Improving Students’ Mathematical Enjoyment Through Math-Related Literature

Cindy L. Haack

Vancouver Island University
Abstract

Students often cite mathematics as their least liked school subject. It is difficult to engage students when they do not enjoy their mathematics class. The purpose of this study was to investigate to what degree the use of math-related literature in a Grade 5 mathematics class affected students’ enjoyment in the mathematics classroom. Starting in September 2010, students took part in a ‘regular’ mathematics class, consisting of a starting activity, direct teaching, and individual assignments for six weeks. After this six week period, students participated in a literature enriched mathematics program for another six weeks. These mathematics lessons involved the teacher reading a math-related story to the students at the beginning of the lesson and using the theme from the book as a focus for the direct teaching and assignments. This quantitative study using a survey administered three times to 16 Grade 5 student participants was conducted to determine students’ mathematical enjoyment at the beginning, the mid-point, and end of the 12 week study. The data showed that the use of literature in the Grade 5 mathematics class increased students’ mathematical enjoyment levels. The survey data indicated that throughout the study students began to enjoy mathematics more than any other class and students increased their confidence in mathematics. The results from this study may encourage teachers to explore ways to include math-related literature into daily mathematics lessons to build students’ enjoyment levels and engage them in their mathematical learning.
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Chapter 1: Problem to be Investigated

Purpose of the Study

The problem investigated in this study was the lack of enjoyment of mathematics in the Grade 5 classroom. Students often selected mathematics as least liked when asked to rate favourite and least favourite school subjects. It was difficult to engage students in their learning when they did not enjoy their mathematics class. With lack of enjoyment, students struggled to see the importance of mathematics. The purpose of this study was to investigate to what degree the use of math-related literature in a Grade 5 mathematics class affected students’ enjoyment in the mathematics classroom. To achieve this, a quantitative study using student surveys was conducted to determine whether the use of literature in a fifth grade mathematics class yielded an increase in students’ enjoyment in mathematics. Through analysis of survey responses the author used the data to guide improvements in teaching and vary mathematical delivery in a Grade 5 mathematics class.

Justification of the Study

When students did not enjoy mathematics class they became anxious, frustrated, had a limited understanding of mathematical concepts, and tried to avoid mathematics as much as possible (Wadlington & Wadlington, 2008). Ashcraft and Kirk (2001) noted there was a significant connection between math anxiety and lack of mathematical competence and achievement. For some students to become successful in mathematics they had to overcome their high degree of anxiety (Wadlington & Wadlington, 2008). This could be accomplished by becoming more proficient in mathematics and developing confidence in their skills (Ashcraft, Krause, & Hopko, 2007). Altieri (2009) stated teachers needed to find ways to help students build their comfort level with mathematics and thus increase their enjoyment. Shatzer (2008)
recognized that children’s literature provided a meaningful context for mathematics which
helped students value their mathematical learning, encouraged problem solving, and provided
meaningful context for communication. Communication, an essential part of mathematics,
should be promoted through integration with other school subjects (Capraro & Capraro, 2006).
Using literature was one way to improve mathematical communication. Reading and listening to
stories was an enjoyable way for students to learn mathematics. The connection between
mathematics and literature was a natural way for teachers to have students see mathematics in
everyday situations and make mathematics more meaningful (Leitze, 1997).

Hong (1996) stated that a positive attitude towards mathematical tasks created a
willingness to work hard. Hong also stated that the storybook could act as a catalyst to motivate
children because they touched on children’s interests and experiences which provided a context
to engage and motivate children. Using story books to teach mathematics would provide students
an opportunity to understand the importance of mathematics in their daily lives and encourage
them to feel more comfortable trying mathematical activities. When students were engaged in
fun, interesting, and relevant problem solving activities they would find more enjoyment in their
learning as it became more purposeful (Altieri, 2009). Literature would also provide the
opportunity for students to enhance their mathematical language and communication and
improve their understanding of terms and concepts (Fleming Amos, 2007). A study that explored
students’ mathematical enjoyment after being taught with a math-related literature approach
would be a logical and sound idea.
Research Question and Hypothesis

The author developed the following question for investigation to guide the research: To what degree, if any, does incorporating math-related literature into the daily class ‘routine’ lead to improvements in students’ level of enjoyment of learning mathematics in a Grade 5 class?

The author hypothesized that Grade 5 students’ mathematical enjoyment would increase 20% with the incorporation of literature into the daily math routine.

Definition of Terms

Definitions of key terms used in this research were provided to ensure understanding. In this study, ‘math-related literature’ was defined as picture story books that introduced a mathematical theme or mathematical concept such as place value, patterning, measurement, or geometry, and which launched mathematical exploration and problem-solving. Math-related literature also included story books that were written specifically for teaching certain mathematical concepts (Lake, 2009).

Many students experience anxiety when asked to take part in mathematics activities. In this study, ‘math anxiety’ was defined as a feeling of tension and/or a fear of mathematics due to past or present negative experiences which caused lack of self-confidence with numbers and mathematical problem-solving (Ashcraft & Moore, 2009).

The term ‘mathematical enjoyment’ was defined as having a positive attitude towards mathematics, a willingness to try mathematical activities, and feeling more confident in one’s own mathematical abilities. In this study, enjoyment was measured through the use of a mathematical enjoyment survey completed by the students. This survey was administered at the beginning, mid-point, and the end of the study.

The author used many different mathematical manipulatives when delivering a lesson. ‘Mathematical manipulatives’ were defined as concrete objects that were physically handled by
students in order to help them see actual examples of mathematical principles at work (Fogelberg et al., 2008). Blocks, shapes, cubes, coloured chips, tiles, and dice were some examples of mathematical manipulatives used in this study.

