# AN ANALYSIS OF GENDER AND PERFORMANCE FOR STUDENTS WRITING THE BRITISH COLUMBIA GRADE 12 PROVINCIAL EXAMS 

## by

## CHUNG YAN IP

Dip. (TESL), University of British Columbia, 2002
B.Ed., University of British Columbia, 2000
B.A., University of British Columbia, 1999

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS
in
THE FACULTY OF GRADUATE STUDIES
(Curriculum Studies)

THE UNIVERSITY OF BRITISH COLUMBIA

September 2007
© Chung Yan Ip, 2007


#### Abstract

Research on gender performance generally focuses on how boys and girls perform on standardized tests. Recent trends indicate that boys are doing worse than girls statistically in the areas of literacy and to a certain degree in the sciences. In British Columbia, students write provincial exams (standardized tests) at the end of a course. The exams count as $40 \%$ of their final grade. This study focuses on assessing whether there are significant differences in the mean scores of boys and girls over ten school years, from 1995-2005, in six provincial exam subjects: Biology 12, Communications 12, English 12, History 12, Principles of Mathematics 12, and Physics 12. Data were obtained from the Ministry of Education through Edudata. Independent t -tests were chosen to assess whether there were significant differences between male scores and female scores for each of the exams written for each school year. Findings from these analyses indicated that there were significant differences on mean scores in exams between males and females. Female students perform higher in Physics 12, Principles of Mathematics 12, English 12, and Communications 12 while male students perform higher in History 12. In Biology 12, there were years where males performed higher and other years where females performed higher.


## Table of Contents

Abstract ..... ii
Table of Contents ..... iii
List of Tables ..... vi
List of Figures ..... vii
Acknowledgements ..... viii
Chapter 1 - Introduction ..... 1
1.1 Background ..... 1
1.2 Societal Interest ..... 2
1.3 Situating the Researcher and the Study ..... 3
1.4 Statement of Purpose ..... 6
1.5 Research Questions ..... 7
1.6 Limitations - Provincial Exams Chosen for Analyses ..... 7
1.7 Definitions. ..... 9
1.8 Organization of Thesis ..... 10
Chapter 2 - Review of Literature. ..... 12
2.1 Introduction ..... 12
2.2 Brain Research ..... 12
2.3 Single-Sex Teaching in United Kingdom ..... 15
2.4 Societal Influences ..... 16
2.5 Gender and Schooling ..... 17
2.6 Gender and Curriculum ..... 19
2.7 Gender Related performance in AP Tests \& SAT II Tests ..... 21
2.8 Test Results (British Columbia) ..... 22
2.9 Observations in Gender differences for schools in Australia ..... 24
2.10 Case Study: James Lyng High School (Montreal) ..... 25
2.11 Case Study: Jefferson Leadership Academies (Long Beach, California) ..... 26
2.12 Schools in British Columbia Today ..... 28
2.13 Teacher Influence on Student Performance ..... 29
2.14 Gender performance differences in Physics ..... 29
2.15 Observations on gender performance differences in Mathematics ..... 30
2.16 Gender performance differences in Biology. ..... 32
2.17 Observations on gender performance differences in Science ..... 32
2.18 Historical Perspectives on gender performance differences in English \& History ..... 34
2.19 Conclusion ..... 34
Chapter 3 - Methodology ..... 36
3.1 Introduction ..... 36
3.2 Statistical Analysis ..... 36
3.3 Null Hypotheses testing for Mathematics 12 and Physics 12 ..... 37
3.4 Null Hypotheses testing for Biology 12, Communications 12, and English 12 ..... 38
3.4 Null Hypotheses testing for History 12 ..... 39
3.5 T-tests. ..... 40
3.6 Inclusion/Exclusion Criteria for these t-tests ..... 41
3.7 Data Files ..... 41
3.7.1 Independent Research Variables ..... 41
3.7.2 Dependent Research Variables ..... 42
3.8 Removal of Data with Missing Variables ..... 43
3.9 Data Collection ..... 44
3.10 Data Analysis ..... 47
3.10.1 English 12 Exam \& Communications 12 Exam ..... 47
3.10.2 History 12 Exam ..... 51
3.10.3 Biology 12 Exam ..... 52
3.10.4 Physics 12 Exam ..... 54
3.10.5 Principles of Mathematics 12 Exam ..... 55
3.11 Data Testing ..... 56
3.12 Ethics Approval \& Research Agreement ..... 57
3.13 Conclusion ..... 57
Chapter 4 - Findings ..... 58
4.1 Introduction ..... 58
4.2 Background to Data Selections ..... 58
4.3 Data Analysis - Year by Year ..... 59
4.3.1 T-Test results for school year 1995-1996 ..... 59
4.3.2 T-Test results for school year 1996-1997 ..... 61
4.3.3 T-Test results for school year 1997-1998 ..... 62
4.3.4 T-Test results for school year 1998-1999 ..... 63
4.3.5 T-Test results for school year 1999-2000 ..... 64
4.3.6 T-Test results for school year 2000-2001 ..... 65
4.3.7 T-Test results for school year 2001-2002 ..... 67
4.3.8 T-Test results for school year 2002-2003 ..... 68
4.3.9 T-Test results for school year 2003-2004 ..... 69
4.3.10 T-Test results for school year 2004-2005 ..... 70
4.4 Findings - Subject by Subject. ..... 71
4.4.1 Biology 12 - Are there significant differences between boys and girls on the Biology 12 exam from 1995-2005? ..... 72
4.4.2 Communications 12 - Do Girls do better than boys on the Communications 12 exam from 1995-2005? ..... 74
4.4.3 English 12 - Do girls do better than boys on the English 12 exam from 1995- 2005? ..... 75
4.4.4 History 12 - Do girls do better than boys on the History 12 exam from 1995- 2005? ..... 77
4.4.5 Principles of Mathematics 12 - Do boys do better than girls on the Principles of Mathematics 12 exam from 1995-2005? ..... 79
4.4.6 Physics 12 - Do boys do better than girls on the Physics 12 exam from $1995-$ 2005? ..... 81
4.5 Conclusion ..... 83
Chapter 5 - Summary, Discussion and Recommendations ..... 84
5.1 Introduction ..... 84
5.2 Summary ..... 84
5.2.1 Biology 12 Exam ..... 84
5.2.2 Communications 12 Exam ..... 85
5.2.3 English 12 Exam ..... 85
5.2.4 History 12 Exam ..... 86
5.2.5 Principles of Mathematics 12 Exam ..... 86
5.2.6 Physics 12 Exam ..... 86
5.3 Discussion ..... 87
Biology 12 ..... 87
Physics 12 \& Principles of Mathematics 12 ..... 88
Communications 12 \& English 12 ..... 89
History 12 ..... 90
5.4 Recommendations ..... 91
Recommendation \#1: Single sex class configuration ..... 91
Recommendation \#2: Literature taught in English classes ..... 93
Recommendation \#3: Realizing the benefits of schooling ..... 94
Recommendation \#4: Professional Development for teachers to address different learning styles. ..... 95
Questions for further research. ..... 96
Thesis Summary ..... 97
Bibliography ..... 99
APPENDIX A: UBC ETHICS APPROVAL FORM ..... 109
APPENDIX B: UBC ETHICS RENEWAL APPROVAL FORM ..... 110
APPENDIX C: RESEARCH AGREEMENT WITH MINISTRY OF EDUCATION ..... 111
APPENDIX D: REVISED RESEARCH AGREEMENT WITH MINISTRY OF EDUCATION ..... 134

## List of Tables

Table 3.1 Independent Research Variables ..... 42
Table 3.2 Dependent Research Variables ..... 43
Table 3.3 Summary of Removed Students Missing Data Files ..... 44
Table 3.4 Total Student Enrolment in Provincial Exams ..... 45
Table 4.1 Summary of T-Test results for school year 1995-1996 ..... 60
Table 4.2 Summary of T-Test results for School Year 1996-1997 ..... 62
Table 4.3 Summary of T-Test results for school year 1997-1998 ..... 63
Table 4.4 Summary of T-Test results for school year 1998-1999 ..... 64
Table 4.5 Summary of T-Test results for school year 1999-2000 ..... 65
Table 4.6 Summary of T-Test results for school year 2000-2001 ..... 66
Table 4.7 Summary of T-Test results for school year 2001-2002 ..... 68
Table 4.8 Summary of T-Test results for school year 2002-2003 ..... 69
Table 4.9 Summary of T-Test results for school year 2003-2004 ..... 70
Table 4.10 Summary of T-Test results for school year 2004-2005 ..... 71
Table 4.11 Summary of T-Test results with significance for Biology 12 ..... 73
Table 4.12 Summary of T-Test results with significance for Communications 12 ..... 74
Table 4.13 Summary of T-Test results with significance for English 12 ..... 76
Table 4.14 Summary of T-Test results with significance for History 12 ..... 78
Table 4.15 Summary of T-Test results with significance for Principle of Mathematics 12 ..... 80
Table 4.16 Summary of T-Test results with significance for Physics 12 ..... 82

## List of Figures

Figure 3.1 Communications 12 Exam Participation Rate. ..... 47
Figure 3.2 English 12 Exam Participation Rate ..... 48
Figure 3.3 English 12 Exam Participants ..... 50
Figure 3.4 Communications 12 Exam Participants ..... 51
Figure 3.5 History 12 Exam Participation Rates ..... 51
Figure 3.6 History 12 Exam Participants ..... 52
Figure 3.7 Biology 12 Exam Participation Rates ..... 53
Figure 3.8 Biology 12 Exam Participants ..... 53
Figure 3.9 Physics 12 Exam Participation Rates ..... 54
Figure 3.10 Physics 12 Exam Participants ..... 55
Figure 3.11 Principles of Math 12 Exam Participation Rates ..... 55
Figure 3.12 Principles of Math 12 Exam Participants ..... 56
Figure 4.1 Mean Scores for Biology 12 Exam ..... 73
Figure 4.2 Mean Scores for Communications 12 Exam ..... 75
Figure 4.3 Mean Scores for English 12 Exam ..... 77
Figure 4.4 Mean Scores for History 12 Exam ..... 79
Figure 4.5 Mean Scores for Principles of Mathematics 12 Exam ..... 81
Figure 4.6 Mean Scores for Physics 12 Exam ..... 83

## Acknowledgements

I would like to acknowledge my supervisor, Dr. Stephen Petrina, for his support and encouragement throughout my MA program. I thank him deeply for guiding me through this whole process of completing a thesis program. Looking back, I can see that I have been challenged and stretched to understand more about an area that sparked a 5-year thesis. My supervising committee members: Dr. Don Krug and Dr. Penney Clark have also played an instrumental role in my undergraduate and graduate studies at UBC.

Many thanks also to my dear friends who played a role in my MA program, Danielle Law and Daniel To. While both continue with new challenges in academia, their continued support has been a true blessing of friendship.

Other people I would like to acknowledge for their assistance and help in my research project includes James Ngai, for his SPSS support, Franc Feng for our long discussions on methodology, Dr. Maria Trache, Jennifer Lloyd and Edudata for their assistance in providing the necessary data needed for this research project. From the Ministry of Education, many thanks to Brent Munro, Chris Hvid, Wang Dehui, and Britta Gundersen-Bryden for some timely assistance and discussion.

I am also very grateful to my parents Y.C. and Catherine Ip along with my younger brother, Chung-Ming, for their encouragement all these years. To my supportive and understanding wife, Karen, thank you for your patience and love.

Lastly, thank you Lord for teaching how to be patient and persevere through this entire process in writing a thesis. There is certainly a sense of satisfaction that comes with seeing a project come into fruition.

To God be the Glory!

## Chapter 1 - Introduction

### 1.1 Background

Our society continuously changes in terms of its approach to life, love, liberty and freedom. In some ways, our society might be described as a living organism with ebbs and flows, as humankind seeks out what it takes to be normal. An excellent case in point would be the vast development of technology. Five to ten years ago, wireless internet was not conceivably available for the general population. Today, countries, business people, and military forces worldwide could not conceive of their existence without computers, the Internet, or the machinery that they have created for their survival. Yet, in this ever-changing society of the $21^{\text {st }}$ century, education is the single most important factor for success in life. United Nations Educational, Scientific, and Cultural Organization (UNSECO) in its World Declaration on Education for All notes that basic education "empowers individuals in any society and confers upon them a responsibility to respect and build upon their collective cultural, linguistic and spiritual heritage, to promote the education of others, to further the cause of social justice, to achieve environmental protection...the aim of educational development is the transmission and enrichment of common cultural and moral values. It is in these values that the individual and society find their identity and worth (UNESCO, 1990)."

As countries throughout the Third World seek to increase the level of education for their children, a trend has been noted in some countries in the western world by various academics. This trend is that boys, especially those in early adolescence, are struggling much more in their academic achievement than girls of the same age group (Phillips, 2003, Weaver-Hightower, 2003). Yet the whole notion that boys are under-performing is questioned extensively by
researchers (Weiner \& Arnot, 1987). Some argue that it is not a case of boys doing poorly but instead a reality of girls succeeding and that boys draw attention to themselves simply because they are noisy. Nonetheless, one cannot deny the fact that female students are out-performing male students in schools, particularly in the humanities area (Statistics Canada, 2003).

An editorial on August 29, 2003 in the USA TODAY entitled "Girls get extra school help while boys get Ritalin," highlights the performance of students today. It provided a case study of a graduation ceremony at Franklin High School near the city of Milwaukee, Wisconsin. Of the four students who tied for valedictorian, three of them were girls. Furthermore, $85 \%$ of the students who were on Franklin's 4.0 honor roll list were girls. The article noted that for students across United States, males are consistently struggling compared to females in terms of literacy and reading. As well, the 2003 Reading component of the National Assessment of Educational Programs found that "female students scored higher on average than male students by 7 points at grade 4, and by 11 points at grade 8" (National Center for Education Statistics-Reading Results, 2003). By $12^{\text {th }}$ grade, the gap between girls and boys was significantly higher at 16 points. In Math, "male students scored higher on average than female students by three points at grade 4 and by two points at grade 8" (National Center for Education Statistics-Math Results, 2003).

### 1.2 Societal Interest

Since education became a right, gender and education has become an area of interest for educators. When talking about education and how it is administered to boys and girls in western countries, discourse prior to 2000 was on discrimination against girls. In 1972, Title IX, was passed in the United States which stated that there was to be equal access to educational opportunities for girls (United States Education Department, 1972). The result of this has been a
significant growth in participation and achievement in all aspects of education including higher education (Statistics Canada, 2003). Another ramification of this passage has been a change in curriculum to include females in curricular materials so that girls and women have positive role models to follow.

The American Association of University Women published an article in 1992 entitled "How Schools Shortchange Girls". The result of this report stimulated discussion but also led to educators and parents taking on different sides, corresponding to debate today about how boys are now suffering in schools. Popular magazines such as Newsweek devoted an issue to explore the difficulties that boys are facing in schools today. In their January 26, 2006 issue titled, "The Boys Crisis," Newsweek highlighted the fact that boys are behind girls in every category such as reading, writing, and arithmetic, and at all age levels.

### 1.3 Situating the Researcher and the Study

As a practicing teacher in the Coquitlam School District, many of my colleagues are encountering a noticeable difference in performance of girls and boys in the elementary and secondary school levels. The Foundation Skill Assessment (FSA) test results for students of the Coquitlam School District in 2002-2003 follow the same statistical pattern previously mentioned. In the areas of reading and writing, grade seven and ten boys are doing poorly when compared to girls at the same age. For reading comprehension at the grade seven level, only $78 \%$ of the boys met or exceeded expectations in comparison to $83 \%$ for girls (BC Ministry of Education, 2003). The gap in writing was much higher with $74 \%$ of the boys meeting expectations while $87 \%$ of the girls met or exceeded expectations (BC Ministry of Education, 2003). Similarly, the reading comprehension level was lower for grade ten students with $69 \%$ of the boys meeting or
exceeding expectations while $78 \%$ of the girls met or exceeded expectations (BC Ministry of Education, 2003). At the writing level, the trend continued with $78 \%$ of the boys meeting or exceeding expectations while $90 \%$ of the girls met or exceeded expectations (BC Ministry of Education, 2003). Only in numeracy were the boys slightly higher than girls with a one-point advantage in both grades (BC Ministry of Education, 2003).

