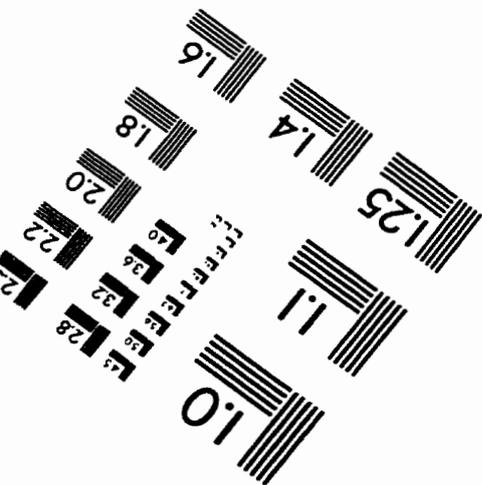
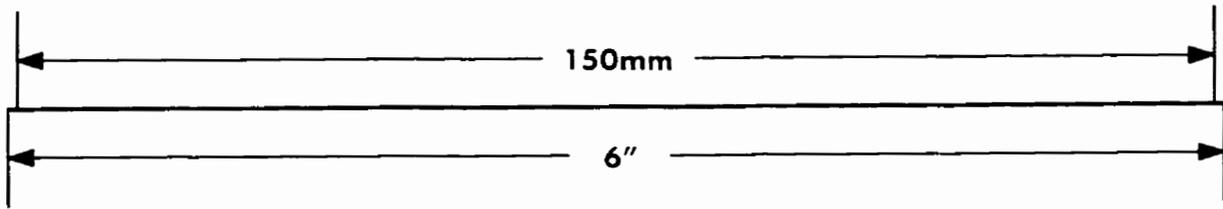
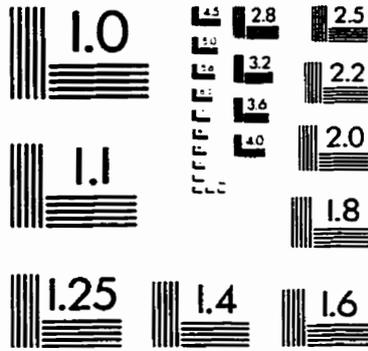
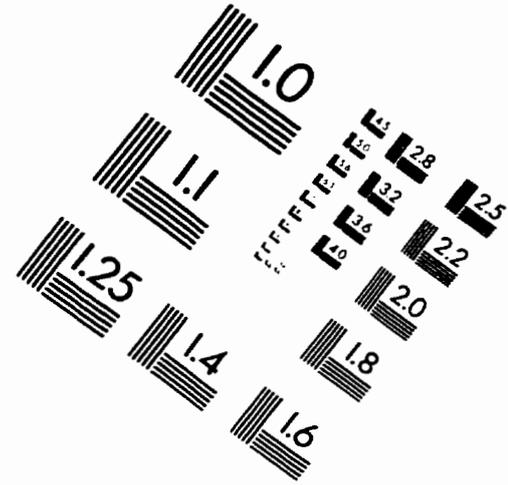
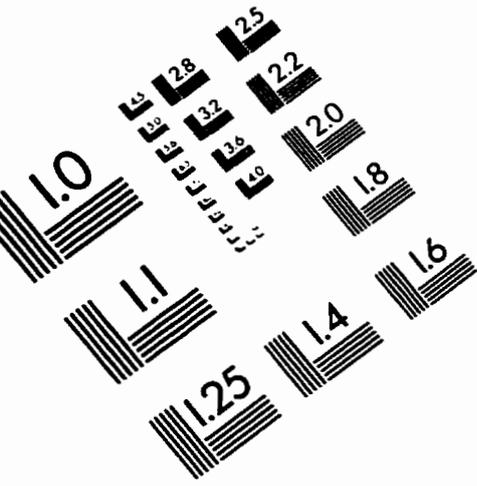
4. The area of a triangle is  $64x^9 y^4$  and its height is  $16x^3 y^2$ . Find the length of the base of the triangle. (2 marks)

5. Evaluate the following expression for  $x=2$  and  $y=-1$  (2 marks)

$$\frac{8x^3 y^5}{-2x^{-2} y^8}$$

6. You have five cubes, each of which has sides of length 'X'. Write an expression for the total volume of the five cubes. (2 marks)

# IMAGE EVALUATION TEST TARGET (QA-3)



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