**Brief Overview of Study**

The study was a quantitative study to investigate to what degree incorporating math-related literature into the daily mathematics ‘routine’ would lead to improvements in students’ levels of mathematical enjoyment. Grade 5 students from an elementary school on mid Vancouver Island were studied from September 2010 to January 2011. The students answered a mathematical enjoyment survey (pre-intervention) at the beginning of the study. From September 2010 to November 2010 students were taught mathematics using mathematical manipulatives, songs, games, and worksheets to learn mathematical concepts such as place value, patterning, and computational skills (addition, subtraction, and multiplication). At the end of this six week period students completed the mathematical enjoyment survey again (mid-intervention) to see if there had been any improvement in the students’ mathematical enjoyment. Between November 2010 and January 2011, the author started each lesson with a read-aloud story to engage students in mathematical thinking. The story was an introduction to the investigation and the lesson was based on the mathematical concept presented in the story. Mathematical manipulatives, games, and worksheets continued to be a part of the lessons as well, but were integrated with the story theme. In January, after teaching mathematics with literature, students were surveyed one more time (post-intervention) to measure their mathematical enjoyment at the end of the intervention. The same survey was administered each of the three times to the students. The data from the surveys was entered into Microsoft Excel 2007. A table and boxplot and whisker graph provided a visual representation of minimum total scores, maximum total
scores, and mean total scores on all three surveys. A second table provided mean scores and their percentage changes on individual survey throughout all three survey periods.
Chapter 2: Background and Review of Related Literature

As stated in the introductory chapter, children’s literature can provide a meaningful context for mathematics which can help students value their mathematical learning (Shatzer, 2008). This review of the literature provided the author with an understanding of research already conducted using children’s literature in the elementary school math program to increase students’ mathematical enjoyment and abilities. A review of the literature helped to provide insight into motivating students in mathematics and helped to guide the development of this study. The research studies provided procedural ideas, children’s literature suggestions, and further study recommendations that were applied to the present study.

The review began with an examination of studies that were directly related to literature and mathematics in elementary classrooms. These studies focussed on students’ attitudes and their achievement in mathematics. Two tangentially related studies were reviewed that provided the author with background knowledge of motivation and achievement in mathematics. The review of related literature provided further support to the value of using children’s literature in mathematics teaching to help increase students’ enjoyment of mathematics.

Studies Directly Related

Capraro and Capraro (2006) clearly stated two research questions for investigation. The first question was, “How does the integration of geometry-centric children’s literature influence students’ understanding of geometry and their performance on content and non-content specific measures of mathematics ability” (Capraro & Capraro, 2006, p. 23)? The second question was “How does geometry-centric children’s literature, read aloud by the teacher, impact mathematical communication” (Capraro & Capraro, 2006, p.23)?
To answer the first research question a comparative study was used in which one class was the story group and two other classes were the non-story group (Capraro & Capraro, 2006). The participants were a sample of sixth-grade students with average math abilities and reading levels. Qualitative data was collected to answer the second research question through videotaped lessons. Capraro and Capraro found that development and understanding of geometry skills and concepts were broadened and strengthened by the use of literature.

Capraro and Capraro (2006) made a strong contribution to the research regarding the importance of using literature as part of the math curriculum. Internal validity was established through triangulation of the data using the qualitative data from student and teacher interviews, researcher field notes, and lesson videotapes. The data was analyzed and coded by the same researcher at the beginning and end of the study. A peer familiar with the study also coded the data independently and results were seen as substantially the same. This made the coding dependable. Semistructured student interviews were used in this study. By using this style of interviewing the investigator would be able to ask for more information while students answered questions. This would lead to a better understanding of students’ responses and clarity for students on questions and meanings in the interview.

Capraro and Capraro’s (2006) research findings were relevant to the author of this study as they support the hypothesis that students’ enjoyment levels will increase with the use of math-related literature in a mathematics lesson. Capraro and Capraro also noted that the use of literature allowed students to experience more hands-on activities through whole group, student-student, teacher-student, and small group settings. The authors found that the use of ‘story’ also allowed the students to develop meaningful formulas and procedures through investigation instead of memorization of terms and formulas. Capraro and Capraro found that ‘literature’
enhanced the mathematical learning outcomes for students and developed strong mathematical vocabulary.

The purpose of Hong’s (1996) study was to investigate the effects of using storybooks in mathematics teaching in Korea. Hong investigated two research questions based on children’s interests/involvement and achievement in mathematics. The first question was “What effects does using children’s literature in mathematics instruction have on dispositions toward mathematics, specifically with regard to sustained interest and involvement in mathematical learning” (Hong, 1996, p. 480)? Hong’s second question was “What effects does using children’s literature in mathematics instruction have on children’s mathematical achievement” (Hong, 1996, p. 480)? To measure children’s mathematical disposition, Hong used results from children’s choices of favourite centres, time spent there, the number of children playing in the mathematics centre, and voluntary participation in mathematical tasks. Children were administered the Learning Readiness Test (LRT) as a pre-test and the Early Mathematics Achievement Test (EMAT) as a post test to assess mathematical achievement at the end of the study.

Hong’s (1996) study population consisted of 57 kindergarteners from a private kindergarten in Korea. The children were randomly assigned to two classrooms. One class was the experimental group and the other the control group. Both classes had teachers that had graduated from two year colleges.

The experimental group were read books that related to the weekly classroom theme and that contained elements that could be developed into mathematics activities or games. The control group read storybooks that related only to the weekly theme and did not have a math focus (Hong, 1996). The experimental group read and extended the story to include discussions
about mathematical problems. The control group had only general story discussions that related to the class theme. After these class discussions, both groups had 40 to 50 minutes of free play where children in both groups could choose from several different learning centres, including a mathematics centre. The experimental group had access to mathematics materials and activities that reflected the story theme and the control group had access to ordinary mathematics materials and activities.

There was no performance difference found in the experimental or control group on both the LRT and EMAT (Hong, 1996). Through the qualitative measures of observation, Hong noted that children in the experimental group were more advanced and detailed in classifications, number combinations, and shape creations during centre time. The findings of the qualitative analysis supported the use of children’s literature in mathematics instruction to improve children’s mathematical thinking and interest in mathematical activities.

There are several limitations to Hong’s (1996) study worth noting. First, the sample population of this study is based on a small group of children with very similar socio-economic backgrounds. Most of the children came from families that had parents with higher educational backgrounds graduating from 4-year colleges. This makes it difficult to generalize the results and does not represent a varied population sample. Second, the experimental group’s math centre had many more added activities that may have been more enticing for children and may have affected the increased number of students who chose the centre affecting the study results. Third, Hong also mentioned in his study that many of the students were receiving extra math support at home as well. The extra math support could have affected the way students felt about mathematics and their centre choices.
Deborah Mink and Barry Fraser (2002) conducted a year-long study to determine the extent to which the classroom implementation of Project SMILE (Science and Math Integrated with Literary Experiences) positively influenced the classroom environment and Grade 5 students’ attitudes toward reading, writing, and mathematics. The evaluation of Project SMILE included two types of variables, namely attitude and classroom environment through the subject of mathematics. Project SMILE focused on teaching students reading, writing, and mathematics through an integrated literature and activity-based (hands-on) mathematics program.

Mink and Fraser (2002) used quantitative and qualitative data in their study. Quantitative information was collected through the administration of established questionnaires and qualitative information was based on observations and interviews. The study consisted of four stages which included pretesting with an attitude questionnaire, professional development of teachers through SMILE in-services, pretesting of the classroom environment through a survey, and finally an attitude and classroom environment post-test.