Examining the differences in academic performance for adolescent boys and girls has become an interest in my teaching career, though I must say that I came upon this area sparked by a thought provoking documentary from the television show 60 Minutes by CBS. The world renowned commentator Ed Bradley presented a piece on an intriguing school in Long Beach California called Jefferson Leadership Academies (JLA). JLA is a middle school whose students come from families with low income and many students are still learning English. In his piece, he highlighted how student achievement increased through creative means of offering classes where boys and girls were segregated for core classes such as English and Mathematics. Only in band were both genders brought back together.

Since I was educated in co-educational settings, the idea of attending a single-sex school seldom crossed my mind. The public school system in British Columbia offers very few single sex schools or classes. It is in the private school setting that one can find single-sex schools. As a beginning teacher and educator trained in the secondary field, I was offered a position at a middle school to teach a grade $6 / 7$ class, which happened in a year when I was laid-off and recalled by my school district.

This exposure to the grade $6 / 7$ level allowed me to observe that girls indeed seemed to be performing better than boys at the early adolescent age. Reflecting back to that school year, I cannot help but note how the large majority of students who repeatedly called out or were
disruptive in the class were boys, while those who were quiet and studious were mostly girls. As students wrote tests and completed unit projects, the marks that the students received repeatedly resulted in higher grades for girls than for boys. Thus, I asked myself would the segregation of my class similar to Jefferson Leadership Academies, result in a better performance for the boys?

Upon leaving the middle school system and re-entering the secondary level, I noticed that the trend continued. In my discussions with colleagues combined with my observations of the students that entered my classroom, girls continuously out-performed boys in academics. That is not to say that the reverse does not take place; there are certainly some very strong academic students who are boys and conversely, there are some very weak students who are girls. Nonetheless, my observations concerning the notable difference in performance between boys and girls leads me to ask: what are the trends in academic performance for students in British Columbia in the core academic subjects of Math, English, Social Studies, and Science? Was the experience I encountered in academic performance, specifically for males, unique or widespread among teachers in other schools across British Columbia?

Gender in education has always been an interesting topic for teachers dating back to at least the early 1960's (Curry \& Hughes, 1965; Cardozier \& Cobb, 1966, Connell, 1995). With today's population trend for children below the age of 19 showing a slightly higher percentage of boys (24.7\%) than girls ( $23.2 \%$ ) in Canada (Statistics Canada, 2006), it is interesting to find out whether the general feeling presented recently by researchers, that boys are struggling in the academics in comparison to girls, corresponds with the examination results.

In British Columbia, government provincial exams are administered at various levels during a student's education. There are two types of exams given to students in all schools, irregardless whether they are attending a public school, or a publicly funded independent school.

For grades four and seven, students write the Foundation Skills Assessment Tests, which test students on their reading comprehension, writing, and numeracy. The focus of these tests is to provide teachers, administration, students and their parents with an idea as to how their child is performing. These are valuable tools for education researchers to do comparisons regarding performance of students in both macro and micro settings.

With the new graduation program implemented beginning in 2004, all students write provincial exams at the grade(s) 10, 11, and 12 levels. However, for the purpose of this study, the provincial exams in grade 12 will be the primary source of data in examining the performance of girls and boys. I have chosen to use exams results because they are more impartial than the school mark or the final mark.

### 1.4 Statement of Purpose

While there are many global studies that examine differences between male students and female students (PIRLS, and TIMSS), very little research has closely examined such trends for students in British Columbia. I intend to research the academic performance of male and female students in British Columbia and to investigate whether there are significant differences between male and female performance in various academic subjects. These differences will be examined through the use of the statistical data provided by the Ministry of Education.

The purpose of this research is to collate the information about the performance of boys in British Columbia's secondary schools with an eye towards creating discussion and dialogue about how to better help male students achieve a higher level of performance in their academic subjects. It is hoped that this research report will aid educators, students, the general public, and
the government to obtain a better understanding about the current situation of academic achievement for boys and girls in British Columbia.

### 1.5 Research Questions

This study seeks to identify gender differences in academic performance, on provincial exams, for secondary students in British Columbia, between the school years of 1995/1996 to 2004/2005 in the subject areas of Principles of Math 12, History 12, English 12,

Communications 12, Biology 12, and Physics 12. Specifically, this study asks:
Are there significant differences in academic performance between male and female students for the above-mentioned provincial exam subjects for the school years of 1995/1996 to 2004/2005?

Academic differences between boys and girls will be assessed independently for 1995/1996, 1996/1997, 1997/1998, 1998/1999, 1999/2000, 2000/2001, 2001/2002, 2002/2003, 2003/2004, 2004/2005 in order to examine whether there are significant gender differences for male and female students in Principles of Math 12, History 12, English 12, Communications 12, Biology 12, and Physics 12.

### 1.6 Limitations - Provincial Exams Chosen for Analyses

Provincial exams exist for grade 12 courses that are academic in nature and are courses that are offered province-wide to all students. For these provincial examinable grade 12 courses, the school mark accounts for $60 \%$ of a student's final mark, while the provincial exam accounts for the remaining $40 \%$ of their final mark. Prior to 2007 , all students enrolled in any provincial examinable course must complete the exam before they receive credit for that course. It should
also be noted that local universities in British Columbia requires high school applicants to complete English 12 and three other provincial examinable subjects as part of their admission criteria.

However, today, with the implementation of the 2004 graduation program, students only need to complete either English 12 or Communications 12 in order to graduate. All other courses in grade 12 are optional and students decide for themselves whether they would like to enroll in them. For the purpose of this research project, I have chosen to look at six courses and the provincial exam results for these courses, with students who were governed under the old 1995 graduation program. The courses selected are English 12, Communications 12, Principles of Math 12, Physics 12, Biology 12, and History 12.

While the current series of provincial exams began in the late 1970's, provincial exams have existed in a various different formats in the 1960's. It was not until the 1990's that the British Columbia Ministry of Education began releasing information on examination performance to researchers. As a result, the only exams that researchers have access to begin with the school calendar year of 1995/1996. All exams written by students in following years can be accessed upon completion of an ethics review. For this reason, while provincial exams have been around for over twenty years, the exams that I can access for this research project are for ten school calendar years as the balance are in formats that can no longer be accessed or released by the British Columbia Ministry of Education.

Another limitation of this research is that I chose not to examine deeper the relationship between school of origin and performance on the exams. My intent in researching gender performance for British Columbia is to examine the performance of students as a whole, irregardless of whether they are attending an independent school or a public school. Much has
been made in discussions by various parties about the differences (i.e. Fraser Report Annual Report Card, BCTF) and while it would be a topic worthy of closer scrutiny, I believe that looking at student performance for the whole province is much more indicative of trends in student performance.

### 1.7 Definitions

Gender and Sex. Gender is typically distinguished from biological sex (Connell, 1996; Bland, 2005). Bland (2005) suggests that gender is the behaviours, attitudes, norms, values, and beliefs a particular cultural group considers appropriate for males and females on the basis of their biological sex. Generally, gender refers to the social construction (expectations, norms, etc.) of the sexes, while biological sex refers to the genetic development of females and males. The term sex as defined by the World Health Organization (WHO) refers to the biological characteristics that define humans as female or male. These sets of biological characteristics are not mutually exclusive as there are individuals who possess both, but these characteristics tend to differentiate humans as males and females (WHO, 2007).

For the purpose of this thesis, the use of the words boys, girls and females, males, will be interchangeable. The term gender and sex are also fairly interchangeable in this thesis. Thus the gender/sex enrollment numbers in this research project are defined as gender (both males and females) that the Ministry of Education released related to how students are categorized in the grade 12 provincial exam and their corresponding exam scores.

Performance and achievement. The University of Iowa (Ulowa), through their renowned Iowa Testing Programs, stipulates that the primary purposes of testing are (1) to describe each student's developmental level within a test area, (2) to identify a student's areas of
relative strength and weakness in subject areas, and (3) to monitor year-to-year growth in the basic skills (Ulowa, 2007). According to the Iowa Testing Program, a test score represents a "test performance on an achievement continuum" (Ulowa, 2007). Hence, for this research, the test scores are referred to as performance scores, which are on an achievement continuum.

For the exam data used for analysis in this thesis, the raw scores were not initially standardized by the Ministry of Education for the purposes of year over year comparisons. As Chris Hvid, representative from the Ministry of Education explained, $50 \%$ for one exam may not necessarily equate to $50 \%$ on another exam (personal communication, July 8, 2006). However, beginning in 2001, the Ministry of Education adopted Item-Response Theory (IRT) so that the ministry staff along with researchers could gather information over time and make more valid comparisons between tests (Dehui, W, personal communication, July 18, 2006). The percentage scores represented within this research project have been standardized by the ministry to a performance score out of an achievement continuum from 0 to 100 .

For this thesis the use of the term performance is defined as the score that a student obtained on an exam transformed into a standardized percentage score by the Ministry of Education. Thus the use of the term performance and achievement are fairly interchangeable within this thesis.

### 1.8 Organization of Thesis

The thesis is organized into five chapters. The first chapter presented the introduction to this study, the researcher's interest in this subject, the problem statement of the thesis, the definition of terms, the limitations of this thesis, and the areas this thesis will address.

The second chapter deals with the literature review and the theoretical framework. This chapter provides an overall picture of what researchers have found concerning the topic of
gender performance in many aspects of education. Both quantitative and qualitative information will be discussed along with anecdotal summaries from different countries throughout the world as they too examine this topic of gender performance in education.

The third chapter deals with the methodology of the research project. I provide a brief overview of the quantitative methodology used, null hypotheses and the $t$-tests that were used to test the hypotheses for the analysis of the six different subjects examined. It will also explain the data source (Edudata), the removal of data files and research variables. For the data analysis process, I highlight the data story for each of the six exam series and finish the chapter with mentioning the research agreement and the ethics approval.

The fourth chapter contains the findings and the data analysis in response to the research questions raised in this thesis. The findings will be analyzed in two major sections. The first section involves a year by year analysis for the test results with a breakdown in gender performance. The second section will examine each of the six subject areas and breakdown the gender performance.

The last chapter, Chapter Five, includes discussion, conclusions, and limitations of this study. I explore implications within the findings and provide recommendations for researchers.

## Chapter 2 - Review of Literature

### 2.1 Introduction

This chapter highlights some of the discussion concerning gender performance. While not exhaustive, I have attempted to summarize the major areas of interest related to this study. Topics mentioned in this chapter include the public's perception about gender and schooling, the pivotal topic of brain research, influences that society and teachers have on students, single sex education in Great Britain and Australia, curriculum and its impact on students, gender performance in the six different subjects being examined, along with some observations concerning SAT/AP tests. The final portion of this chapter deals with a couple of case studies of schools where segregation of boys from girls within schools improved the academic performance of students all around.

### 2.2 Brain Research

Brain research as cited by Michael Gurian and Patricia Henley in their book Boys and Girls Learn Differently, suggests that girls have advantages in certain areas. In academic subjects, girls tend to study harder, get better grades, and are less disruptive in class. Boys tend to act the opposite, as they goof off more, get worse grades, and are more disruptive. During the adolescent and puberty stages for males and females, these characteristics are more pronounced, especially if classes are co-educational. Gurian \& Henley (2001) argue that girls "tend to have better verbal abilities and rely heavily on verbal communication while boys tend to rely heavily on nonverbal communication" (p.27). Although the general educational environment is that children must sit properly in their seats and be attentive to their teacher, for some boys
movement, such as assisting teachers with handing out papers, may help them to mange and relive impulsive behavior (Gurian, 2001, p. 47). Generally, girls also mature earlier than boys as they may often demonstrate complex verbal skills at the pre-school level, while boys of the same age are still lagging behind by a few years. This difference in intellectual capacity may at times be demonstrated through the adolescent stage.

Researchers closely examining the brains of males and females have found some distinct differences due to hormonal and neurological reasons. In the matter of eating disorders, Gurian (2001) notes that for a female brain:

The etiology of eating disorders is related to hormonal and brain chemistry, though stimulation toward the disorder is often external, in cultural imagery and social pressure. Males do not experience a menstrual cycle, dominance by estrogen or progesterone, or so delicate a balance of serotonin cycles, and consequently they do not experience as many eating disorders.

The female brain, emphasizing left-hemisphere development, does not suffer as many attention problems. Females also secrete more serotonin than males and are less inclined to a hyperactive disorder. (p. 60)

With regards to the male brain, Gurian (2001) continues by saying that:
The male brain tends to lateralize its activity - compartmentalizing it in smaller areas of the brain - and therefore suffers more learning disorders. Thus...the female brain is a better learning brain because it uses more cortical areas for more learning functions. If one area of the female brain experiences a slight defect, another makes up for it. Because the male brain lateralizes, a defect in one area of the brain may well affect the only area of the brain where a particular learning function is taking place. (p. 60)

As an indication, more boys require the services of special education, alternative education, and learning-different classrooms. Often times, a child acts out because they are bored and this may result in them being labeled a behavior problem. Gurian (2001), comments that boys get bored easier than girls, resulting in a need for a variety of stimulants to keep their attention. Girls are better at self-managing boredom during instruction (Gurian, 2001, p.46), and tend to have longer attention spans than males, meaning that they cope with fewer interactive
classroom activities for comprehension. This may result in many boys being misdiagnosed with ADHD, ADD, and other learning disorders simply because one typically assumes that if a boy is loud, disruptive, or impulsive, he is not meeting the intended learning outcomes. Thus we may be evaluating a boy based on criteria that may be typically used when evaluating girls.

Leonard Sax in his book entitled, Why Gender Matters discusses how important it is that parents and teachers realize that there are innate areas of differences between boys and girls both from anatomical and psychological perspectives. He describes how female brains and male brains differ, and notes that recent research done by scientists has discovered that females have more X chromosomes than males (Sax, 2005). Furthermore, the differences in brain anatomy are genetically programmed at birth, and this is not a result of hormonal differences (Sax, 2005).

Sax (2005) continues to point out the differences between male brains and female brains with a situational description of an interaction between a kindergarten teacher and her two students.

This female teacher asks that her students draw pictures of anything they like. The teacher finds that one of the female students at the age of five has used multi-colors to draw her family. At the same time, one of her male students has used one color to draw a rocket smashing into the earth. This little case study shows how boys and girls at a young age have a different sense idea about drawing. Boys, tend to draw actions while girls draw people. Yet this interaction between the students and their teacher is not complete without looking at the teacher's response to these drawings.

The teacher's response is interesting as it points to teacher affirmation and the importance for teachers to realize that how quickly their students react to a perceived response of assignments. The boy, looking at the picture as being incomplete and lacking may begin to perceive that art is a "girl's" subject and that he is not good at this subject or "at anything else that's going on in a twenty-first-century "gender-neutral" kindergarten. The teacher wants him to sit still and be quiet and listen, while he wants to run around and jump and yell. After a few weeks he's not going to see the point of going to school at all. That's when the tantrums begin." (pp. 24-25)

### 2.3 Single-Sex Teaching in United Kingdom

While the vast majority of public schools throughout North America are mixed sex schools, single sex schools are more commonly found in private school settings. Recently, there has been a trend to institute single-sex schools in the public school system (Austin, 2004). With the rise in popularity throughout North America for single-sex schools, or a more likely scenario of having single-sex classes within a mixed school setting, education systems in Australia, the United Kingdom and New Zealand have advocated segregating boys and girls with the hopes of improving achievement.

In the United Kingdom during the 1980s, the primary areas of interest were examining ways to improve achievement for girls in science and mathematics. By the 1990s, the focus was on the 'laddish culture' that seemed to disrupt classes throughout the public school system by incorporating single-sex classes (Woodward, 2000). Younger, Warrington, and Mclellan (2002) studied how co-educational schools dealt with this new initiative of having single sex classes and evaluated the concept of single-sex classes. What they found was that some schools benefited greatly while others did not. Those schools that felt single-sex classes were not effective "tended to be schools where single-sex teaching had either been undertaken for only a short period, though, or where some staff lacked commitment to the initiative, or where apparently little thought had gone into teaching strategies or management issues" (Warrington and Younger, 2001, p. 345). Warrington and Younger (2001) also noted that a positive aspect to single-sex classes was an increase in participation in lessons and a greater level of confidence.

However, Warrington and Younger (2003) noted that one of the side-effects of single-sex classes for boys was that boys' laddish behavior increased. For some schools:
sometimes the boys settled down more as they got used to being with their own sex, but this did not always happen, and in fact, in several schools, the reasons for abandonment
of single-sex teaching was a worsening, or lack of improvement, in boys' behavior. (p. 347)

Younger et al. (2002) continue by commenting that a more well thought out approach, such as placing teachers with more effective classroom management skills into such classrooms, would assist in smoothing out the operation of single-sex classes for boys. Their conclusion was that the success or failure in raising boys' achievement will be determined by "whether these strategies are received and accepted (or not) by a small number of influential boys, the opinion leaders and role models within each school" (Younger et al., 2002, p. 401).

### 2.4 Societal Influences

A few reasons have been suggested as to why boys are struggling in school. One main reason put forward by those studying this area of boys' poor academic scores in high school, is the feminization of schooling (Skelton, 2001). Although it may not be intentional, female teachers may have unknowingly structured their teaching to suit their gender (Maynard, 2002, p.
19). As the vast majority of elementary school teachers are women, some concerns have been raised about how the teaching of literacy focuses on (feminine) child-centered approaches that are much more suitable for girls than boys (Nichols, 2002, p. 127).

Another reason put forward by some scholars as to why boys are doing worse than before is the breakdown of the 'traditional' family. With an increase in the number of single parents (Noble, 2000; Skelton, 2001), the burden falls on mothers without the support of a dominant male role model to raise their boys. Ted Byfield (1995) suggests that it is possible that "one boy in four is being raised by a single mom." This is a major issue because boys raised by their mother may not have any contact with a positive male 'role-model' in their schooling until they
are well into their upper intermediate or high school years. Many of the male 'role-models' that boys interact with today are not necessarily positive, which can result in boys following the negative patterns of their fathers (Head, 1999). Stronger supportive families tend to be better equipped to withstand the surge in the development stage of adolescent children (O'Conner \& Miranda, 2002; Wasonga, Christman, \& Kilmer, 2003).

Another important reason why boys are presently struggling academically in comparison to girls is the change in the field of employment (Noble, 2000). Prior to the 1960's there was little difficulty finding a job in various trades, labor work or apprenticeships. During that time, it was possible for boys to drop out from high school and still find a decent paying job, which could support a family. Today, the 'industrial' forms of occupation are in decline while what had been termed as 'women's jobs' have increased substantially. Office jobs in areas of commerce, finance, tourism and clerical positions require good communication skills, which require a more educated work force. Since males tend to cope better with manual work or hard labor, this change in employment has caused the generation of boys to consider occupations that require less physical strength but more analytical and communicational aptitude (Noble, 2000).

### 2.5 Gender and Schooling

In Answering Back, a book examining the issue of girls, boys and feminism in schools, the authors Jane Kenway and Sue Willis along with Jill Blackmore and Leonie Rennie interviewed a cross-section of high school students in numerous Australian high schools on this topic of gender and schooling. Below is a conversation that took place between some male students at a school in Neerbin, Australia, about their general feelings towards school and how girls are successful in their school (Kenway et al., 1998):

Julian: Girls, I reckon have more fun. Generally boys don't enjoy being at school - they just can't wait to get out. Like girls come to school and they socialize a bit more.
Wayne: They do, generally in this school. Do you reckon they get better grades?
Matt: Yeah. They kind of dominate everything.
Julian: Yeah, I would say they do.
Matt: In the classroom and in other things like grades, behavior and all that. (p. 52)
What is interesting is that these types of comments by boys in a secondary school in Australia can easily be found in many school hallways or cafeterias in other Western nations.

Many boys think school is boring, laborious, and a waste of time. On the other hand, some of the grade eleven girls that were interviewed at Wattlehill, Australia, commented about their attachment to school, stating that:

Tracey: In most cases, girls have got more motivation to be at school. Boys can't be bothered.
Jody: The boys don't have to work. Most boys don't have to work at their grades. It's a week before exams when they start studying. Us girls start studying like four weeks before thinking, "Oh my god, oh my god, we gonna fail," and we panic. (p. 53)

Teachers too have noticed a difference in outlook by boys towards schooling. Lynn, who taught at Riverside Secondary in Australia, commented that:

Girls don't tend to act out their problems in the same loud, violent way as the boys. So the girls are left at the back of the classroom while the boys are directed into special programs. For lots of teachers, it's a battle for survival and the loss of a quiet, wellmannered, almost obsequious in her manner toward you, girl makes space for another loud, bumptious, non-achieving boy who is likely to treat the teacher like last night's garbage. (p. 52)

Arguments have also been made that adolescents do not always place a top priority on academic achievement. Van Houtte (2004) noted that for both boys and girls:
being popular is exactly what counts in adolescence, but with respect to boys it can be stated that achievement does not suit their image. Girls, on the other hand, seem permitted to combine two images: as long as they come across as 'cool' outside school... (p. 160)

Spencer, Porche, and Tolman, (2003) commented too in their study of student teacher classroom interaction that:
girls consistently tended to be much less vocal during classroom lessons, to work quietly and independently in same-sex small groups, and to take charge of co-ed activities. In contrast, the boys consistently tended to be more vocal in class discussions and to demand more teacher attention - and the attention of the girls - while working independently, as well as when working in small groups. (p. 1797)

Several of the boys in our study made the assumption that despite poor performance in school, things would be "all right" for them in the future. We were struck by this seeming blind faith in the future and had the distinct feeling that these boys may later confront unexpected closed doors. (p. 1802)

### 2.6 Gender and Curriculum

The issue of what kinds of literacy and the types of curriculum that captivate boys is an
area that must also be noted. Thomas Newkirk (2002) argues in his book, Misreading
Masculinity: Boys, Literacy, and Popular Culture, that:
Too many of our schools are failing too many of our boys, particularly in the area of reading and writing. By defining, teaching, and evaluating literacy in narrow ways--even under the banner of "choice" and a student-centered curriculum-we have failed to support, or even allow, in our literacy programs the tastes, values, and learning styles of many boys. More specifically, we have discouraged, devalued, or even prohibited the genres of reading and writing that are most popular with boys, stories that include violence, parody, and bodily humor. (p. xvi)

Newkirk continues noting that boys may often regard schoolwork as an area of distain or and that to show interest in the area of language arts would undermine their identity as a "real boy" (p. 39). Contrast this perception by males about schooling with the notion that work, especially physical work, is authentic and valuable. Newkirk paints the picture that:

The traits developed on the athletic field and in male friendships are the ones that make the difference. Males can, in effect, make an end run around the educational system and its ladder of credentials. Bart Simpson, despite his poor disruptive school record, will manage to do as well as his high-flying sister Lisa. (p. 44)

Newkirk argues instead that the boys' literacy is vastly different from those of girls. He cites the examples of what boys often enjoy reading, topics such as sports and the statistical information that correlates with it. For example, looking at tables of various sports teams in their statistical standings, these numbers to the causal observer might seem purely mathematical but it can be for the skilled reader "full of stories, even morality tales, though it takes a bit of prior knowledge to construct them" (p. 70). These "facts" actually convey a different type of literacy and literacy in schools should not be based upon the ability to read a novel and respond to the topic.

Alloway and Gilbert (1997) also commented that literacy performance tends to be "evaluated in schools, despite the fact that this represents only one literacy site" (p.54).

Alloway and Gilbert continue:
Many boys have literacy skills that are not recognized in the classroom, but that are potentially very powerful and useful communication technologies of the future. Surfing the net, reading video screens and engaging with computers all demand levels of literate competence that do not figure highly in school measurements of literacy (p. 54).

Alloway and Gilbert (1997) continue to argue that for literacy, being good at reading and writing has not "necessarily led to careers in language-based professions-or even to well-paid jobs. It is still predominately girls who become secretaries and typists for male managers and bosses; it is still predominately women who do the word-processing while men write software programs" (p.57). Like Newkirk, Alloway and Gilbert argue that schools should broaden their text selection so as to incorporate masculinity in order to alleviate the perception by many adolescent boys that English is feminized as it deals with feelings and thoughts, aspects that boys tend to avoid addressing.

In a three year survey of schools to examine the aspect of curriculum and literacy, Bearne and Warrington (2003) noted that boys were often "embarrassed to read aloud" (p. 18). They continued by commenting that many schools instituted strategies to assist raising boys' confidence in reading by:

- enhanced and extended provision of books and other texts which include boys' preference
- homework which specifically encourages pupils to read all kinds of texts
- reading groups led by members of the community who are not teachers, where there is emphatically no overt 'teaching' but a general sharing of reading pleasures, based on all kinds of texts
- buddy systems, where older boys who have 'barriers to learning', mentor younger readers (where possible, pairings have been matched according to home language) (p.18)


### 2.7 Gender Related performance in AP Tests \& SAT II Tests

It is interesting to highlight that gender performance in the United States is a topic that generates much discussion. In a study which looked at student achievement in 29 Advance Placement Tests along with 21 College Board Scholastic Assessment (SAT) II Achievement (subject) tests, Stumpf and Stanley (1998) noted that:

Most differences remained fairly constant across time, but in some cases, females have gained considerably in performance relative to males. It appears to be premature to conclude that gender-related differences in this area are declining in general, but some do not appear to be unchangeable. (p. 196)

The AP tests along with SAT II tests are exams that students in their last two years of high school write in order to enter into a college or university along with course selection. Some of the findings from Stumpf and Stanley (1988) were that males had advantages in many of the quantitative sciences such as Physics, Computer Science A, Chemistry, and Calculus along with

Economics, Government, U.S. History, and Biology. Females had advantages in Spanish Literature and French Literature. Stumpf and Stanley (1998) continue:

An additional concern is that even for some tests on which there has been a decline in gender differences in performance, especially Computer Science AB, participation of females is still extremely low. (p. 196)

Researchers know little for sure about the declines in differences, such as the declines in Computer Science AB exam and on the SAT II tests in American History. This however, does not mean that it is sufficient to simply wait until the differences decline. (p. 196)

Another observation was that girls in high school tend to score higher than boys in language usage, but not necessarily in verbal reasoning ability (Hyde \& Linn, 1988). Stumpf and Stanley (1996) remarked that girls might therefore have some advantage on many of the AP examinations which have $50 \%$ open-ended tasks, whereas the Achievement tests are entirely multiple-choice and the "advantage female students might have on open-ended tasks is confined chiefly to those tests for which language usage is important."

### 2.8 Test Results (British Columbia)

Statistically, boys are doing worse than girls in the academic subjects in high school. Reports generated by the BC Ministry of Education, which closely monitors the graduation rates and provincial exam results, show that in both of these important areas boys are not performing as well as girls. With entrance to post-secondary institutions becoming more competitive and minimum entrance requirements escalating, girls are receiving more scholarships and graduating with a higher percentage than boys.

In the school year of 2001/2002, girls won $55 \%$ of the provincial scholarships compared with $45 \%$ won by boys (BC Ministry of Education, 2002). For the school year of 2004/2005, the percentage breakdown remains the same at $55 \%$ for girls compared with $45 \%$ for boys (BC

Ministry of Education, 2005). As for students who graduated with honors in 2002, of the girls who graduated, $55 \%$ received honors standing. In comparison, $37 \%$ of the boys who graduated received honors standing (BC Ministry of Education, 2002). In 2005, the number of female students who graduated with honors increased four percentage points to $59 \%$ while the number of boys also increased four percentage points to $41 \%$, yet the difference in students enrolled for each gender was still the same.

Looking at high school dropouts across Canada in 2000, 14.7\% of the boys at the age of 20 had yet to complete their high school education compared to $9.2 \%$ of girls at the same age (Statistics Canada, 2002). For the boys who did drop out, it was discovered that many repeated a grade in elementary school.

The Foundation Skills Assessment (FSA) tests done yearly by the British Columbia Ministry of Education provide another picture that reaffirms the gap in academic performance between boys and girls. All students in grades four, seven, and ten in British Columbia write the FSAs, regardless of whether they are attending a public or private school. These tests are broken down into three parts: reading comprehension, writing, and numeracy. What is interesting to note for the 2002/2003 FSA was that boys consistently did poorly compared to girls for the reading comprehension and writing sections. For the grade seven results in reading comprehension, $80 \%$ of the female students met or exceeded expectations compared to $73 \%$ of the male students (BC Ministry of Education, 2003). Likewise in writing, $87 \%$ of the female students met or exceeded expectations while only $72 \%$ male students met or exceeded expectations (BC Ministry of Education, 2003).

At the grade ten level the marks were very similar. In reading comprehension, $80 \%$ of the female students met or exceeded expectations compared to $68 \%$ for male students (BC

Ministry of Education, 2003). Similarly, $89 \%$ of the female students met or exceeded expectations in writing compared to $77 \%$ for male students (BC Ministry of Education, 2003). The only portion of the FSA test where male students scored slightly higher than female students was in numeracy. For grade seven students, $84 \%$ of the male students met or exceeded expectations compared to $83 \%$ for female students (BC Ministry of Education, 2003). As well, $79 \%$ of the male students met or exceeded expectations compared to $77 \%$ for female students (BC Ministry of Education, 2003). One outspoken critic of the use of FSA testing is the British Columbia Teachers' Federation (BCTF). The BCTF has criticized these tests for being unscientific and doing more harm than good to the public school system. In spite of BCTF's criticism, the FSA testing does provide researchers with a quick snapshot as to how students in those respective grades are progressing (BCTF, 2002).

While some, namely many feminist thinkers, would argue that there is no major problem with such trends as males dominate the yearly Forbes list of Millionaires, comprise the topechelon power brokers in the corporate structure, and are typically the top income earners in most professions (Forbes.com, 2005). For the year 2005, for example, there were 49 women on the Forbes 400 list corresponding to a $12 \%$ total. Yet with such overwhelming statistics pointing to a lack of balance between male and female students in all the different areas of high school academic performance, one could argue that educators need to ask themselves whether they are effectively teaching for the needs of both male and female students.

### 2.9 Observations in Gender differences for schools in Australia

Australians have been prolific in researching the topic of gender differences in education.
Matters et al. commented (as cited in Matters, Allen, Gray, and Pitman, 1999, p. 291) that "girls
may be doing better at schools to some extent because schools have become feminized at a much faster rate than the surrounding society." Some of the changes in Australia that have impacted how curriculum is designed and their content are:

- cutting out topics in which boys continued to outperform the girls (e.g. solid geometry);
- decreasing the emphasis on technical correctness in English;
- redefining mathematics so that it is less abstract;
- concentrating on the local rather that the global in geography;
- contextualizing test items, especially those in the quantitative domain.
(Matters et al., 1999, p. 291)
Matters et al. provided (as cited in Matters et al. 1999, p.293) some possible explanations for why boys' have such poor performance (see also Newkirk):
- lack of variation of teaching strategies to take into account differing learning styles;
- curriculum changes that cater better for the orientation of girls, but at the expense of alienating girls;
- prejudiced statements devaluing performance in the subjects in which boys excel;
- increasing numbers of female teachers and markers who unknowingly value the perspectives of boys less than those of girls;
- extra encouragement and resources for girls to lift their game in mathematics and science;
- increased concentration on group, rather than individual, activities;
(Matters et al. 1999, p.293)
It is important to keep in mind that there are many other possible factors at work that also have an impact on boys' poor performance in education. These include the portrayal of males in the media in a specific genre, especially with the hip-hop and gangster culture promoting violence, the need for curriculum to be sensitive to learning style, and the social and school factors that are determinants of boys' aspirations (Matters et al., 1999).


### 2.10 Case Study: James Lyng High School (Montreal)

James Lyng High School is a public school situated in a blue-collar working area of
Montreal. An inner city school with many families who did not complete high school, five years
ago, it turned to a same-sex class format in order to tackle the lack of class discipline and its low English-language academic performance. Since that time, the experiment has provided benefits to students and teachers alike. Absenteeism has dropped to $7 \%$ from $20 \%$ prior to the conversion and about $80 \%$ of the students have passed their final exams, a jump of $15 \%$ from when the school switched to a single-sex format (CBC.News Online, 2002).

Many of the students at the school have embraced this philosophy. Boys that used to visit the principal's office twice a week in elementary school are now calmer, eager to learn, and frequently obtain honor roll status. The girls who used to show off to others are also doing well as they too are in a class full of girls. This has allowed the girls to ask questions without worrying about rude comments coming from over-rambunctious boys. Teachers too have noticed the difference as they geared their teaching styles differently. When teaching girls, they focus on the interpersonal relationships, while for boys, the focus is on the classic who wins and who loses. More importantly, as Principal Wayne Commeford stated, "it has allowed the students to express themselves without the fear of being laughed at or embarrassed" (Peritz, 2003).

### 2.11 Case Study: Jefferson Leadership Academies (Long Beach, California)

Jefferson Leadership Academies is a middle school in Long Beach California, with a total population of 1200 students from grades six through eight. Every class that is offered is segregated with the exception of band. Over $80 \%$ of the students who attend Jefferson come from families with low income and about a third of the students are classified as still learning English. The school switched to a single-sex schooling philosophy in 1999 as it noticed a
decline in academic performances of its students (Ritsch, 2002). Principal Jill Rojas designed the voluntary program with the idea of improving academic marks for students of both genders.