Six classes of Grade 5 students participated in the SMILE pilot study. The sample consisted of 120 students that were from two different elementary schools in Florida (Mink & Fraser, 2002).

Mink and Fraser (2002) found that there was a significant difference in student attitudes towards both writing and mathematics between pre-test and post-test with the implementation of the SMILE program. Mink and Fraser used the data collected in the study to state that the data provided strong support for the effectiveness of the SMILE program and that the use of literature in the mathematics classroom empowered students to learn mathematical concepts.

There are some limitations to Mink and Fraser’s (2002) study. First, the sample group of teachers were provided money to buy materials and supplies for the project. The two schools in
the study were also used as pilot sites and were offered as sites for district-wide professional
development. This may have been an enticement for some teachers to take part in the study as
well as pressure may have been put on the teachers to do this study as the school principals at
both schools decided to put their schools forward for this research project. Second, Mink and
Fraser noted that there were other factors such as new textbooks, group lessons, and ability
grouping in the fifth grade that may have had some impact in the change of students’ attitude
towards mathematics. Third, Mink and Fraser not only introduced mathematical literature to the
students but also had the students work in groups while working on mathematical problems. This
change in the way mathematics was presented to the students may have also been a factor in the
way students felt about their learning. Mink and Fraser noted that more in-service needed to be
provided to teachers to continue with the success of the study and research needed to be done to
evaluate the effectiveness of the SMILE program on student academic achievement.

Keat and Wilburne (2009) examined the impact of storybooks on kindergarten children’s
mathematical achievement and approaches to learning. The authors posed two research questions
which were: “How was student achievement influenced in a mathematical unit taught through
storybook?” and “How were student approaches to learning influenced when storybooks were
integrated into a mathematics unit” (Keat & Wilburne, 2009, p. 62)? The researchers designed
the study as a mixed-method investigation using quantitative measures to compare student
achievement of specific learning objectives before and after instruction and qualitative measures
to understand student thoughts, feelings, and attitudes throughout the unit.

The participants in the study were three kindergarten teachers and their students from
three school districts in Central Pennsylvania (Keat & Wilburne, 2009). The three teachers all
shared the same concerns about finding time to offer a quality mathematics program that met the
needs of the new state standards and also inspired positive student attitudes. The three teachers used storybooks with mathematical content that related to money. They read these books daily and the mathematical learning objectives were related to recognizing coins and coin value.

The first research question was answered using data collected through a pre- and post-test to measure students’ knowledge of money. The comparison of scores provided the researchers with evidence that time taken to read and discuss storybooks did not detract from student achievement of the mathematical objectives (Keat & Wilburne, 2009). The answer to the second research question was determined by a thematic analysis of student and teacher surveys, interviews, and documents. Keat and Wilburne noted potential themes and reasoning. Four themes were identified through this study. They were sequence of mathematical problem solving, use of imagination regarding mathematical thinking, pattern of involvement, and evidence of enthusiasm and engagement.

Some limitations of the Keat and Wilburne (2009) study should be highlighted. First, Keat and Wilburne do not clearly answer the question of whether the use of storybooks influenced student achievement. The study did not compare classrooms using a more traditional worksheet method to the storybook method of teaching mathematics. This may have helped give a better understanding of the difference of teaching with two styles. This would provide teachers with a difference between right-answer mathematics and inquiry mathematics. Second, Keat and Wilburne’s study was based on the themes that were identified through observations and survey questions. Keat and Wilburne did not include their survey questions in the study which may have provided a better understanding of how the themes were created. Third, although Keat and Wilburne used a large population of diverse kindergarten students, the population was from one geographical area and the researchers’ results may be difficult to generalize to other populations.
Studies Tangentially Related

Schweinle, Meyer, and Turner (2006) conducted a two-part study. In the first part of the study they examined the relationship between motivation and affect in students’ reports during mathematics instruction. In the second part of the study the authors investigated how instructional environments effected student motivation. Surveys were administered to 42 Grade 5 and 6 students eight times in the first study. Schweinle et al. used audio-tape recordings and researcher observations of three mathematics teachers in study 2. Schweinle et al. found evidence to suggest that learning is not merely a cognitive activity, but also an emotional experience for students. Students were motivated when presented with challenges that were engaging and not deemed too difficult. When teacher feedback was frequent, elaborative, positive, and used to help students develop understanding, students reported higher affect, efficacy, and importance of their learning.

There were a few limitations of Schweinle et al.’s (2006) study. The selection of students for study 1 was taken from three predominately “white” public elementary schools in a small, middle-class town in rural Pennsylvania. The results may not be transferrable to many multicultural and urban school settings. The sample group was a large sample that consisted of 42 students in seven different classes. Students in the sample were all enrolled in ability grouping classes. Students were randomly selected from the seven classes which increased the confidence that the students sampled were representative of their respective classes. A limitation to Schweinle et al.’s study was that the students were from different classes with different teachers, the results may have been affected by instructional differences as well. The results may represent instructional differences more than ability differences. By limiting the sample to Grade 5 and 6
students, the results may not be applicable to other grades as different developmental factors may be an issue.

Schweinle et al. (2006) based their findings on student survey data. Schweinle et al. used self-report measures when obtaining student perceptions of their environment. This was a good method to use as it best answered the research questions asked in the study. A strength to Schweinle et al.’s survey method was that they surveyed students during the last five minutes of class and asked students to generalize their feelings about the entire class experience. By surveying at the end of class there was very little disruption to instruction and work time and students were able to reflect on their whole class experience.

Skaalvik and Valas (1999) examined the relationship of achievement, self-concept, and motivation in mathematics and language arts among third-, sixth-, and eighth-grade Norwegian students during a two year study. The sample group for Skaalvik and Valas’ study included 1,005 primary and middle school students. Data was collected once during the first year and again in the second year after all students had advanced to the next grade.

Skaalvik and Valas (1999) collected data through achievement tests and teacher ratings. Teachers evaluated students’ achievement, self-concept, and motivation factors based on a six-point scale. The achievement measures for all three grade levels remained very consistent from Time 1 to Time 2. Skaalvik and Valas found evidence that there was no increase in motivation with increasing age in the groups, but found a significant increase in mathematics self-concept as the age of the students increased. Skaalvik and Valas suggested students’ academic self-concept had not been established during the early years. They also found evidence that mathematics motivation had a significant effect on mathematics self-concept in the youngest test group, suggesting a strong interest may increase the feeling of ability in mathematics.
A limitation, as addressed by Skaalvik and Valas (1999), was that possible influences of self-concept and motivation on achievement may be hidden and require more investigation. Skaalvik and Valas suggested allowing longer time lags between the measures as well as collecting data more frequently.