After its first year as a school with single-sex classes, The Long Beach United School District Office of Research, Planning and Evaluation compared the GPAs of its students (Long Beach, 2000). They compared the GPAs of all the students who attended Jefferson the year prior to when it was established as a single-sex school (1998-1999), to the same group of students who attended Jefferson in its first year as a single-sex school (1999-2000). They found that:

- Student grade point averages for students who had previously attended Jefferson in either grades 6 or 7 increased for all students, male and female, in both grades 7 and 8 under the single gender academy configuration.
- The increase was statistically significant for both genders at grade 7 and for males at grade 8. (Sharpe, 2000)

The actual statistical increase in GPA for grade seven students was a 0.54 point jump for boys and a 0.38 jump for girls for an average increase of 0.45 points. For grade 8 students, the girls increased by 0.12 points while the boys increased by 0.24 points (Long Beach, 2000). Clearly, there have been many benefits to students of both genders who are attending single-sex classes at Jefferson.

Students who have attended Jefferson have responded in a variety of ways. Many boys have acknowledged that the presence of girls would distract them, and that by having single-sex classes, they have been able to learn about military battles in humanities. Likewise, for girls, the responses were favorable as well as female students could ask their teachers a 'girlie' type of question and not have to worry about boys saying funny jokes or being cruel to a response. Although there are critics who argue that single-sex schools are not "the real world", and that they are promoting an idea that boys and girls can't learn together, not all students are suitable for this type of program (Ritsch, 2002).

### 2.12 Schools in British Columbia Today

Elementary schools tend to be dominated by female teachers (Skelton, 2001; UBC Calendar, 2005). During the early stages of childhood, children need and require a nurturing environment that women are more likely to provide. That is one of the main reasons why males tend to avoid teaching in elementary schools because they may not have the necessary empathy skills. Those males who do teach at an elementary school tend to be in the upper intermediate areas where discipline and the need for structure provide male teachers with a foundation to work from.

The Fraser Institute, a right-wing think tank, does a yearly survey on secondary schools in the province of British Columbia. In the most recent Fraser Institute Reports on high school rankings, the top four schools for the past few years are single sex private schools, either all-girls schools or all-boys schools. St. George's, an all-boys school, or York House and Crofton House, both of which are all-girls schools, have entrance requirements and are highly selective of their students.

Further analysis of the student population for private schools reveals that students enrolled in these schools often come from a higher socio-economic background and tend to have smaller class sizes compared to public schools. There are many other important factors that aid the success of students. These include parental support, the ethos of the school, and a for certain areas, the racial mix and balance. It must be noted that not all private schools are single sex schools as there many private schools that are coeducational. Nonetheless, the single sex private schools in British Columbia provide a small microcosm of some possible ways the public school system might be able to address certain areas when teaching to a specific sex, and more
specifically, boys. For the private schools mentioned, a strict dress code is enforced and students have high expectations placed on them. In addition, many all-boys schools are matched up with all-girls schools so that there are opportunities to interact in a social setting.

### 2.13 Teacher Influence on Student Performance

Joseph Klein (2004), an Israeli educational researcher comments that teachers play an important role in influencing gender achievement. He noted that often a students' social behavior impacted how they are graded and that male teachers tended to be more biased in their assessment than female teachers. Also, general observations were that girls were perceived to be better-behaved, which gave them an advantage when teachers evaluate their achievement (Extrom, 1994). Boys on the other hand were more aggressive, assertive, and more active than girls which resulted in teachers, especially females, to more likely punish such male behaviors that were perceived to be unreasonable (Wooldridge \& Richman, 1985).

### 2.14 Gender performance differences in Physics

Physics, being a heavily male-dominated domain (UBC Calendar, 2005, Statistics Canada, 2003), has often been an area that educators highlight. Nashon (2005) in his survey of pre-service science teachers for physics in British Columbia found that there was an "under representation of women in physics; a factor that sends mixed messages to would be female physics majors" (p. 29).

In England, single sex classes for Physics were tested in a mixed school setting to monitor changes in the performance for girls. The study found that girls' performance increased as they "felt more relaxed, free and open in class" (Gillibrand, Robinson, Brawn, \& Osborn,
1999). Other observations by Gillibrand et al. (1999), concerning classroom climate included the fact that female students were focused on discussing the topic of Physics and that "no horseplay or aggressive shouting" were observed that were common in multi sex classes. At the conclusion of the term, the female students in the single sex classes were polled and indicated their desire to continue onto the GCE A-level, a testament to the fact that performance can be improved within a single-sex classroom environment.

Researchers in Great Britain examined the performance of students in the National Curriculum for Science from schools throughout England and Wales. With a sampling strategy that encompassed schools from all the various regions, the selection was whittled down to 46 schools and from those schools, 50 students were chosen to complete the 'Key Stage 3 tests'. In a t-test comparison of how students scored on questions throughout the test, it was found that for the more difficult questions related to Earth Science, Physics, and Chemistry, the largest gender gaps in performance in favor of boys were in Physics (Preece, Skinner \& Riall, 1999).

Similarly, researchers in the United States compared the performance of males and females at the undergraduate level with university physics versus college physics. What they found was that in terminal algebra-based physics females perform better than males, while in calculus based physics courses, which leads to advanced study in many fields, women do "significantly worse" than their male counterparts with the same background (Tai \& Sadler, 2001, p. 1017).

### 2.15 Observations on gender performance differences in Mathematics

Julia Sherman (1982) in her observations for high school girls and their performance in Mathematics found that a female student's attitude toward this subject had a huge influence as to
whether she continued. Sherman found that female students who had a stable "fatherly" figure and a positive belief in her mathematical abilities tended to do better and continued studying in math. Her concluding statement in the 1982 study was that there needed to be a "more encouraging and supportive learning atmosphere" (p. 140).

Hilary Schofield (1982) in an assessment of students' attitudes and their achievement in mathematics at the grade 4 through 6 level found that boys scored higher than girls (Schofield, 1982, p. 283). Schofield does note that attitudes do not necessarily result in success in subjects, but that it does allow students to have a positive influence on what they believe they can accomplish and that factors influencing future academic performance in mathematics can start at the elementary school level (Schofield, 1982, p. 284). Similarly, Jesse Wilkins in his study of student performance for all participants in the Third International Mathematics and Science Study (TIMSS) found that there is a positive relationship between self-concept and achievement (Wilkins, 2004). He also found that "students' belief in their abilities to perform in mathematics and science tend to decline as they move through school, and boys tend to be more confident in their ability to perform than girls" (p. 344).

Gallagher (1996) argues that the gap in mathematics is a gender gap among gifted students in complex mathematics problem solving. He notes that the way to assist girls to close this gap is to help girls develop "autonomous learning behaviors." This helps girls become more confident in their ability to navigate the external and internal variables that Eccles and Jacobs (1986) argue are what determine how girls choose their courses. Sherman and Fennema (1977) support this argument as they comment that fewer girls than boys continued to enroll in additional mathematics courses due to lack of self-confidence in mathematics and the lack of support from their parents. Penner (2003) notes too that in his survey of item difficulty
interactions for the 2003 Trends in International Mathematics and Science Study (TIMSS), he found that for the ten countries that he compared, the gender differences consistently favored boys.

### 2.16 Gender performance differences in Biology

While physics has often been termed the "hard" science, biology is seen to be the "girl" friendly science. Part of that can be attributed to the fact that physics ties in with mechanical toys that boys at a young age play with while biology ties to more of the human aspect that girls are more in tune with at a young age. This correlates to the science subject that boys and girls take in high school. Taber (1991) comments that girls were more interested in human biology subjects such as pregnancy and birth, germs and illnesses, hair, skin and teeth, and thus would choose to take biology more so than physics.

Weinburgh and Englehar (1994) note that females have a more positive attitude towards biology, as at the young age of 11 girls show more interest in health and the human body. Biology is also a subject that requires less mathematical skill in comparison to physics and chemistry, and causes less anxiety for girls (Campbell \& Evans, 1997; Eccles \& Jacobs, 1986). At the 16-year old level, the differences in science performance continue with boys doing well in physics contexts such as mechanics and earth and science, and differences in favor of females for human biology (Bell, 2001).

### 2.17 Observations on gender performance differences in Science

In a series of questionnaires and surveys to a selection of schools in England, Warrington and Younger (2000) polled year 11 students (equivalent to grade 11 in British Columbia) on their
career choice and expectations of GCSE results, along with staff at those respective schools.
Some of the comments made by students to Warrington and Younger summarize what one may see in schools throughout western nations. On the notion that science is a boy's subject:

I think the boys generally think they're better at science than anything else. Definitely Physics is the male subject. It is here. (S4GM)

I think science is--this is going to sound really sexist-but that's a boy's subject I think, traditionally. Like boys like making things and building things, and girls like reading and sewing things, but science is like nearer to mechanics and stuff and things like thatmaking things and doing experiments. Girls sometimes have difficulty-they tend to have trouble more often than the boys do. Boys are technically minded-they're more into that sort of thing. (C13BH) (pp. 496-497)

Comments from science teachers about the perception of male dominance in science also
highlight the thoughts that teachers would have concerning the students in their classes:
The boys are more confident in physics, which is a traditionally male subject-even if they're not very good, whereas the girls are tentative about it, a bit more wary, even though they're very good. I don't think there's any difference in ability, but there is a difference in approach. Boys are much more gung-ho. (female teacher, S2)

I think we have some very high ability girls who won't actually go for physics. Their presence is not so obvious, they lack confidence, need reassurance; want help with the little things: have I put this wire in the right place? What colour wire should I use?--The confidence thing again. (male teacher, C2) (p. 497)

In a survey administered to 1419 students at the grades 7 and 10 levels in urban and rural Calgary asking adolescents regarding academic achievement, interests, values, and life-role expectations, the male student responses to interest and perceived ability in science are significantly higher than those of female students. Likewise, when asked to respond to the question "No matter how hard I try, I feel I just cannot understand ___", females responded significantly more with math and science while males responded significantly more with English/LA (Lupart, Cannon, \& Telfer, 2004, p. 33).

Even with a racial difference, there remains a gender achievement gap in science. Bacharach, Baumeister, and Furr (2003) found in their comparison study of black and white children for grade 8,10 and 12 students that boys did significantly better than girls in a test administered to students who completed the National Educational Longitudinal Study (NELS).

### 2.18 Historical Perspectives on gender performance differences in English \&

## History

As far back as the 1960's and 1970's gender differences had been identified in the subjects of English and History. McTeer, Blanton and Lee (1975) conducted a study to examine the interests of secondary school males and females in a school in Atlanta. In their findings, they found that:

- Boys expressed a higher interest in social studies when compared to interest in English. High school girls showed higher interest in English.
- High school boys express a higher interest in science when compared to interest in social studies. Girls have more interest in social studies than in science.
- Mothers of students having high interest in math have a higher level of education as reflected by number of years in school than do mothers of students having low interest in social studies and high interest in math. (McTeer et al., 1975, pp. 239-240)


### 2.19 Conclusion

The information presented in this chapter dealt with research throughout the world on how boys and girls are performing in different subjects. Other areas highlighted in this chapter included the topic of brain research, societal influences, different types of literacy, and two case studies on how single sex classes helped to improve boys' performances in school. Comments were also made about test results for students writing the FSA exams in British Columbia, a prelude to the provincial exams that students write in grade 12.

In the next chapter, I will discuss the methodology of this thesis, and the use of t-tests to test for significant difference. This includes an overview of $t$-tests as a quantitative method, null hypothesis, data selection procedures, and data analysis.

## Chapter 3 - Methodology

### 3.1 Introduction

In this chapter, I discuss the primary, quantitative method used to analyze differences between boys' and girls' performance in six chosen subjects of Principles of Math 12, History 12, English 12, Communications 12, Biology 12, and Physics 12. In various large group surveys (NCES, TIMSS, SAIP, PISA), hypothesis testing is frequently used as a method of analyzing whether there is a significance difference in gender performance on exams. The use of t-tests is thus a very common quantitative method and one that I will use to address my thesis questions.

In this chapter, I will also explain why certain subjects were grouped together for the purposes of testing and why Biology 12 and Physics 12 are in two different null hypotheses groups. Upon completing the testing, a qualitative approach is taken to interpret the results of the tests. Other areas mentioned in this chapter include breaking down the different data sets based upon subjects and describing the different participation rates and number of participants per exam.

### 3.2 Statistical Analysis

Statistical analysis of gender performance is a common practice throughout the world (PIRLS, TIMSS, etc.) and even more so for comparisons about which schools perform better. In British Columbia, the Fraser Institute has become a household name as it yearly ranks not only secondary schools, but also elementary schools based on their students' performance. Rightly or wrongly, this type of exercise of comparing student performance often creates assumptions and divides educators on the merits of public education.

Jacob Cohen notes "when behavioral scientists occasionally don the mantle of the applied statistician, the probability is high that it will be for the purpose of testing one or more null hypothesis" (Cohen, 1977, p. 1). As this research cannot be completed without the use of statistics, I am donning "the hat of that statistician" that Cohen (1977) notes and using null hypotheses to assist in addressing the questions that led me to this research project. The null hypothesis as defined by Gall, Gall, \& Borg (2003), is that "no difference between groups on a measured variable will be found" (p. 136). As there are a total of six different subjects being tested, I will categorize the subjects based on the assumption that boys do better in classes that are more mathematical whereas girls do better in literacy courses.

### 3.3 Null Hypotheses testing for Mathematics 12 and Physics 12

The dependent variable is exam scores and the independent variable is gender (male and female). The null hypothesis ( H 0 ) is that exam scores for male_m equal the exam scores for female_f. The alternative hypothesis $\left(\mathrm{H}_{1}\right)$ is that exam scores for male_m does not equal scores for female_f.

Gender: $\mathrm{H} 0: \ldots \mathrm{m}=\ldots \mathrm{f}$
H1:_m $\neq$ f
My assumptions for placing the two subjects of Mathematics 12 and Physics 12 together into one series of hypotheses testing is based on previous research presented through the many years of testing done throughout the world. Researchers over the last 35-40 years have commented that males are doing better than females in Mathematics and Science (Sherman, 1977, 1982; Johnson, 1987; Penner, 2003; Wilkins, 2004; Schofield, 1982; Campbell \& Evans, 1997; Eccles \& Jacobs, 1986). In the 2003 Trends and International Mathematics and Science

Study (TIMSS), boys performed higher than girls in both Mathematics and Science. In Science, for Physics, the general consensus by previous studies and researchers is the same in that boys are performing better than girls (Tai and Sadler, 2001; Preece et al., 1999). However, comments were also made that the differences were getting smaller between males and females (Lupart et al., 2004).

### 3.4 Null Hypotheses testing for Biology 12, Communications 12, and English 12

The dependent variable is exam scores and the independent variable is gender (male and female). The null hypothesis $\left(\mathrm{H}_{0}\right)$ is that exam scores for male_ı equals that for female_f, and the alternative hypothesis $\left(\mathrm{H}_{1}\right)$ is that exam scores for male_m is lower than female_f.

Gender: H0: _m = _f
H : __m $<$ _f
My assumptions for placing the two subjects of Communications 12 and English 12 together into one series of null hypotheses testing is based on research and tests done that have shown that girls are doing better than boys. In the Trends in Educational Equity of Girls and Women, a study drawn on data from the National Center for Educational Statistics, "females have consistently outperformed males in reading and writing" (NCES, 2005). In the School Achievement Indicators Program (SAIP), a pan-Canadian assessment body that assesses students across Canada, the Writing III Assessment test of spring 2002, girls were performing at a higher level than boys (SAIP, 2002). Likewise, in the Programme for International Student Assessment (PISA) 2006 assessment for reading, writing, science and mathematics, girls were performing better than boys in reading (PISA, 2006).

Biology 12 has also been placed under the same null hypotheses testing separate of Physics and Math even though it is a science course. Recent studies have shown that girls have done better than boys in this area of science (Bell, 2001; Campbell \& Evans, 1997). Girls are generally more interested in human biology (Weinburger \& Englehar, 1994; Taber, 1991) as opposed to playing with machinery. This is demonstrated by the large numbers of women in the medical field as nurses, doctors, or rehabilitation specialists (Statscan, 2000).

### 3.4 Null Hypotheses testing for History 12

The dependent variable is exam scores and the independent variable is gender (male and female). The null hypothesis $\left(\mathrm{H}_{0}\right)$ is that exam scores for male_m equals that for female_f, the alternative hypothesis $\left(\mathrm{H}_{1}\right)$ is that exam scores for male_m is higher than exam scores for female_f.