Skaalvik and Valas (1999) found evidence that a student’s self-concept may go through a process of change and reshaping with the influence of academic experiences. They suggest that by the end of Grade 8, the self-concept-achievement relation that is assumed in the developmental model has not yet occurred. Since two of the groups in this study were under the age of 15 this sample group may not be appropriate. A study sample of older students may have been more relevant.

Although there was a vast amount of information on the importance of incorporating literature into math instruction to increase students’ attitudes and achievement in mathematics there was very little empirical research on the topic. Most of the empirical research was based mainly at the primary grades. This has led to the author’s interest in investigating whether using literature in a Grade 5 mathematics class will increase students’ enjoyment levels in mathematics. Information gained from the above literature reviews was used to develop this study. Suggestions of children’s literature from the above studies were examined and included in the book list (Appendix C). Examples of mathematical lessons and strategies were also implemented in the teaching of mathematical lessons in this study.
Chapter 3: Procedures and Methods

Description of the Research Design

Quantitative data was collected through participant surveys to investigate if incorporating math-related literature into the daily mathematics ‘routine’ would lead to improvements in students’ level of mathematical enjoyment in a Grade 5 class. The same survey was administered to the participants at the beginning, middle, and end of this study to provide comparisons of mathematical enjoyment levels before, during, and after the intervention.

Description of the Sample

The sample for this study consisted of 16 fifth grade students from an inner city elementary school on mid Vancouver Island. The participants in this sample were nine and ten year olds who came from varied socioeconomic status and cultural backgrounds. There was a wide range of academic abilities in the classroom with some students receiving extra support with their work. The author was also the sample group’s teacher.

Description of the Instrument Used

To measure mathematical enjoyment, participants were asked to complete a survey that measured their level of mathematical enjoyment. Participants were asked to respond to a set of five statements that were all related to mathematical enjoyment. The survey used a Likert-type scale to measure the level of agreement with survey responses. Under each of the five statements, were the numbers one to five. The number one was labelled as “strongly disagree”; the number two was labelled as “disagree”; the number three was labelled as “don’t know; the number four was labelled as “agree”; and the number 5 was labelled as “strongly agree”. The directions on the page instructed the participants to circle the number that best described their level of feelings towards each statement. The survey was presented in paper form with the
Vancouver Island University (VIU) logo on the top of the page. Participants were asked to complete their survey in pencil. This enjoyment survey was created by the author (see Appendix A).

The circled responses on the survey provided a numerical score for the survey. The total survey scores out of a possible 25 were used to assist with data analysis when creating a table and boxplot and whiskers graph.

**Explanation of the Procedures Followed**

The following explanation of the procedures described how the author investigated to what degree incorporating math-related literature into the daily class ‘routine’ led to improvements in students’ level of enjoyment of learning mathematics. The author took on the role of both researcher *and* teacher in this action research project. To help clarify the roles of each, the tasks were divided, and are presented below under the respective sub-headings.

**The role of the researcher.**

In September 2010, the author approached the school principal at an afterschool meeting. At this time, consent was requested for the research to take place. Also a request was made of the neighbouring teacher to collect the consent forms and administer the surveys at three different times to the participants. Survey procedures and ethics guidelines were discussed with the neighbouring teacher at this time as well. Later that month, the author handed out consent forms (see Appendix B) in sealed envelopes to the potential participants. Potential participants were instructed to take home the consent forms and pass them on to their parents/guardians to read over at their leisure. Participants returned signed consent forms to the neighbouring teacher. This procedure was repeated as some potential participants forgot or misplaced the initial consent form. The neighbouring teacher placed the signed consent forms in the principal’s locked filing
cabinet. With a list of participants, the neighbouring teacher came into the author’s classroom the morning before mathematics class began to administer the pre-intervention survey. Before her arrival, the author distributed a mathematic puzzle sheet to all participants and non-participants. The directions for the puzzle sheet were made clear and the non-participants were asked to begin work on the sheet. The author explained that the participants would be taking part in the study and would be completing the survey as part of the study. The author explained the survey instructions to the participants and demonstrated an example on the blackboard. This example was not a part of the survey but was in the same format as the survey statements. This provided the participants with the knowledge of how to fill out the survey. At this point, the author left the room and the neighbouring teacher was present in the classroom. The neighbouring teacher handed each participant a survey and an envelope. Participants were instructed not to put their names on the survey to ensure anonymity. Participants and non-participants remained in their desks. Participants were encouraged to read the survey quietly and keep their answers to themselves. When the participants had completed their survey they were directed to put it into the provided envelope and seal it. The sealed envelopes were handed in and placed into a bin labelled “surveys”. This survey procedure took no longer than 5 minutes. When participants had handed in their survey they were to work on their puzzle sheet. Non-participants, who did not have parental consent and were not taking the survey remained in their desks during this time and worked on their puzzle sheet while the participants completed the survey. The collected surveys were given to the principal by the neighbouring teacher. The principal kept the surveys in her locked filing cabinet. Out of school time, the author collected the surveys from the principal when they were to be entered into the Microsoft Excel 2007 computer program. The data was saved on a password secured U-drive. The paper surveys were returned to the locked
filing cabinet. The survey was administered at the beginning of the study to provide the author with information on mathematical enjoyment before any mathematical teaching in the Grade 5 classroom began.

**The role of the teacher.**

After the first survey was completed, the author began to teach mathematics to all the participants and non-participants in the Grade 5 class. At this time, the author was in the role of the teacher. The mathematics class took place every morning on a daily basis for a one hour period. All lessons taught during this study were in alignment with the learning outcomes of the Grade 5 British Columbia mathematics curriculum. During this time, the mathematics lessons consisted of a starting activity such as a mathematically themed song, a computational worksheet, or mathematical game. The lesson progressed to the direct teaching of a mathematical concept with participant and non-participant involvement. After the direct teaching, an individual assignment such as a worksheet, textbook assignment, or an activity using manipulatives was completed. This was the regular ‘routine’ in the mathematics classroom for a period of six weeks. During this time, mathematical concepts taught included place value, patterning, addition, subtraction, and multiplication.

**Back in the role of researcher.**

In November, the neighbouring teacher surveyed the participants again using the same five statements from the first survey. The same survey administration was followed as discussed in the previous researcher role section. All survey procedures were reviewed at this point. Participants and non-participants followed the same procedures as the first survey administration. The midpoint-intervention survey provided information on mathematical enjoyment levels after six weeks of ‘regular’ mathematical instruction.
Back in the role of teacher.

After the second survey, the mathematics lessons were taught with the incorporation of math-related literature. The mathematics classes during this time began with the author reading a math-related storybook aloud (see Appendix C). After the story, there was a discussion of how the book related to a mathematical concept. Lessons included songs, computational worksheets, and games that related to the theme of the book read. The mathematical concept was reinforced through direct instruction that focussed on the storybook theme. Assignments included worksheets, textbook pages, or activities using manipulatives.

Returning to the role of researcher.

In January, after six weeks of using math-related literature in the mathematics class, participants completed the same survey again. The previous survey administration procedures were followed as discussed above. The post-intervention survey provided information on mathematical enjoyment based on the incorporation of literature in the Grade 5 mathematics class.

Results of the pre-, midpoint-, and post- intervention surveys were used for comparison during data analysis using Microsoft Excel 2007. The results from all three surveys were entered into Microsoft Excel 2007 to create two tables and a boxplot and whisker graph. The results were compared, to investigate to what degree the level of mathematical enjoyment had increased throughout the intervention.

Discussion of Validity

To ensure validity in this study, the survey was designed to ensure all five questions led to identifying mathematical enjoyment levels in the Grade 5 participants. The same five questions were asked on all three surveys that were administered to the same participants at three
different times during the 12 week study. The same survey administration procedures were followed for each of the three survey periods.

**Description and Justification of the Statistical Techniques Used**

Results of the comparison of pre-, midpoint-, and post-intervention surveys provided data to identify participants’ level of enjoyment of mathematics. Level of enjoyment scores were produced by adding the responses to the five survey statements on each of the participants’ surveys. Each survey statement had a value of five. With five survey statements on each survey a total score of 25 was possible. All participants’ total scores were then totalled and divided by the number of surveys completed. This provided an average score for all the surveys completed. This procedure was used for each of the three survey periods to provide an average score for each of the three surveys. The survey data was entered into Microsoft Excel 2007 by the author. With the use of Microsoft Excel 2007, two tables and a boxplot and whisker graph were created.

The first table provided numerical information on the three surveys. The table consisted of three rows that represented each of the three surveys. The table provided the minimum score, maximum score, mean, standard deviation, and number of participants for each survey. The boxplot and whisker graph provided a visual representation of the range of answers on all three surveys. The horizontal axis on the graph was labelled with *survey times* (1,2,3) and the vertical axis was labelled with *measure of enjoyment*. The centre of the boxplot represented the median score and the measure of spread represented the standard deviation. The “whiskers” at either end of the box extended to the sample minimum and sample maximum scores and displayed the range of responses. A boxplot was created for each of the three surveys. This provided a comparison of the distribution of the three surveys. A second table was created that provided
numerical information on the mean scores on the individual survey statements on all three surveys. This table also provided a percentage change for each statement throughout the survey.

By displaying the students’ survey responses in a table and boxplot graph the author was able to identify the mean and median scores for the Grade 5 class and note the change in students’ level of mathematical enjoyment as a result of the intervention. The author set percentage changes to determine the amount of improvement in students’ enjoyment levels between ‘regular’ mathematics teaching and literature enriched mathematics teaching. A 10% increase from Survey 2 to Survey 3 demonstrated a minimal change in enjoyment, an increase of 20% in the two surveys showed a meaningful change, and a 30% increase from Survey 2 to Survey 3 demonstrated a significant change in students’ enjoyment in mathematics. This allowed for a statement of whether the intervention created a minimal, meaningful, or significant change in students’ mathematical enjoyment levels. All this analysis of the data through a table and boxplot and whiskers graph gave evidence to enable the author to answer the following research question: To what degree, if any, does incorporating math-related literature into the daily class ‘routine’ lead to improvements in students’ level of enjoyment of mathematics in a Grade 5 class?
Chapter Four: Data Analysis

The purpose of this study was to investigate to what degree the use of math-related literature in a Grade 5 mathematics class affected students’ enjoyment of mathematics. Chapter 4 contains the report of the results, attained by employing the statistical methods described in Chapter 3. Data were generated from one math enjoyment survey that was administered three times to the same Grade 5 students over a 12 week period. A total of 16 out of a possible 21 students participated in the survey with parental consent. The same survey was administered at three different times throughout the study. The pre-intervention survey was first administered in the beginning of the study in early September 2010. The mid-point survey was then administered 6 weeks later, after mathematics was taught in a ‘regular’ format. Participants completed the survey (post-intervention) a third time after 6 weeks of being introduced and taught with a literature-based mathematics program. The survey consisted of five Likert style response questions about students’ enjoyment of mathematics. Results for each question and the survey overall are discussed.

Table 4.1 displays the number of participants in the study, the participants’ minimum and maximum total scores, mean, and standard deviation for each of the three survey periods. The survey (Appendix A) presented five statements with an accompanying five point Likert scale, the individual participants’ total scores were calculated and could range from a minimum of 5 to a maximum of 25. The minimum total score was the lowest score of all 16 student surveys at each survey period. The maximum total score was the highest score of all 16 student surveys at each survey period.
Table 4.1

*Mean Total Survey Scores*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum Total Scores</th>
<th>Maximum Total Scores</th>
<th>Mean Total Scores</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-intervention</td>
<td>16</td>
<td>5</td>
<td>25</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>survey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid-point survey</td>
<td>16</td>
<td>6</td>
<td>25</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-intervention</td>
<td>16</td>
<td>11</td>
<td>24</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>survey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.1 shows that the mean score on each survey increased throughout the study. There was a 13% increase in mean score from the pre-intervention survey to the mid-point survey and an 6% increase in mean score from the mid-point survey to the post-intervention survey. The author had defined percentage changes to determine the amount of improvement in students’ enjoyment levels between the ‘regular’ math teaching and literature enriched mathematics teaching. The percentage increase in the mid-point survey to the post-intervention survey did not meet the 10% increase that was determined to indicate a minimal change in enjoyment.

Figure 4.1, a box and whisker plot, provides a visual representation of the range and distribution of total scores for each survey. The range of scores is indicated by the top “whisker”, the maximum total score, to the bottom “whisker”, the minimum total score. The centre of the
boxplot represents the median score on each survey, the bottom line of the boxplot marks the first quartile or the 25th percentile, and the top line of the boxplot marks the third quartile or the 75th percentile. Figure 4.1 provides a visual representation for comparing the three surveys. The centre line in the boxplots shows that the median score increased during each of the survey periods. The graph provides a visual representation of the range. The pre-intervention survey and mid-point survey was the same at 20, but the range decreased to 13 in the post-intervention survey. Figure 4.1 also displays a greater spread of total scores in the third quartile in the pre-intervention survey. In the mid-point survey, the spread is slightly greater in the first quartile. There is a greater spread in total scores in the first quartile of the post-intervention survey.