Gender: $\mathrm{H} 0: \_\mathrm{m}={ }_{-}{ }^{\mathrm{f}}$
Hı:_m > ff
I have decided to separate History 12 from the other subjects for testing as History is a unique course as it involves both literacy skills found in English and a passion for debates. Males tend to be more fascinated by events such as wars and politics; more so than females, as demonstrated by the number of politicians and military service personnel who are males. Males are also more fascinated with strategies, as seen by the large number of young male adolescents who play strategy computer games such as Starcraft, Warcraft, and dating back to the 1980s, Dungeons and Dragons.

### 3.5 T-tests

In order to determine whether there is significant difference in performance and to complete the null hypotheses testing, I have chosen to run independent sample $t$-tests because the students who wrote the provincial exams one year are not the same students who write them the following year. Upon completion of the $t$-tests for each subject, if the p -value in the t score calculated is below the statistical significance figure of 0.05 , then the null hypothesis is discarded in favor of the alternate hypothesis. To help highlight whether there is a greater chance of statistical difference, p -values are broken down into three groups, $\mathrm{p}<.001, \mathrm{p}<.01$, and $\mathrm{p}<.05$. It should be noted that $p$-value is about probabilities and confidence, protecting from a Type 1 error in this case. So the first level of cautious reporting is that the risk of rejecting the null hypothesis could be incorrect 1 out of 20 times with a .05 p -value. After looking at the p-values, I can infer that there is a $95 \%$ probability that group A will outperform group B on the measure of the dependent variable (the course subject provincial exam being tested) using the mean score as the number to report on the statistical differences in performance from that one school year on that specific exam.

As I am looking at comparing gender performance in provincial exams for the six subjects of Biology 12, Communications 12, English 12, History 12, Physics 12, and Principles of Math 12, a total of 60 independent sample $t$-tests were completed. The independent sample $t$ tests were done in two phases. The first phase is doing $t$-tests for the six subjects within the school calendar year. After completing these $t$-tests for ten school years, the second phase is to do an anecdotal analysis comparing the gender performance of students in the ten year span.

### 3.6 Inclusion/Exclusion Criteria for these $t$-tests

Each school year, there are up to six sittings for provincial exams. As a majority of the schools in British Columbia are on a linear program, meaning that they run from September of year 1 to June of year 2, the largest number of students writing exams is in June of each calendar year. For the purpose of this study, I have not differentiated whether a student wrote an exam in November, January, April, June, or August. Any student, be they in grade 9,$10 ; 11$, or 12, who wrote a provincial exam for any of the six subjects: Biology 12, English 12, Communications 12, History 12, Principles of Math 12, or Physics 12, between the school years of 1995/1996 to 2004/2005, and obtained a mark, is considered a participant in this study.

### 3.7 Data Files

All the files that are needed in order to complete this research were obtained through Edudata, the educational research company that has contractual access to BC Ministry of Education data files. From Edudata, I received one file with eleven different variables. The file had the following variables: edudataid, year, course level, gender, school type, Math 12, English 12, Physics 12, Biology 12, Communications 12, History 12 (with the best exam mark selected for each of the subjects).

### 3.7.1 Independent Research Variables

There are four independent research variables. The first independent variable is gender. All students who were identified as either male or female were selected. The second independent variable is school type. For schools, there are only two types that exist within British Columbia: Public or Independent. Public schools are defined as schools that are 100\%
funded by the government. Independent schools are any schools that have private funds along with public funds.

The third independent variable is year. The years listed for this variable start with the school year of 1995/1996 and continue to the school year of 2004/2005 for a total of 10 school years. The fourth independent variable is course level. All subjects chosen for this project are grade 12 level courses and are denoted with the number 12 . Table 3.1 provides a summary of the four independent research variables.

Table 3.1 Independent Research Variables

| Independent Variables |
| :--- |
| Gender |
| School Type (Schtype) |
| Year |
| Course Level (Crslevel) |

### 3.7.2 Dependent Research Variables

There are six dependent research variables. In order to protect anonymity, each student was given a random generated number and thus, no two numbers are given for the same individual. As was mentioned earlier, only six subjects are part of this research project. Principles of Mathematics 12 is the first dependent variable, English 12 the second dependent variable, Physics 12 the third dependent variable, Biology 12 the fourth dependent variable, Communications 12 the fifth dependent variable, and History 12 the sixth and final dependent variable. Only those students who wrote these exams and had an exam score were kept. All other exams and scores were discarded. It must be noted here that I chose to keep only the best
score for any student who wrote multiple times for the same exam. The lowest scores for any rewrites were discarded. Table 3.2 provides a summary of the dependent research variables.

## Table 3.2 Dependent Research Variables

```
Dependent Variables
    Edudata ID (Edudataid)
    Principles of Mathematics }12\mathrm{ (Ma 12)
    Biology 12(Bi 12)
    English }12\mathrm{ (En12)
    Communications }12\mathrm{ (Com 12)
    History }12\mathrm{ (Hi 12)
    Physics 12 (Ph 12)
```


### 3.8 Removal of Data with Missing Variables

Upon receiving the file, I went through a filtering process. In the file, I had some subjects who were missing a variable or two and thus had to be discarded from the analysis. The three major fields that had some missing variables were gender, school type, and scores. One explanation for why there were so many missing scores variables is that Edudata provided a file with all the students who wrote exams for each year, irregardless of whether they wrote the six exams that I am focusing on. It must also be pointed out that there were some anomalies for the missing information for the school type variable for the school years of 1995-1996, 2003-2004, and 2004-2005. While for 1995-1996, there were over 7300 removed, only one or two were removed for 2003-2004 and 2004-2005.

Upon closer analysis, depending on the school year, the number of fields that did not have the gender field filled ranged from 432 to 1093. For fields that were missing scores, from 566 to 4504 were removed from the data file. Table 3.3 below shows the number of fields
removed from the original data file. All remaining cases had valid information for any of the 11 variables and were thus eligible to be tested.

Table 3.3 Summary of Removed Students Missing Data Files

| Year | Missing Gender | Missing School | Missing Scores |
| :---: | :---: | :---: | :---: |
| $1995-1996$ | 965 | 7394 | 3114 |
| $1996-1997$ | 906 | 228 | 3749 |
| $1997-1998$ | 984 | 251 | 4166 |
| $1998-1999$ | 1056 | 122 | 4237 |
| $1999-2000$ | 1074 | 133 | 4395 |
| $2000-2001$ | 1093 | 130 | 4504 |
| $2001-2002$ | 744 | 86 | 4134 |
| $2002-2003$ | 726 | 109 | 3985 |
| $2003-2004$ | 508 | 0 | 592 |
| $2004-2005$ | 432 | 1 | 566 |

### 3.9 Data Collection

The total number of students participating in each provincial exam varies from year to year. The general trend found in participation rates for students in the six different provincial exams was consistent over the ten year period. As English 12 or Communications 12 are the only two exams that are mandatory in order to graduate, these two courses are the best barometer concerning enrollment level and gender performance. History 12, Biology 12, Physics 12, and Principles of Mathematics 12 and their correlating provincial exam are optional so students have their choice as to which subject(s) and exam to take. This means that students are not required to take courses they do not like if they choose to do so. However, as universities do have program prerequisites, students may end up enrolling in courses that they do not particularly like or in which they had negative experiences.

Table 3.4 provides the raw numbers of students who participated in the six different exams over the ten year period after the missing variables had been removed. While the number of students may increase, the percentage breakdown remains fairly consistent with regards to gender breakdown.

Table 3.4 Total Student Enrolment in Provincial Exams

| Year | Course | Female | $\%$ | Male | $\%$ | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1995-1996 | Biology 12 | 8969 | 62.6 | 5351 | 37.4 | 14320 |
|  | Communications 12 | 2508 | 37.1 | 4259 | 62.9 | 6767 |
|  | English 12 | 19998 | 52.2 | 18340 | 47.8 | 38338 |
|  | History 12 | 4715 | 52 | 4360 | 48 | 9075 |
|  | Physics 12 | 2313 | 31.4 | 5055 | 68.6 | 7368 |
|  | Principles of Math 12 | 9254 | 46.4 | 10699 | 53.6 | 19953 |
| 1996-1997 | Biology 12 | 9584 | 63.9 | 5409 | 36.1 | 14993 |
|  | Communications 12 | 2349 | 36.2 | 4135 | 63.8 | 6484 |
|  | English 12 | 20936 | 52.1 | 19220 | 47.9 | 40156 |
|  | History 12 | 4719 | 51.9 | 4368 | 48.1 | 9087 |
|  | Physics 12 | 2159 | 29.1 | 5273 | 70.9 | 7432 |
|  | Principles of Math 12 | 9908 | 46.3 | 11499 | 53.7 | 21407 |
|  | Biology 12 | 10360 | 64.6 | 5674 | 35.4 | 16034 |
| $1997-1998$ | Communications 12 | 2392 | 35.9 | 4266 | 64.1 | 6658 |
|  | English 12 | 22113 | 52.3 | 20174 | 47.7 | 42287 |
|  | History 12 | 4898 | 50.7 | 4759 | 49.3 | 9657 |
|  | Physics 12 | 2310 | 29.6 | 5501 | 70.4 | 7811 |
|  | Principles of Math 12 | 10422 | 46.1 | 12165 | 53.9 | 22587 |
|  | Biology 12 | 10771 | 64.7 | 5864 | 35.3 | 16635 |
|  | Bommunications 12 | 2628 | 36.4 | 4585 | 63.6 | 7213 |
|  | English 12 | 22558 | 51.9 | 20946 | 48.1 | 43504 |
|  | History 12 | 5185 | 51.2 | 4949 | 48.8 | 10134 |
|  | Physics 12 | 2442 | 28.8 | 6044 | 71.2 | 8486 |
|  | Principles of Math 12 | 10655 | 45.6 | 12688 | 54.4 | 23343 |


| Year | Course | Female | \% | Male | \% | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1999-2000 | Biology 12 | 11607 | 65.3 | 6155 | 34.7 | 17762 |
|  | Communications 12 | 2902 | 35.9 | 5177 | 64.1 | 8079 |
|  | English 12 | 23523 | 51.8 | 21930 | 48.2 | 45453 |
|  | History 12 | 5304 | 50.2 | 5264 | 49.8 | 10568 |
|  | Physics 12 | 2653 | 29.7 | 6276 | 70.3 | 8929 |
|  | Principles of Math 12 | 10933 | 45.5 | 13116 | 54.5 | 24049 |
| 2000-2001 | Biology 12 | 12208 | 65.7 | 6375 | 34.3 | 18583 |
|  | Communications 12 | 3103 | 36.1 | 5491 | 63.9 | 8594 |
|  | English 12 | 23735 | 52.1 | 21829 | 47.9 | 45564 |
|  | History 12 | 5473 | 50.9 | 5281 | 49.1 | 10754 |
|  | Physics 12 | 2609 | 29.4 | 6255 | 70.6 | 8864 |
|  | Principles of Math 12 | 11555 | 46.3 | 13389 | 53.7 | 24944 |
| 2001-2002 | Biology 12 | 12235 | 65.6 | 6412 | 34.4 | 18647 |
|  | Communications 12 | 2760 | 36.1 | 4890 | 63.9 | 7650 |
|  | English 12 | 22817 | 52.4 | 20686 | 47.6 | 43503 |
|  | History 12 | 5699 | 50.3 | 5630 | 49.7 | 11329 |
|  | Physics 12 | 2478 | 29.2 | 6018 | 70.8 | 8496 |
|  | Principles of Math 12 | 9653 | 46 | 11323 | 54 | 20976 |
| 2002-2003 | Biology 12 | 12952 | 65.4 | 6856 | 34.6 | 19808 |
|  | Communications 12 | 2881 | 36 | 5116 | 64 | 7997 |
|  | English 12 | 23539 | 52.9 | 20926 | 47.1 | 44465 |
|  | History 12 | 5942 | 50.1 | 5910 | 49.9 | 11852 |
|  | Physics 12 | 2577 | 30.2 | 5948 | 69.8 | 8525 |
|  | Principles of Math 12 | 10600 | 46.7 | 12116 | 53.3 | 22716 |
| 2003-2004 | Biology 12 | 10278 | 64.5 | 5655 | 35.5 | 15933 |
|  | Communications 12 | 2309 | 34.9 | 4313 | 65.1 | 6622 |
|  | English 12 | 19952 | 52.1 | 18314 | 47.9 | 38266 |
|  | History 12 | 4712 | 47.9 | 5124 | 52.1 | 9836 |
|  | Physics 12 | 2303 | 31.1 | 5098 | 68.9 | 7401 |
|  | Principles of Math 12 | 7860 | 47.2 | 8806 | 52.8 | 16666 |
| 2004-2005 | Biology 12 | 10641 | 64.2 | 5923 | 35.8 | 16564 |
|  | Communications 12 | 2327 | 35.2 | 4290 | 64.8 | 6617 |
|  | English 12 | 20937 | 52.6 | 18896 | 47.4 | 39833 |
|  | History 12 | 5140 | 49.9 | 5151 | 50.1 | 10291 |
|  | Physics 12 | 2244 | 30.5 | 5110 | 69.5 | 7354 |
|  | Principles of Math 12 | 8127 | 47.3 | 9072 | 52.7 | 17199 |

### 3.10 Data Analysis

### 3.10.1 English 12 Exam \& Communications 12 Exam

Upon closer examination, one can note which of the six subjects have more participants from one demographic. As either the completion of English 12 or Communications 12 is mandatory prior to graduation from high school, a closer inspection reveals that there are slightly more females enrolled in English 12 while in Communications 12, it is a reversal with almost a 2 to 1 ratio for males (see Figure 3.1, 3.2). The curriculum of Communications 12 may at times be perceived by the student population to be lower than that of English 12. For many, Communications 12 is the class that has a higher percentage of students with language or learning difficulties.

Figure 3.1 Communications 12 Exam Participation Rate


Figure 3.2 English 12 Exam Participation Rate


The participation rates for the English 12 exam over the 10 school years for males and females were fairly consistent as they varied between $+/-2 \%$. The percentage of female students who wrote the English 12 exam ranged from 51-52\% while ranging for male students from 47$48 \%$ (Figure 3.2). For the Communications 12 exam, the participation rates were generally the same with nearly a 2-1 ratio for male students who wrote it compared to female students. The percentage of female students who wrote the Communications 12 exam over the ten school years ranged from $34-37 \%$ while ranging for male students from 62-65\% (Figure 3.1).

Although the percentage breakdown for males and females in the Communications 12 exam and the English 12 exam were fairly consistent over the ten years, the actual number of students who wrote the exams fluctuated. For the English 12 exam, there was a general increase between 1000-2000 students per year starting with the 1995-1996 school year to a peak of 45564 students in the school years of 1999-2000 and 2000-2001. Proceeding those two school years, there was a decrease by 2000 students for the following school year of 2001-2002, and a gentle rebound upwards of 1000 students for the 2002-2003 school year. Then, there was a sharp
decrease of 6000 students for the following school year in 2003-2004 to 38,266 students with an increase by 1000 students to 39,833 in 2004-2005 (Figure 3.3).

For the Communications 12 exam, a similar picture is presented when compared to English 12. The number of students between the school years of 1995-1996 to 1997-1998 fluctuated by around 300 students. Starting with the year of 1998-1999, participation for the Communications 12 exam increased from an average of 6500 students to 7200 students. The following school year of 1999-2000 saw 8079 students followed by a peak of 8594 students in the 2000-2001 school year. There was a slight dip in the number of students who wrote the Communications 12 exam in 2001-2002 and 2002-2003 to 7650 and 7997 students respectively. The school years of 2003-2004 and 2004-2005 continued to fall back to similar numbers prior to the school year of 1998-1999 (Figure 3.4).

While it is natural to have a fluctuation in enrollment, it is interesting to note that during the seven year period from 1996-2003, many students in the British Columbia school system are children of immigrants from Asia, specifically Hong Kong. This was because many families from Hong Kong immigrated to British Columbia, specifically Vancouver, for fear of uncertainties with Hong Kong reverting back to China. From 1989-1995, thousands of new immigrants moved to Greater Vancouver, flooding the school systems with children in elementary schools and secondary schools. The effect of these new students was more profound initially on elementary schools, especially for assistance for English as a Second Language (ESL).

The net effect is that the number of participants in provincial exams continued to increase after 1.997 as the children from the families from Hong Kong stayed in the school system and completed their high school graduation. Following that, many students continued their studies in
post secondary institutions with a large percentage staying in British Columbia, with the remainder attending universities in United States or Eastern Canada. This may help to explain why the student enrollment was highest in 1999-2000 and 2000-2001, a result of the immigration effect on British Columbia's school system. It should be noted too that one can only make these assumptions based on English 12 and Communications 12 as the completion of either one of them are mandatory to complete high school in British Columbia.

Figure 3.3 English 12 Exam Participants

English 12 Exam Participants


Figure 3.4 Communications 12 Exam Participants

Communications 12 Exam Participants


### 3.10.2 History 12 Exam

For the History 12 exam, a quick glance shows that generally more girls than boys wrote the exam, but not by much. The school years of 2003-2004 and 2004-2005 were exceptions where there were more male students than female students who wrote the exam. For the school years of 2001-2002 and 2002-2003, the percentage of students was almost on par (Figure 3.5).

Figure 3.5 History 12 Exam Participation Rates

History 12 Exam Participation Rates


The number of students who wrote the History 12 exam fluctuated from a low of 9075 students in the school year of 1995-1996 to a high of 11852 students in the school year of 20022003 (Figure 3.6).

Figure 3.6 History 12 Exam Participants


### 3.10.3 Biology 12 Exam

For Biology 12, the percentage breakdown of students who wrote the exam was the reverse of Communications 12 with more female students who wrote the exam compared to male students. The percentage of female students who wrote the Biology 12 exam over the ten school years varied from $62-65 \%$, while for male students, it varied from 34-37\% (Figure 3.7).

Figure 3.7 Biology 12 Exam Participation Rates


The total number of exam participants for Biology 12 varied between a high of 19808 students writing in the school year of 2002-2003 to a low of 14320 students writing in the 19951996 school year. Figure 3.8 details the breakdown of the Biology 12 Exam participants over the ten school years.

Figure 3.8 Biology 12 Exam Participants


### 3.10.4 Physics 12 Exam

The percentage breakdown of students who wrote the Physics 12 provincial exam was fairly consistent. For exam participants, the percentage of male students ranged between $68 \%$ $70 \%$, while for female students the range was between $28-31 \%$ over the ten year period. Figure 3.9 provides a graphic comparison representation highlighting the fact that male students dominate the course by a 2-1 ratio.

Figure 3.9 Physics 12 Exam Participation Rates

Physics 12 Exam Participation Rates


While the percentage breakdown remained consistent, the number of students who wrote the exam ranged from a low of 7354 students in the 2004-2005 school year to a high of 8929 students in the school year of 1999-2000. Figure 3.10 charts out the number of students enrolled each year in the exam.

Figure 3.10 Physics 12 Exam Participants

Physics 12 Exam Participants


### 3.10.5 Principles of Mathematics 12 Exam

In the Principles of Mathematics 12 exam, there were more male students who wrote the exam for the ten year period compared to female students. The percentage breakdown was between $45 \%-47 \%$ for female students who wrote the exam, while for male students it ranged between $52 \%-54 \%$ over the same ten year period (Figure 3.11).

Figure 3.11 Principles of Math 12 Exam Participation Rates

Principles of Math 12 Exam Participation Rates


Figure 3.12 graphs out the changes in participants in the Principles of Mathematics 12 exam over the ten year period. There was a gentle increase of student participants to a peak in the 2000-2001 school year with 24,944 students, followed by a slight dip for the 2001-2002 school year and a momentary increase in the 2002-2003 school year. The lowest number over the ten year period was the 2003-2004 school year with 16,666 students participating in the Principles of Math 12 exam.

Figure 3.12 Principles of Math 12 Exam Participants

Principles of Math 12 Exam Participants


### 3.11 Data Testing

All information obtained from the MOE from Edudata was first stored as data files in SPSS (Statistical Package for the Social Sciences) format. When running the t -tests, I used SPSS (Statistical Package for the Social Sciences) Version 10.0 for Windows.

### 3.12 Ethics Approval \& Research Agreement

This study received ethics approval from the University of British Columbia Office of Research Services and Administration Behavioral Research Ethics Board (Appendix A). A Research Agreement was also signed with the British Columbia Ministry of Education and Edudata in order for me to obtain the necessary data files (Appendix B).

### 3.13 Conclusion

This chapter presents the use of null hypotheses as the method involved in assessing whether there are any statistical differences in gender performance in the exam scores for the six subjects of Biology 12, Communications 12, English 12, History 12, Principles of Mathematics 12, and Physics 12. I also explained why there are three separate groupings for null hypothesis testing based upon research presented in the literature review in Chapter 2. I presented the use of independent sample based t -tests to examine the difference in mean scores and the p-values used to get to the $95 \%$ confidence level. Anecdotal descriptions and visuals are presented to breakdown each of the different subjects along with inferences that can be made concerning the data sets.

Data files used for testing came from Edudata stored in SPSS format. SPSS version 10 was the program used to run the 60 t-tests. The two research agreements needed in order to obtain the data file were also mentioned in this chapter and can be found in the appendix section.

In the next chapter, I will discuss the findings as a result of running the 60 t-tests using the method of testing described.

## Chapter 4 - Findings

### 4.1 Introduction

This chapter presents the results of the $t$-tests conducted to address the hypotheses raised in chapter three of this thesis: (1) Do boys or girls do better in the Principles of Mathematics 12 exam and the Physics 12 exam for the school years of 1995/1996-2004/2005?; (2) Do girls do better in the Biology 12 exam, the Communications 12 exam, and the English 12 exam, for the school years of 1995/1996-2004/2005?; (3) Do boys do better on the History 12 exam for the school years of 1995/1996-2004/2005?

The findings for whether there are significant differences in the six Provincial Exams over the ten year span are separated into two major sections. The first major section examines the results through a year by year analysis. The second major section looks at the results through a subject by subject analysis. An anecdotal description follows each analysis for the subject and yearly analysis.

### 4.2 Background to Data Selections

Prior to the school year of 2001-2002, each provincial exam had a different possible maximum score. Beginning with the school year of 2001-2002 and all subsequent years, the ministry began to use the Item Response Theory (IRT) in order to "standardize" tests across the years and to allow for commonalities in exams. In my discussions with Brent Munro, Manager, Surveys and Data Exchange in the Ministry of Education, he highlighted that the exam maximum scores fluctuated over the years because they were the "actual scores off each exam
booklet and each year the length of test, questions themselves, value of the questions, etc. change."

For this research project and the testing involved, Edudata has provided the percentage scores. The percentage scores are calculated by taking a student's actual score divided into the maximum possible score. Since the purpose of this project is to examine the differences in performance between gender for each of the exams over the ten year period and to discuss some of the trends over that period of time, there will not be any comparison of performance between the different years as the examinations prior to the 2001-2002 school year did not have commonalities within the exam to allow for such a comparison. I provide some generalities in my qualitative discussion on the results of the t -tests.

### 4.3 Data Analysis - Year by Year

In this section, I examine the results of the 60 different t -tests that I ran through SPSS on a year by year basis. Tables 4.1 to 4.10 presents only the results of the $t$-tests for one specific year followed by a breakdown on how males and females performed for each of the six different exams being examined: Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12.

### 4.3.1 T-Test results for school year 1995-1996

Table 4.1 details the results of the independent t-tests for the 1995-1996 school year that were conducted to compare gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six exams tested, five demonstrated significant differences in exam scores between males and females. Within these
five exams, three have the highest degree of significance with p -values $<.001$, one with a pvalue $<.01$, and 1 with a p-value $<.05$.

For the Biology12 exam, there was no significant difference in exam scores for males ( $\underline{M}$ $=23.54, \underline{\mathrm{SD}}=64.67)$, and females $[\underline{\mathrm{M}}=64.28, \underline{\mathrm{SD}}=22.84 ; \underline{\mathrm{t}}(14318)=0.99, \underline{n s}]$. For

Communications 12, a significant difference was found in exam scores for males ( $M=54.79, \underline{S D}$ $=27.69$, and females $[\underline{M}=56.95, \underline{\mathrm{SD}}=28.53 ; \underline{\mathrm{t}}(6765)=3.06, \mathrm{p}<.01]$. In English 12, a significant difference was found in exam scores for male ( $\underline{M}=60.10, \underline{S D}=21.86$ ), and females $[\underline{M}=64.95, \underline{S D}=20.98 ; \underline{t}(38336)=22.18, \underline{p}<.001]$. A significant difference in exam scores was also found in History 12 between males $(\underline{M}=63.26, \underline{S D}=22.36)$, and females $[\underline{M}=60.71$, $\underline{S D}=22.40 ; \underline{t}(9073)=5.43, \underline{p}<.001]$. For Principles of Mathematics 12, a significant difference was found in exam scores for males $(\underline{M}=61.09, \underline{S D}=25.87)$, and females $[\underline{M}=61.99, \underline{S D}=$ 24.02; $\mathrm{t}(19951)=2.54, \underline{p}<.05]$. In Physics 12, a significant difference was found in exam scores for males $(\underline{M}=63.70, \underline{S D}=25.70)$, and females $[\underline{M}=66.82, \underline{S D}=22.81 ; \underline{\mathrm{t}}(7366)=5.01$, $\mathrm{p}<.001]$.

Table 4.1 Summary of T-Test results for school year 1995-1996

| Subject | Gender |  |  |  |  |  | t | df | $\begin{gathered} \mathrm{p}- \\ \text { value } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | N | M | SD | n |  |  |  |
| Biology 12 | 64.67 | 23.54 | 5351 | 64.28 | 22.84 | 8969 | 0.99 | 14318 | 0.322 |
| Communications $12$ | 54.79 | 27.69 | 4259 | 56.95 | 28.53 | 2508 | 3.06** | 6765 | 0.002 |
| English 12 | 60.10 | 21.86 | 18340 | 64.95 | 20.98 | 19998 | 22.18*** | 38336 | 0.000 |
| History 12 | 63.26 | 22.36 | 4360 | 60.71 | 22.40 | 4715 | 5.43*** | 9073 | 0.000 |
| Math 12 | 61.09 | 25.87 | 10699 | 61.99 | 24.02 | 9254 | 2.54*. | 19951 | 0.011 |
| Physics 12 | 63.70 | 25.70 | 5055 | 66.82 | 22.81 | 2313 | 5.01 *** | 7366 | 0.000 |

### 4.3.2 T-Test results for school year 1996-1997

Table 4.2 details the results of the independent t-tests for the 1996-1997 school year that were conducted to compare the gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six exams tested, four indicated significant differences in exam scores between males and females. Within these four exams, three have the highest degree of significance with $p$-values $<.001$, and one with a $p$-value $<.05$.

For Biology12, there was no significant difference in exam scores for males ( $M=61.82$, $\underline{\mathrm{SD}}=23.04)$, and females $[\underline{\mathrm{M}}=61.17, \underline{\mathrm{SD}}=22.78 ; \underline{\mathrm{t}}(15)=1.69, \underline{n s}]$. For Communications 12 , no significant difference was found in exam scores for males $(\underline{M}=54.66, \underline{\mathrm{D}}=27.3)$, and females $[\underline{M}=55.78, \underline{\mathrm{SD}}=28.25 ; \underline{\mathrm{t}}(65)=1.57, \underline{n s}]$. In English 12, a significant difference was found in exam scores for male $(\underline{M}=60.62, \underline{S D}=21.99)$, and females $[\underline{M}=65.11, \underline{S D}=21.35$; $\underline{t}(40)=20.8, \underline{p}<.001]$. A significant difference in exam scores was also found in History 12 between males $(\underline{M}=63.09, \underline{S D}=22.36)$, and females $[\underline{M}=60.96, \underline{\mathrm{SD}}=22.17 ; \underline{\mathrm{t}}(9085)=4.56, \underline{p}$ <.001]. For Principles of Mathematics 12, a significant difference was found in exam scores for males $(\underline{M}=59.68, \underline{\mathrm{SD}}=27.25)$, and females $[\underline{\mathrm{M}}=61.39, \underline{\mathrm{SD}}=25.11 ; \underline{\mathrm{t}}(21405)=4.76, \underline{p}<.001]$. In Physics 12, a significant difference was found in exam scores for males $(\underline{M}=64.39, \underline{\mathrm{SD}}=$ 26.67), and females $[\underline{M}=65.68, \underline{\mathrm{SD}}=25.32 ; \underline{\mathrm{t}}(7430)=1.92, \underline{p}<.05]$.

Table 4.2 Summary of T-Test results for School Year 1996-1997

| Subject | Gender |  |  |  |  |  | t | df | $\begin{gathered} \mathrm{p}- \\ \text { value } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | n | M | SD | N |  |  |  |
| Biology 12 | 61.82 | 23.04 | 5409 | 61.17 | 22.78 | 9584 | 1.69 | 15 | 0.092 |
| Communications 12 | 54.66 | 27.3 | 4135 | 55.78 | 28.25 | 2349 | 1.57 | 65 | 0.117 |
| English 12 | 60.62 | 21.99 | 19220 | 65.11 | 21.35 | 20936 | 20.8*** | 40 | 0.000 |
| History 12 | 63.09 | 22.36 | 4368 | 60.96 | 22.17 | 4719 | 4.56*** | 9085 | 0.000 |
| Math 12 | 59.68 | 27.25 | 11499 | 61.39 | 25.11 | 9908 | 4.76*** | 21405 | 0.000 |
| Physics 12 | 64.39 | 26.67 | 5273 | 65.68 | 25.32 | 2159 | 1.92* | 7430 | 0.054 |

### 4.3.3 T-Test results for school year 1997-1998

Table 4.3 details the results of the independent $t$-tests for the 1997-1998 school year that were conducted to compare the gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six exams tested, five indicated significant differences in exam scores between males and females. Within these five exams, four have the highest degree of significance with p-values $<.001$, and one with a $p$-value $<.01$.

For Communications 12, no significant difference was found in exam scores for males $(\underline{M}=53.22, \underline{S D}=25.54)$, and females $[\underline{M}=53.19, \underline{\mathrm{~S}}=26.35 ; \underline{t}(6656)=0.04, \underline{n s}]$. For Biology12, there was significant difference in exam scores for males ( $\underline{M}=60.72, \underline{\mathrm{~S}}=23.72$ ), and females $[\underline{M}=62.06, \underline{\mathrm{SD}}=22.56 ; \underline{t}(16032)=3.52, \underline{p}<0.001]$. In English 12, a significant difference was found in exam scores for males $(\underline{M}=59.79, \underline{S D}=21.24)$, and females $[\underline{M}=$ $64.95, \underline{\mathrm{SD}}=20.73 ; \underline{\mathrm{t}}(42285)=25.25, \mathrm{p}<.001]$. A significant difference in exam scores was also found in History 12 between males $(\underline{M}=62.82, \underline{S D}=22.40)$, and females $[\underline{M}=61.85, \underline{S D}=$ $22.20 ; \underline{t}(9655)=2.14, \underline{p}<.01]$. For Principles of Mathematics 12, a significant difference was
found in exam scores for males $(\underline{M}=60.56, \underline{S D}=26.89)$, and females $[\underline{M}=63.11, \underline{S D}=24.31$; $\mathrm{t}(22585)=7.42, \mathrm{p}<.001]$. In Physics 12, a significant difference was found in exam scores for males $(\underline{M}=64.74, \underline{\mathrm{SD}}=24.48)$, and females $[\underline{\mathrm{M}}=67.06, \underline{\mathrm{SD}}=22.92 ; \underline{\mathrm{t}}(7809)=3.89, \underline{p}<.001]$.

Table 4.3 Summary of T-Test results for school year 1997-1998

| Subject | Gender |  |  |  |  |  | t | df | pvalue |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |  |
| Biology 12 | 60.72 | 23.72 | 5674 | 62.06 | 22.56 | 10360 | $3.52^{* * *}$ | 16032 | 0.000 |
| Communications 12 | 53.22 | 25.54 | 4266 | 53.19 | 26.35 | 2392 | 0.04 | 6656 | 0.966 |
| English 12 | 59.79 | 21.24 | 20174 | 64.95 | 20.73 | 22113 | 25.25*** | 42285 | 0.000 |
| History 12 | 62.82 | 22.40 | 4759 | 61.85 | 22.20 | 4898 | 2.14** | 9655 | 0.032 |
| Math 12 | 60.56 | 26.89 | 12165 | 63.11 | 24.31 | 10422 | 7.42*** | 22585 | 0.000 |
| Physics 12 | 64.74 | 24.48 | 5501 | 67.06 | 22.92 | 2310 | $3.89 * * *$ | 7809 | 0.000 |

### 4.3.4 T-Test results for school year 1998-1999

Table 4.4 details the results of the independent t -tests for the 1998-1999 school year that were conducted to compare the gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six exams tested, all six indicated significant differences in exam scores between males and females. Within these six exams, four have the highest degree of significance with p-values $<.001$, and two with the lowest degree of significance with p -values $<.05$.