![Figure 4.1 Box and Whisker Plot for Math Enjoyment Survey](image)
Table 4.2 displays the mean scores for each of the five statements for each of the survey periods and the total survey score mean. Since the survey (Appendix A) presented statements with an accompanying five point Likert scale, potential mean scores for each question could range from 1 to 5. The total percentage increase for each statement from the pre-intervention survey to the post-intervention survey was also calculated and included in the table. All five statements yielded a percentage increase from the mid-point survey to the post-intervention survey. Statement question 3 (I enjoy math more than any other class) had the lowest mean score on all three survey times, however it did have the greatest percentage increase from the mid-point survey to the post-intervention survey. Statement question 2 (I really enjoy learning math in school) was the only statement to decrease from the pre-intervention survey to the mid-point survey, but increased again in the post-intervention survey.
Table 4.2

*Mean Scores on Individual Survey Statements and Total Score Mean*

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total Score Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-intervention survey</td>
<td>3.4</td>
<td>3.6</td>
<td>2.1</td>
<td>3.0</td>
<td>2.9</td>
<td>15</td>
</tr>
<tr>
<td>Mid-point survey</td>
<td>3.6</td>
<td>3.5</td>
<td>2.4</td>
<td>3.6</td>
<td>3.1</td>
<td>17</td>
</tr>
<tr>
<td>Post-intervention survey</td>
<td>3.8</td>
<td>4.0</td>
<td>2.9</td>
<td>3.9</td>
<td>3.4</td>
<td>18</td>
</tr>
<tr>
<td>Percentage Change from Pre-intervention survey to Mid-point survey</td>
<td>+6%</td>
<td>-3%</td>
<td>+14%</td>
<td>+20%</td>
<td>+7%</td>
<td>+13%</td>
</tr>
<tr>
<td>Percentage Change from Mid-point survey to Post-intervention survey</td>
<td>+6%</td>
<td>+14%</td>
<td>+21%</td>
<td>+8%</td>
<td>+10%</td>
<td>+6%</td>
</tr>
</tbody>
</table>

Although the data did not yield the total mean score percentage changes that the author defined to be a meaningful or significant change in students’ mathematical enjoyment, there was an increase in the students’ enjoyment with the use of literature in the mathematics daily class ‘routine’. The data were used to discuss implications of the findings and suggestions for further research.
Chapter Five: Summary and Conclusions

Summary

This study investigated how the use of math-related literature in a Grade 5 mathematics class would affect students’ enjoyment of mathematics. The following question was developed to guide the research: To what degree, if any, does incorporating math-related literature into the daily class ‘routine’ lead to improvements in students’ level of enjoyment of mathematics in a Grade 5 class?

To further understand the use of literature in the mathematics classroom, a literature review of six empirical studies was undertaken. In September 2010, Grade 5 students participated in a mathematics enjoyment survey which included five statements based on a five-point Likert scale. The information from this pre-intervention survey provided the author with an understanding of how students felt about mathematics before any mathematical teaching began in the Grade 5 classroom. For the next six weeks students were taught mathematics on a daily basis for a one hour period. At this time the ‘regular’ routine consisted of songs, drill computational sheets, or games as a starting activity. This was followed by a direct teaching activity with student involvement and ended with individual student assignments involving worksheets or manipulative activities. After six weeks of this ‘regular’ mathematics routine, students were administered the same math enjoyment survey again. This provided a measure of their enjoyment levels after the ‘regular’ mathematical instruction. With this mid-point survey complete, mathematics lessons were taught by incorporating math-related literature. The mathematics lessons began with the reading of a math-related book. The mathematical theme of the book became the topic of the mathematics lesson. Lessons continued to involve songs, games, computational sheets, manipulative activities, and mathematical worksheets. At the end
of this six week period students completed the mathematics enjoyment survey for the third time. The final post-intervention survey provided information on students’ mathematical enjoyment levels after the use of literature in the Grade 5 mathematics class.

The data from the three survey periods were analyzed to determine if there had been an increase in students’ mathematical enjoyment throughout the 12 week period. The author had defined percentage increase points from the mid-point survey to the post-intervention survey to measure the effectiveness of using literature in the mathematics class. The mean total test scores on each survey were calculated and compared to see if there was any percentage increase. The research findings indicated a 13% increase in mathematical enjoyment from the beginning of the Grade 5 school year to the mid-point of the study and a 6% increase from the mid-point survey to the pre-intervention survey. These survey results showed a close to minimal increase in enjoyment of mathematics with the use of literature in the mathematics class.

**Discussion of the Implications of the Findings**

The use of children’s literature in the Grade 5 mathematics class provided positive results towards students’ mathematical enjoyment levels. The study provided several important findings. Although the results from the study did not yield the 20% increase the author had hypothesized, the mean scores did improve throughout the study and discussion of the increase is necessary.

Throughout the study students indicated their mathematical enjoyment levels by completing the same mathematics enjoyment survey three times. The three different survey administration data indicate that there was less spread in the data as the present study progressed. At the beginning of the study students who answered the survey with lower scores felt very similar about mathematics. There was a larger range in the scores of the students who answered more favourably on the first survey administration. By the mid-point survey administration there
was less spread in the top survey responses. The bottom survey responses showed a greater spread than the first survey administration. The top 50% of students felt very similar about mathematics when the post-intervention survey administration was complete. Thus literature may be more useful for improving enjoyment with students who do not already enjoy mathematics. Literature may be useful in engaging students early in the year to build their interests in mathematics. Through the use of ‘story’ students may gain more interest in mathematics which could increase their confidence and enjoyment levels.

With the use of literature in the mathematics classroom, Grade 5 students were asked to listen to a story that related to a mathematical concept and build their learning through a variety of mathematical activities that included manipulatives and problem solving activities. By starting a mathematics class with a story, opportunities were created for students to look for themes in the story as well as look for ways that the mathematics in the story connected to real life or to the students’ own experiences. Math-related literature can help to provide a meaningful context for mathematics and encourage problem solving as well as provide meaningful contexts for building understanding (Shatzer, 2008). Through the survey responses, students were able to express an increase in mathematical enjoyment when using math-related literature in the Grade 5 mathematics class.