For Biology12, there was a significant difference in exam scores for males $(\underline{M}=61.34$, $\underline{S D}=23.78)$, and females $[\underline{M}=62.16, \underline{S D}=23.17 ; \underline{t}(16633)=2.16, \underline{p}<0.05]$. For

Communications 12 , a significant difference was found in exam scores for males $(\underline{M}=55.07, \underline{S D}$ $=25.03$ ), and females $[\underline{M}=56.48, \underline{\mathrm{SD}}=26.07 ; \underline{\mathrm{t}}(7211)=2.28, \underline{p}<0.05]$. In English 12, a significant difference was found in exam scores for male $(\underline{M}=59.10, \underline{S D}=21.36)$, and females
$[\underline{M}=64.45, \underline{\mathrm{SD}}=20.65 ; \underline{\mathrm{t}}(43502)=26.53, \underline{p}<.001]$. A significant difference in exam scores was also found in History 12 between males $(\underline{M}=65.15, \underline{S D}=21.98)$, and females $[\underline{M}=63.52$, $\underline{\mathrm{SD}}=22.58 ; \underline{\mathrm{t}}(10132)=3.69, \mathrm{p}<.001]$. For Principles of Mathematics 12, a significant difference was found in exam scores for males $(\underline{M}=60.36, \underline{S D}=27.01)$, and females $[\underline{M}=$
 in exam scores for males $(\underline{M}=65.79, \underline{S D}=26.08)$, and females $[\underline{M}=67.93, \underline{S D}=24.82 ; \underline{t}(8484)$ $=3.47, \mathrm{p}<.001]$.

Table 4.4 Summary of T-Test results for school year 1998-1999

| Subject | Gender |  |  |  |  |  | t | df | pvalue |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |  |
| Biology 12 | 61.34 | 23.78 | 5864 | 62.16 | 23.17 | 10771 | 2.16* | 16633 | 0.031 |
| Communications $12$ | 55.07 | 25.03 | 4585 | 56.48 | 26.07 | 2628 | $2.28 *$ | 7211 | 0.023 |
| English 12 | 59.10 | 21.36 | 20946 | 64.45 | 20.65 | 22558 | 26.53*** | 43502 | 0.000 |
| History 12 | 65.15 | 21.98 | 4949 | 63.52 | 22.58 | 5185 | 3.69*** | 10132 | 0.000 |
| Math 12 | 60.36 | 27.01 | 12688 | 61.75 | 25.29 | 10655 | 4.04*** | 23341 | 0.000 |
| Physics 12 | 65.79 | 26.08 | 6044 | 67.93 | 24.82 | 2442 | 3.47*** | 8484 | 0.001 |

### 4.3.5 T-Test results for school year 1999-2000

Table 4.5 details the results of the independent $t$-tests for the 1999-2000 school year that were conducted to compare the gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six subjects tested, four indicated significant differences in exam scores between males and females, all indicating a high degree of significance with p -values $<.001$.

For Biology12, there was no significant difference in exam scores for males $(\underline{M}=62.17$, $\underline{S D}=23.53$ ), and females $[\underline{M}=62.43, \underline{\mathrm{SD}}=23.41 ; \underline{t}(17760)=0.70, \underline{n s}]$. Likewise for

Communications 12 , there was no significant difference in exam scores for males ( $\underline{M}=56.38$, $\underline{S D}=26.39)$, and females $[\underline{M}=56.89, \underline{\mathrm{SD}}=27.22 ; \underline{t}(8077)=0.82, \underline{n s}]$. In English 12, a significant difference was found in exam scores for males $(\underline{M}=59.17, \underline{S D}=21.67)$, and females $[\underline{M}=64.76, \underline{S D}=20.94 ; \underline{t}(45451)=27.98, \underline{p}<.001]$. A significant difference in exam scores was also found in History 12 between males $(\underline{M}=65.40, \underline{S D}=21.73)$, and females $[\underline{M}=63.39$, $\underline{S D}=21.86 ; \underline{t}(10566)=4.74, \underline{p}<.001]$. For Principles of Mathematics 12, a significant difference was found in exam scores for males $(\underline{M}=60.69, \underline{S D}=27.37)$, and females $[\underline{M}=$ 62.64, $\underline{\mathrm{SD}}=25.66 ; \underline{\mathrm{t}}(24047)=5.65, \underline{p}<.001]$. In Physics 12, a significant difference was found in exam scores for males $(\underline{M}=65.71, \underline{S D}=26.96)$, and females $[\underline{M}=68.97, \underline{\mathrm{SD}}=24.29 ; \underline{t}(8927)$ $=5.37, \mathrm{p}<.001]$.

Table 4.5 Summary of T-Test results for school year 1999-2000 .

| Subject | Gender |  |  |  |  |  | t | df | $\begin{gathered} \mathrm{p}- \\ \text { value } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |  |
| Biology 12 | 62.17 | 23.53 | 6155 | 62.43 | 23.41 | 11607 | 0.70 | 17760 | 0.484 |
| Communications 12 | 56.38 | 26.39 | 5177 | 56.89 | 27.22 | 2902 | 0.82 | 8077 | 0.413 |
| English 12 | 59.17 | 21.67 | 21930 | 64.76 | 20.94 | 23523 | 27.98*** | 45451 | 0.000 |
| History 12 | 65.40 | 21.73 | 5264 | 63.39 | 21.86 | 5304 | 4.74*** | 10566 | 0.000 |
| Math 12 | 60.69 | 27.37 | 13116 | 62.64 | 25.66 | 10933 | 5.65*** | 24047 | 0.000 |
| Physics 12 | 65.71 | 26.96 | 6276 | 68.97 | 24.29 | 2653 | 5.37*** | 8927 | 0.000 |

### 4.3.6 T-Test results for school year 2000-2001

Table 4.6 details the results of the independent $t$-tests for the 2000-2001 school year that were conducted to compare gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six subjects tested, all six indicated significant differences in exam scores between males and females. Within these six
exams, two have the highest degree of significance with p -values $<.001$. There were two with a moderate degree of significance with p -values $<.01$ and two with the lowest degree of significance with p-values $<.05$.

For Biology 12, there was a significant difference in exam scores for males $(\underline{M}=61.20$, $\underline{\mathrm{SD}}=24.25)$, and females $[\underline{\mathrm{M}}=60.19, \underline{\mathrm{SD}}=24.57 ; \underline{\mathrm{t}}(18581)=2.67, \underline{p}<.01]$. For

Communications 12 , there was a significant difference in exam scores for males $(\underline{M}=53.70, \underline{\mathrm{SD}}$ $=25.77$ ), and females $[\underline{M}=55.23, \underline{\mathrm{SD}}=26.47 ; \mathrm{t}(8592)=2.63, \underline{p}<.01]$. In English 12, a significant difference was found in exam scores for males $(\underline{M}=60.72, \underline{\mathrm{~S}}=21.89)$, and females $[\underline{M}=65.38, \underline{\mathrm{SD}}=21.32 ; \underline{\mathrm{t}}(45562)=22.99, \underline{p}<.001]$. A significant difference in exam scores was also found in History 12 between males $(\underline{M}=68.38, \underline{S D}=21.64)$, and females $[\underline{M}=67.46$, $\underline{S D}=21.35 ; \underline{t}(10752)=2.23, \underline{p}<.05]$. For Principles of Mathematics 12, a significant difference was found in exam scores for males $(\underline{M}=62.76, \underline{S D}=26.95)$, and females $[\underline{M}=64.67, \underline{S D}=$ 25.25; $\mathfrak{t}(24942)=5.74, \underline{p}<.001]$. In Physics 12, a significant difference was found in exam scores for males $(\underline{M}=65.55, \underline{\mathrm{SD}}=24.60)$, and females $[\underline{M}=66.84, \underline{\mathrm{SD}}=23.51 ; \underline{\mathrm{t}}(8862)=2.28$, $\mathrm{p}<.05]$.

Table 4.6 Summary of T-Test results for school year 2000-2001

| Subject | Gender |  |  |  |  |  | t | df | $\begin{gathered} \mathrm{p}- \\ \text { value } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |  |
| Biology 12 | 61.20 | 24.25 | 6375 | 60.19 | 24.57 | 12208 | 2.67** | 18581 | 0.008 |
| Communications 12 | 53.70 | 25.77 | 5491 | 55.23 | 26.47 | 3103 | 2.629** | 8592 | 0.009 |
| English 12 | 60.72 | 21.89 | 21829 | 65.38 | 21.32 | 23735 | 22.99*** | 45562 | 0.000 |
| History 12 | 68.38 | 21.64 | 5281 | 67.46 | 21.35 | 5473 | 2.23* | 10752 | 0.026 |
| Math 12 | 62.76 | 26.95 | 13389 | 64.67 | 25.25 | 11555 | 5.74*** | 24942 | 0.000 |
| Physics 12 | 65.55 | 24.60 | 6255 | 66.84 | 23.51 | 2609 | 2.28* | 8862 | 0.023 |

### 4.3.7 T-Test results for school year 2001-2002

Table 4.7 details the results of the independent t-tests for the 2001-2002 school year that were conducted to compare gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six exams tested, five indicated significant differences in exam scores between males and females, all indicating a high degree of significance with p -values $<.001$.

For Biology 12, there was no significant difference in exam scores for males ( $\underline{M}=65.46$, $\underline{\mathrm{SD}}=20.09$ ), and females $[\underline{\mathrm{M}}=65.06, \underline{\mathrm{SD}}=19.75 ; \underline{t}(18645)=1.31, \underline{\mathrm{~ns}}]$. For Communications 12 , there was a significant difference in exam scores for males $(\underline{M}=65.27, \underline{S D}=15.17)$, and females $[\underline{M}=66.47, \underline{S D}=15.81 ; \underline{t}(7648)=3.28, \underline{p}<.001]$. In English 12, a significant difference was found in exam scores for males $(\underline{M}=65.10, \underline{S D}=15.63)$, and females $[\underline{M}=$ $69.00, \underline{\mathrm{SD}}=15.97 ; \underline{\mathrm{t}}(43501)=25.66, \underline{\mathrm{p}}<.001]$. A significant difference in exam scores was also found in History 12 between males $(\underline{M}=69.76, \underline{S D}=16.00)$, and females $[\underline{M}=68.40, \underline{S D}=$ $16.38 ; \underline{t}(11327)=4.45, \underline{p}<.001]$. For Principles of Mathematics 12 , a significant difference was found in exam scores for males $(\underline{M}=69.18, \underline{S D}=20.33)$, and females $[\underline{M}=71.61, \underline{S D}=19.55$; $\underline{t}(20974)=8.77, \underline{p}<.001]$. In Physics 12, a significant difference was found in exam scores for males $(\underline{M}=68.21, \underline{S D}=20.45)$, and females $[\underline{M}=70.67, \underline{\mathrm{SD}}=18.22 ; \underline{\mathrm{t}}(8494)=5.19, \underline{p}<.001]$.

Table 4.7 Summary of T-Test results for school year 2001-2002

| Subject | Gender |  |  |  |  |  | t | df | $\begin{gathered} \mathrm{p}- \\ \text { value } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | N | M | SD | n |  |  |  |
| Biology 12 | 65.46 | 20.09 | 6412 | 65.06 | 19.75 | 12235 | 1.31 | 18645 | 0.189 |
| Communications $12$ | 65.27 | 15.17 | 4890 | 66.47 | 15.81 | 2760 | 3.28*** | 7648 | 0.001 |
| English 12 | 65.10 | 15.63 | 20686 | 69.00 | 15.97 | 22817 | 25.66*** | 43501 | 0.000 |
| History 12 | 69.76 | 16.00 | 5630 | 68.40 | 16.38 | 5699 | 4.45*** | 11327 | 0.000 |
| Math 12 | 69.18 | 20.33 | 11323 | 71.61 | 19.55 | 9653 | 8.77*** | 20974 | 0.000 |
| Physics 12 | 68.21 | 20.45 | 6018 | 70.67 | 18.22 | 2478 | 5.19*** | 8494 | 0.000 |

### 4.3.8 T-Test results for school year 2002-2003

Table 4.8 details the results of the independent $t$-tests for the 2002-2003 school year that were conducted to compare gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six exams tested, four indicated significant differences in exam scores between males and females, three of them indicating a high degree of significance with p -values $<.001$ and one with a moderate degree of significance with a p-value of $<.01$.

For Biology 12, there was no significant difference in exam scores for males ( $\underline{M}=64.48$, $\underline{S D}=20.62)$, and females $[\underline{M}=64.20, \underline{S D}=20.48 ; \underline{t}(19806)=0.90, \underline{n s}]$. No significant difference in exam scores was also found in History 12 between males ( $\underline{M}=67.05, \underline{S D}=16.67$ ), and females $[\underline{M}=66.61, \underline{\mathrm{SD}}=17.32 ; \underline{\mathrm{t}}(11850)=1.38, \underline{\mathrm{~ns}}]$. For Communications 12 , there was a significant difference found in exam scores for males $(\underline{M}=66.01, \underline{S D}=15.08)$, and females $[\underline{M}$ $=67.08, \underline{\mathrm{SD}}=16.10 ; \underline{\mathrm{t}}(7995)=2.96, \mathrm{p}<.01]$. In English 12, a significant difference was found in exam scores for males $(\underline{M}=65.46, \underline{S D}=16.05)$, and females $[\underline{M}=69.17, \underline{S D}=16.44$; $\mathrm{t}(44463)=23.99, \underline{p}<.001]$. For Principles of Mathematics 12, a significant difference was
found in exam scores for males $(\underline{M}=69.81, \underline{S D}=20.94)$, and females $[\underline{M}=71.78, \underline{S D}=19.53$; $\underline{\mathrm{t}}(22714)=7.22, \mathrm{p}<.001]$. In Physics 12, a significant difference was found in exam scores for males $(\underline{M}=67.91, \underline{\mathrm{SD}}=20.40)$, and females $[\underline{\mathrm{M}}=71.68, \underline{\mathrm{SD}}=19.08 ; \underline{\mathrm{t}}(8523)=8.00, \underline{\mathrm{p}}<.001]$.

Table 4.8 Summary of T-Test results for school year 2002-2003

| Subject | Gender |  |  |  |  |  | t | Df | $\begin{gathered} \mathrm{p}- \\ \text { value } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |  |
| Biology 12 | 64.48 | 20.62 | 6856 | 64.20 | 20.48 | 12952 | 0.90 | 19806 | 0.366 |
| Communications 12 | 66.01 | 15.08 | 5116 | 67.08 | 16.10 | 2881 | 2.96** | 7995 | 0.003 |
| English 12 | 65.46 | 16.05 | 20926 | 69.17 | 16.44 | 23539 | 23.99*** | 44463 | 0.000 |
| History 12 | 67.05 | 16.67 | 5910 | 66.61 | 17.32 | 5942 | 1.38 | 11850 | 0.167 |
| Math 12 | 69.81 | 20.94 | 12116 | 71.78 | 19.53 | 10600 | 7.22*** | 22714 | 0.000 |
| Physics 12 | 67.91 | 20.40 | 5948 | 71.68 | 19.08 | 2577 | $8.00^{* * *}$ | 8523 | 0.000 |

### 4.3.9 T-Test results for school year 2003-2004

Table 4.9 details the results of the independent t-tests for the 2003-2004 school year that were conducted to compare the gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six exams tested, five indicated significant differences in exam scores between males and females, four of them reporting a high degree of significance with p-values $<.001$ and one with a nominal degree of significance with a p-value of $<.05$.