The survey statement “I enjoy math more than any other class” had a 21% increase from the mid-point survey to the post-intervention survey. This is seen as a significant change in students’ mathematical enjoyment levels as described in this study. When students were exposed to math-related literature they gained more enjoyment in mathematics. This could be because the literature approach allows students to integrate their interest in language arts with mathematics. Many of the mathematics lessons were accompanied by problem solving activities that could be
explained through the use of art. Students were asked to solve problems and express their thinking through drawings and posters. Mathematical displays became a large part of the class decor and bulletin boards. It was the author’s observation that the students were engaged and eager to explain their mathematical reasoning and share their ideas with the rest of the class. This observation is similar to Hong’s (1996) research in which he found that through the use of children’s literature mathematical experiences could build on children’s and teachers’ imaginations and engage children to solve mathematical problems.

Survey statement 2 (I really enjoy learning math in class) increased from the mid-point survey to the post-intervention survey. During this study, the amount of time dedicated to mathematics increased in the daily schedule as the story and discussion took more time. It was observed that students showed more interest in continuing with mathematics lessons which supports the students’ survey response increases in enjoying mathematics more than any other class and enjoying learning math in class. By increasing the mathematics time, students were actively engaged in mathematical lessons for a longer period of time. The author also noted that more students became engaged in class discussions as students had the opportunity to share and relate comments to the books rather than only to mathematics. The author noted that as the six weeks of literature based mathematics teaching continued the discussions moved away from the story and elements of the book to how the book related to mathematics. This finding supports the research that communication is an important part of mathematics and can be integrated through other school subjects (Capraro & Capraro, 2006).

Students’ confidence levels increased throughout the study as the survey statement “I am confident in math” yielded a large percentage throughout the survey. Researchers Ashcraft, Krause, and Hopko (2007) state that with more mathematical proficiency and confidence
students will overcome their anxieties with mathematics and gain enjoyment. Students may have started to feel more confident in mathematics as the literature approach to mathematics allowed for a wider variety of problem solving activities that related to the book theme. The fact that many of the lessons that accompanied the math-related literature did not involve solving mathematical problems in only one way and allowed students to carry out a variety of strategies helped to build students’ confidence in their abilities. The literature also provided an opportunity for students to see how the characters in a story solved problems and apply the examples of problem solving to their own problems in following mathematical activities. This finding is similar to Keats and Wilburn’s (2009) research in which students were presented with opportunities to see characters in a story struggle to solve mathematical problems which allowed them to relate to the characters and think of mathematical thinking as a natural way of helping solve a problem.

The author observed that the activities presented in the mathematics class provided opportunities for students to be engaged and lent themselves well to working in partner or group settings. When working in small groups the participants were encouraged to work together and share their learning with each other. Students were provided the opportunity to express their learning and confusion with others allowing students to mentor each other and explain how they each solved problems. This style of teaching provided students the opportunity to feel successful in their work as there was not the ‘one right answer’ that often comes with mathematical worksheet activities. The author noted that one change in the mathematics class during the literature based teaching was the increased amount of mathematical communication and vocabulary development. While students were working together they were able to build their mathematical vocabulary and were confident using new mathematical terms throughout the
lessons. Capraro and Capraro (2006) found similar results in their research as the use of literature allowed students to experience more hands-on activities in group settings and found the use of ‘story’ allowed students to develop strong mathematical vocabularies.

**Limitations**

Although this study yielded positive results for the case of including math-related literature into the mathematics curriculum, the limitations of the study must be addressed. The length of the study may not have provided participants enough time to build a good understanding of how the mathematics curriculum was enhanced with the use of math-related literature. It may take more time for students to understand and reflect on how the use of literature in mathematics can connect to their daily lives and relate to other school subjects. A study of longer duration might lead to increased enjoyment levels.

Another limitation of the study was the small sample size which consisted of 16 Grade 5 students. This small sample does not allow for any generalization of the data. Although the sample included students of varied mathematical abilities, it is difficult to generalize the results to other Grade 5 students in the district. It should also be noted that the participants in the study were also students in the author’s classroom. Students may have felt they needed to provide higher survey scores to please the teacher.

All study findings were based on the mathematics enjoyment survey. The survey statements may have been interpreted differently by each of the participants as they were unable to ask questions about the statements while completing the survey. Providing a more open-ended survey which allowed students to explain their thoughts may have given the students an opportunity to expand on their survey responses and may have provided the author with more information on the areas of mathematics students found enjoyable. Using some classroom
observations would have allowed the author to focus on an area such as increased communication, as Capraro and Capraro’s study (2006) did, to build more into the discussion of how students’ mathematical communication increased with more mathematical enjoyment. Using mathematical achievement scores through a standardized test may have also provided more information for the author such as whether the students’ enjoyment was related to their academic achievement.

**Recommendations for Practice**

Based on the positive outcomes of this study the author has made some recommendations for practice to build literature into the mathematics program to help increase students’ mathematical enjoyment. This study’s school has invested time into creating school-wide literature sequences to help build literacy skills throughout the Kindergarten to Grade 7 grades. These literacy sequences involve the selection of a story that builds such skills as questioning, inferring, and transferring. Building a literacy sequence around a math-related story would allow the integration of both literacy and mathematics.

This study was built around reading a new book every day or every second day. The author would suggest creating units around a book to introduce a mathematical concept to build students’ interests and provide a variety of problem-solving opportunities for students. This would allow students the opportunity to build on their prior knowledge and use their literary knowledge to connect with their new mathematical learning. A suggested delivery of math-related literature would be to read one story at the beginning of the week and create a sequence of lessons that could be taught throughout the week. This may allow students more time to grasp concepts as well as help provide an opportunity for more project based activities. A sequence of lessons would offer students the chance to build new skills onto existing knowledge.
Extensive bibliographies of math-related literature and mathematics lesson resource books are readily available to educators. The District Resource Centre has an extensive list of mathematical supplies and mathematical manipulatives as well as math-related book kits created by teachers in the district that can be signed out. With so many excellent resources available to schools, teachers may want to take the opportunity to try mathematical activities with their classes. Teachers may wish to create mathematical bins that include math-related literature and manipulatives. These bins would help teachers who may lack confidence and experience with teaching mathematics. Since many teachers feel comfortable teaching language arts, having easy access to supplies to teach a literature based mathematics lesson may be a way to encourage teachers to try this type of mathematical delivery.

**Suggestions for Further Research**

The author recommends further research based on using math-related literature to determine the extent to which it may affect students’ enjoyment in mathematics. Since this study was based on the enjoyment levels of students in Grade 5 the author suggests repeating the study with a different grade level. Using the same research question with a primary grade may provide different student responses. As the upper intermediate grades are being encouraged to use a more mathematical manipulative approach to learning it would be valuable to investigate if the use of literature at the upper grades can help to strengthen the hands-on mathematics approach. It would also be beneficial to investigate what type of literature would be appealing to upper elementary students.

Since this study was based on a short time frame it would be worth repeating the study with a longer time period to build literature into the mathematics class. Working with fewer math-related books but over a longer period of time would also be beneficial to study. Basing a
mathematical theme on a book would allow for many different activities over a longer period of time. Adding more time to the study would allow students to recognize the changes in their mathematical learning with the use of literature in the mathematics program.

As some increase in student enjoyment was noted in this study it would be interesting to look at how the use of math-related literature could affect student mathematical achievement as well. The author would use the math enjoyment survey as well as use the Vancouver Island Net Diagnostic Math Assessment at the beginning and end of the study to measure student mathematical achievement. This assessment is suggested because it matches well with the learning outcomes for each grade level. The assessment at the beginning of the study would provide the researcher with a good understanding of areas of learning to focus on and books could be selected based on the mathematical needs of the students. Being able to use observations during class time would also be useful so that the researcher could record the amount and increase of dialogue and verbal mathematical communication during mathematics lessons.

Conclusion

This research project, which explored if the use of literature in the mathematics classroom would increase Grade 5 students’ mathematical enjoyment levels, has successfully demonstrated that students enjoy literature being integrated into the mathematics class. The author is hopeful that the findings from this study will lead to further research, as suggested in this chapter, to help build a stronger understanding of students’ feelings towards literature in the mathematics class. Incorporating literature into the mathematics class allows for engaging lessons that motivate students to work through problem solving activities that are relevant and provide opportunities for sharing of ideas and thinking. The author continues to feel strongly that
if students can enjoy mathematics it will help to build a deeper understanding of mathematical concepts.
References


## Math Enjoyment Survey

**Directions:** Circle the number below each statement that best describes your feelings.

1. **I enjoy math.**
   - Strongly Disagree: 1
   - Disagree: 2
   - Don’t Know: 3
   - Agree: 4
   - Strongly Agree: 5

2. **I really enjoy learning math in school.**
   - Strongly Disagree: 1
   - Disagree: 2
   - Don’t Know: 3
   - Agree: 4
   - Strongly Agree: 5

3. **I enjoy math more than any other class.**
   - Strongly Disagree: 1
   - Disagree: 2
   - Don’t Know: 3
   - Agree: 4
   - Strongly Agree: 5

4. **I am confident in math.**
   - Strongly Disagree: 1
   - Disagree: 2
   - Don’t Know: 3
   - Agree: 4
   - Strongly Agree: 5

5. **Math is a fun school subject.**
   - Strongly Disagree: 1
   - Disagree: 2
   - Don’t Know: 3
   - Agree: 4
   - Strongly Agree: 5
APPENDIX B

RESEARCH CONSENT FORM

“IMPROVING STUDENTS’ MATHEMATICAL ENJOYMENT THROUGH MATH-RELATED LITERATURE”

September 2010

Cindy Haack
Masters of Education Student
Vancouver Island University
chaack@sd68.bc.ca

Harry Janzen, Ph. D., Supervisor
Dean of Faculty of Education
Vancouver Island University
(250) 740-6220

I am a student in a university-level research methods course. This course requires me to gain applied experience in designing and conducting research. As such, I have designed a 12 week research project to study the use of children’s literature in a mathematics class and see to what degree it can increase students’ enjoyment levels in mathematics.

During this study, your child will be asked to complete a 5 question survey to measure their degree of enjoyment with mathematics. Your child will be asked to complete this survey three times throughout the study (before, during, and after). The survey will take no longer than 10 minutes to complete and will be administered by Mrs. Torgerson, a teacher in the school.

There are no known harms associated with your child’s participation in this research. The potential benefits are that the information from the surveys and study will help to bring some change to the mathematics class. Participants will have the opportunity to take part in relevant lessons that will include the use of storybooks in the mathematics class.

Your child’s participation will be kept strictly confidential, such that only I and Mrs. Torgerson will have access to the information. Your child’s name will not appear on any of the surveys. Surveys will be stored in a locked cabinet in the principal’s office. The surveys will be destroyed by shredding at the end of the project, approximately June 30, 2011. Electronic files will also be deleted at that time. The results from this study will be reported in a written research report and will be presented in a university class presentation.

Your child’s participation is completely voluntary. You may withdraw your child at any time for any reason without explanation and without penalty. Your child, on his/her own, may also withdraw from the study at any time and without penalty. Your child may choose not to answer any question for any reason. Since the survey is anonymous, all completed surveys will be used in the study and your child’s previous surveys cannot be withdrawn.
If you should have any concerns about your child’s treatment as a research participant in this study, please contact the VIU Research Ethics Officer, by telephone at 250-753-3245 (ext. 2665) or by email at reb@viu.ca.

If you have any questions about this research project, or would like more information, please feel free to contact me by email at chaack@sd68.bc.ca or by telephone at 250-753-1044.

I have read the above form, understand the information read, understand that I can ask questions or withdraw my child at any time. I consent to have my child participate in this research study.

____________________________________________________________________________
Parent/Guardian’s Signature                                           Date
Appendix C

Math-Related Literature Used in this Study

Patterns in Peru by Cindy Neuschwander
Measuring Penny by Loreen Leedy
G is for Googol! by David Swartz
Even Steven and Odd Todd by Kathryn Crisoldi
Earth Day Hooray! by Stuart Murphy
Marvelous Math by Lee Bennett Hopkins
The Fly on the Ceiling by Dr. Julie Glass
The Best of Times by Greg Tang
Betcha! by Stuart Murphy
Math Curse by Jon Scieszka and Lane Smith
If the World Were a Village by David Smith
Pigs will be Pigs by Amy Axelrod
Anno’s Mysterious Multiplying Jar by Mitsumasa and Masaichiro Anno
Fraction Action by Loreen Leedy
Mission Addition by Loreen Leedy
Subtraction Action by Loreen Leedy
How Much is a Million? by David M. Schwartz
Math Appeal by Greg Tang
Math Fables by Greg Tang
Math for All Seasons by Greg Tang
Math Potatoes by Greg Tang
Math-terpieces by Greg Tang
The Grapes of Math by Greg Tang

The Best of Times by Greg Tang

Tally O’Malley by Stuart Murphy

A Remainder of One by Elinor Pinczes

The Lion’s Share by Matthew McElligott

Math Attack! by Joan Horton