For Communications 12, there was no significant difference in exam scores for males ( $\underline{M}$ $=65.51, \underline{\mathrm{SD}}=12.24)$, and females $[\underline{\mathrm{M}}=65.75, \underline{\mathrm{SD}}=13.57 ; \underline{\mathrm{t}}(6620)=0.73, \underline{\mathrm{~ns}}]$. In Biology $12, \mathrm{a}$ significant difference in exam scores was found between males $(\underline{M}=67.45, \underline{S D}=18.24)$, and females $[\underline{M}=66.34, \underline{S D}=18.71 ; \underline{t}(15931)=3.62, p<.001]$. For English 12, a significant difference was found in exam scores between males $(\underline{M}=66.94, \underline{S D}=13.19)$, and females $[\underline{M}=$
$70.56, \underline{\mathrm{SD}}=13.29 ; \underline{\mathrm{t}}(38264)=26.72, \mathrm{p}<.001]$. In History 12 , there was a significant difference found in exam scores between males $(\underline{M}=71.25, \underline{S D}=14.35)$, and females $[\underline{M}=69.37, \underline{S D}=$ 15.63; $\mathrm{t}(9834)=6.22, \mathrm{p}<.001]$. For Principles of Mathematics 12, a significant difference was found in exam scores between males $(\underline{M}=68.31, \underline{S D}=18.10)$, and females $[\underline{M}=69.65, \underline{S D}=$ 17.12; $\mathrm{t}(16664)=4.92, \mathrm{p}<.001]$. In Physics 12, a nominal significant difference was found in exam scores between males $(\underline{M}=69.53, \underline{S D}=18.52)$, and females $[\underline{M}=70.64, \underline{S D}=17.19$; $\mathrm{t}(7399)=2.44, \mathrm{p}<.05]$.

Table 4.9 Summary of T-Test results for school year 2003-2004

| Subject | Gender |  |  |  |  |  | t | df | $\begin{gathered} \mathrm{p}- \\ \text { value } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |  |
| Biology 12 | 67.45 | 18.24 | 5655 | 66.34 | 18.71 | 10278 | 3.62*** | 15931 | 0.000 |
| Communications 12 | 65.51 | 12.24 | 4313 | 65.75 | 13.57 | 2309. | 0.73 | 6620 | 0.465 |
| English 12 | 66.94 | 13.19 | 18314 | 70.56 | 13.29 | 19952 | 26.72*** | 38264 | 0.000 |
| History 12 | 71.25 | 14.35 | 5124 | 69.37 | 15.63 | 4712 | $6.22 * * *$ | 9834 | 0.000 |
| Math 12 | 68.31 | 18.10 | 8806 | 69.65 | 17.12 | 7860 | 4.92*** | 16664 | 0.000 |
| Physics 12 | 69.53 | 18.52 | 5098 | 70.64 | 17.19 | 2303 | 2.44* | 7399 | 0.015 |

### 4.3.10 T-Test results for school year 2004-2005

Table 4.10 details the results of the independent $t$-tests for the 2004-2005 school year that were conducted to compare the gender performance on exams in Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. Of the six exams tested, five indicated significant differences in exam scores between males and females, four of them indicating a high degree of significance with p-values $<.001$ and one with a nominal degree of significance with a p-value of $<.05$.

For Physics 12, there was no significant difference in exam scores for males ( $\underline{M}=72.36$, $\underline{\mathrm{SD}}=16.72)$, and females $[\underline{\mathrm{M}}=71.79, \underline{\mathrm{SD}}=16.43 ; \underline{\mathrm{t}}(7352)=1.37, \underline{\mathrm{~ns}}]$. For Biology 12, a nominal degree of significant difference in exam scores was found between males ( $\underline{M}=67.83$, $\underline{\mathrm{SD}}=18.24)$, and females $[\underline{\mathrm{M}}=67.07, \underline{\mathrm{SD}}=18.83 ; \underline{\mathrm{t}}(16562)=2.47, \mathrm{p}<.05]$. In

Communications 12, a high degree of significant difference was found in exam scores between males $(\underline{M}=64.96, \underline{\mathrm{SD}}=13.54)$, and females $[\underline{M}=66.48, \underline{\mathrm{SD}}=13.06 ; \underline{\mathrm{t}}(6615)=4.42, \underline{\mathrm{p}}<.001]$. For English 12, a significant difference was found in exam scores between males ( $\underline{M}=68.34, \underline{\mathrm{SD}}$ $=13.35)$, and females $[\underline{\mathrm{M}}=72.20, \underline{\mathrm{~S}}=13.52 ; \underline{\mathrm{t}}(39831)=28.56, \underline{\mathrm{p}}<.001]$. In History 12, there was a significant difference found in exam scores between males ( $\underline{M}=71.11, \underline{S D}=13.25$ ), and females $[\underline{M}=69.48, \underline{S D}=14.57 ; \underline{t}(10289)=5.94, \underline{p}<.001]$. For Principles of Mathematics 12, a significant difference were found in exam scores between males ( $\underline{M}=69.51, \underline{\mathrm{SD}}=16.72$ ), and females $[\underline{M}=71.79, \underline{\mathrm{SD}}=16.43 ; \underline{\mathrm{t}}(17197)=6.99, \underline{p}<.001]$.

Table 4.10 Summary of T-Test results for school year 2004-2005

| Subject | Gender |  |  |  |  |  | t | df | $\begin{gathered} \text { p- } \\ \text { value } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |  |
| Biology 12 | 67.83 | 18.94 | 5923 | 67.07 | 18.83 | 10641 | 2.47* | 16562 | 0.014 |
| Communications 12 | 64.96 | 13.54 | 4290 | 66.48 | 13.06 | 2327 | 4.42*** | 6615 | 0.000 |
| English 12 | 68.34 | 13.35 | 18896 | 72.20 | 13.52 | 20937 | 28.56*** | 39831 | 0.000 |
| History 12 | 71.11 | 13.25 | 5151 | 69.48 | 14.57 | 5140 | 5.94*** | 10289 | 0.000 |
| Math 12 | 69.51 | 18.20 | 9072 | 71.38 | 16.83 | 8127 | 6.99*** | 17197 | 0.000 |
| Physics 12 | 72.36 | 16.72 | 5110 | 71.79 | 16.43 | 2244 | 1.37 | 7352 | 0.172 |

### 4.4 Findings - Subject by Subject

In this section, I examine the results of the 60 different $t$-tests that I ran through SPSS by subject. Tables 4.11 to 4.16 present the results of the $t$-tests of the six different exam subjects:

Biology 12, Communications 12, English 12, History 12, Principles of Math 12, and Physics 12. It should be noted once again that the p-value is about probabilities and confidence, protecting from a Type 1 error in this case. So the first level of cautious reporting is that the risk of rejecting the null hypothesis could be incorrect 1 out of 20 times with a .05 p-value. After looking at the p-values, I can infer that there is a $95 \%$ probability that group A will outperform group B on the measure of the dependent variable (the course subject being tested) using the mean score as the number to report on the statistical differences in performance from that one school year on that specific exam.

### 4.4.1 Biology 12 - Are there significant differences between boys and girls on the Biology

## 12 exam from 1995-2005?

Table 4.11 summarizes the results of the t-tests analysis comparing the mean scores of males and females for school years where significant differences were found for the Biology 12 exam. From the ten school years tested for significant differences, five indicated different degrees of significant differences. Based on these findings, the null hypothesis that boys and girls exam scores are equal can be accepted for only five school years. For the alternate hypothesis that girls are doing better boys, only two school years supported this hypothesis (1997-1998 and 1998-1999) while three school years favored males (2000-2001, 2003-2004 and 2004-2005).

Table 4.11 Summary of T-Test results with significance for Biology 12

| Year | Gender |  |  |  |  |  | t | df |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |
| 1997-1998 | 60.72 | 23.72 | 5674 | 62.06 | 22.56 | 10360 | 3.52*** | 16032 |
| 1998-1999 | 61.34 | 23.78 | 5864 | 62.16 | 23.17 | 10771 | 2.16* | 16633 |
| 2000-2001 | 61.20 | 24.25 | 6375 | 60.19 | 24.57 | 12208 | 2.67** | 18581 |
| 2003-2004 | 67.45 | 18.24 | 5655 | 66.34 | 18.71 | 10278 | $3.616^{* * *}$ | 15931 |
| 2004-2005 | 67.83 | 18.94 | 5923 | 67.07 | 18.83 | 10641 | 2.468* | 16562 |

Figure 4.1 displays the mean scores for the Biology 12 exam over the ten school years.
The male and female exam performance was not uniform as there were years when males performed higher than females and vice versa. For the 1998-1999 and 1999-2000 school years, the difference in mean scores favored females by a 1-2 percent margin while for the school years of 1995-1996 and 1996-1997, the difference in mean scores was 0.4-0.6 percent in favor of males. Overall, in seven of the ten school years, females scored lower than males in the Biology 12 Exam.

Figure 4.1 Mean Scores for Biology 12 Exam


### 4.4.2 Communications 12 - Do Girls do better than boys on the Communications 12 exam

 from 1995-2005?Table 4.12 summarizes the results of the t-tests analysis comparing the mean scores of males and females for school years where significant differences were found for the Communications 12 exam. From the ten school years tested for significant differences, six indicated different degrees of significant differences. For the six school years that had significant differences, two of these school years had significant differences with p-values $<$ .001 , three school years had significant differences with p -values $<.05$, and 1 school year with a significant difference of $\mathrm{p}<.01$. Based on these findings, I have to reject the null hypothesis, the assumption that male and female exam scores are equal, and accept an alternate hypothesis, that the male students are performing lower than female students.

Table 4.12 Summary of T-Test results with significance for Communications 12

| Year | Gender |  |  |  |  |  | t | df |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |
|  | M | SD | n | M | SD | N |  |  |
| 1995-1996 | 54.79 | 27.69 | 4259 | 56.95 | 28.53 | 2508 | 3.06** | 6765 |
| 1998-1999 | 55.07 | 25.03 | 4585 | 56.48 | 26.07 | 2628 | 2.28* | 7211 |
| 2000-2001 | 53.70 | 25.77 | 5491 | 55.23 | 26.47 | 3103 | $2.629^{* *}$ | 8592 |
| 2001-2002 | 65.27 | 15.17 | 4890 | 66.47 | 15.81 | 2760 | 3.28*** | 7648 |
| 2002-2003 | 66.01 | 15.08 | 5116 | 67.08 | 16.10 | 2881 | 2.956** | 7995 |
| 2004-2005 | 64.96 | 13.54 | 4290 | 66.48 | 13.06 | 2327 | 4.420*** | 6615 |

Figure 4.2 displays the means scores for the Communications 12 exam over ten school years. With the exception of one school year (1997-1998) where the mean score for males was
higher than females (by 0.3 percent); females students scored higher than males for nine school years on the Communications 12 exam.

Figure 4.2 Mean Scores for Communications 12 Exam


### 4.4.3 English 12 - Do girls do better than boys on the English 12 exam from 1995-2005?

Table 4.13 summarizes the results of the t-tests analysis comparing the mean scores of males and females for school years where significant differences were found for the English 12 exam. For each school year, significant differences were found in the means scores with pvalues of $<.001$. Based on these findings, I have to reject the null hypothesis, the assumption that male and female exam scores are equal, and accept the alternate hypothesis, that the male students are performing lower than female students.

Table 4.13 Summary of T-Test results with significance for English 12

|  | Gender |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Year | Male |  |  |  |  |  |  |  |  |  | t | df |
| $1995-1996$ | 60.10 | 21.86 | 18340 | 64.95 | 20.98 | 19998 | $22.18^{* * *}$ | 38336 |  |  |  |  |
| $1996-1997$ | 60.62 | 21.99 | 19220 | 65.11 | 21.35 | 20936 | $20.8^{* * *}$ | 40 |  |  |  |  |
| $1997-1998$ | 59.79 | 21.24 | 20174 | 64.95 | 20.73 | 22113 | $25.25^{* * *}$ | 42285 |  |  |  |  |
| $1998-1999$ | 59.10 | 21.36 | 20946 | 64.45 | 20.65 | 22558 | $26.53^{* * *}$ | 43502 |  |  |  |  |
| $1999-2000$ | 59.17 | 21.67 | 21930 | 64.76 | 20.94 | 23523 | $27.98^{* * *}$ | 45451 |  |  |  |  |
| $2000-2001$ | 60.72 | 21.89 | 21829 | 65.38 | 21.32 | 23735 | $22.99^{* * *}$ | 45562 |  |  |  |  |
| $2001-2002$ | 65.10 | 15.63 | 20686 | 69.00 | 15.97 | 22817 | $25.66^{* * *}$ | 43501 |  |  |  |  |
| $2002-2003$ | 65.46 | 16.05 | 20926 | 69.17 | 16.44 | 23539 | $23.990^{* * *}$ | 44463 |  |  |  |  |
| $2003-2004$ | 66.94 | 13.19 | 18314 | 70.56 | 13.29 | 19952 | $26.716^{* * *}$ | 38264 |  |  |  |  |
| $2004-2005$ | 68.34 | 13.35 | 18896 | 72.20 | 13.52 | 20937 | $28.556^{* * *}$ | 39831 |  |  |  |  |
| $* * * \mathrm{p}<.001, * * \mathrm{p}<.01, * \mathrm{p}<.05$ |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 4.3 graphs the mean scores for the English 12 exam for the ten school years being tested. It is important to note that the difference in mean scores favoring females over males is fairly consistent at around four to five points each year. Results from PIRLS and NCES have also shown that females perform higher than males in literacy, of which the English 12 exam is the best barometer for students in British Columbia as this is a mandatory course for high school graduation.

Figure 4.3 Mean Scores for English 12 Exam

4.4.4 History 12 - Do girls do better than boys on the History 12 exam from 1995-2005?

Table 4.14 summarizes the results of the $t$-tests analysis comparing the mean scores of males and females for school years where significant differences were found for the History 12 exam. For each school year, significant differences were found in the mean scores with eight school years having p-values of $<.001$, one school year with a p-value $<.01$, and one school year with a p-value $<.05$. Based on these findings, I have to reject the null hypothesis, the assumption that male and female exam scores are equal, and accept the alternate hypothesis, that male students are performing higher than female students.

Table 4.14 Summary of T-Test results with significance for History 12

| Year | Gender |  |  |  |  |  | t | df |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |
| 1995-1996 | 63.26 | 22.36 | 4360 | 60.71 | 22.40 | 4715 | 5.43*** | 9073 |
| 1996-1997 | 63.09 | 22.36 | 4368 | 60.96 | 22.17 | 4719 | 4.56 *** | 9085 |
| 1997-1998 | 62.82 | 22.40 | 4759 | 61.85 | 22.20 | 4898 | 2.14** | 9655 |
| 1998-1999 | 65.15 | 21.98 | 4949 | 63.52 | 22.58 | 5185 | 3.69*** | 10132 |
| 1999-2000 | 65.40 | 21.73 | 5264 | 63.39 | 21.86 | 5304 | 4.74*** | 10566 |
| 2000-2001 | 68.38 | 21.64 | 5281 | 67.46 | 21.35 | 5473 | 2.23* | 10752 |
| 2001-2002 | 69.76 | 16.00 | 5630 | 68.40 | 16.38 | 5699 | $4.45 * * *$ | 11327 |
| 2002-2003 | 67.05 | 16.67 | 5910 | 66.61 | 17.32 | 5942 | 4.454*** | 11327 |
| 2003-2004 | 71.25 | 14.35 | 5124 | 69.37 | 15.63 | 4712 | 6.221*** | 9834 |
| 2004-2005 | 71.11 | 13.25 | 5151 | 69.48 | 14.57 | 5140 | $5.943^{* * *}$ | 10289 |

Figure 4.4 graphs the mean scores for the History 12 exam for the ten school years being tested. It is important to note that the difference in mean scores favoring males over females is around one to three percentage points each year. This is an interesting finding as History 12 is very much a literacy based course and with females having scored higher than males in the English 12 exam and the Communications 12 exam, the reversal takes place here with males performing higher than females.

Figure 4.4 Mean Scores for History 12 Exam


### 4.4.5 Principles of Mathematics 12 - Do boys do better than girls on the Principles of Mathematics 12 exam from 1995-2005?

Table 4.15 summarizes the results of the $t$-tests analysis comparing the mean scores of males and females for school years where significant differences were found for the Principles of Mathematics 12 exam. For each school year tested, significant differences were found in the means scores with nine school years having p-values of $<.001$ and one school year with a pvalue $<.05$. Based on these findings, I have to reject both the null hypothesis, the assumption that male and female exam scores would be equal, and accept the alternate hypothesis, that the male scores do not equal with female scores. I conclude also that with $95 \%$ probability, females are doing better than males for Principles of Mathematics 12 based upon the exam scores.

Table 4.15 Summary of T-Test results with significance for Principle of Mathematics 12

| Year | Gender |  |  |  |  |  | t | df |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |
|  | M | SD | n | M | SD | n |  |  |
| 1995-1996 | 61.09 | 25.87 | 10699 | 61.99 | 24.02 | 9254 | 2.539* | 19951 |
| 1996-1997 | 59.68 | 27.25 | 11499 | 61.39 | 25.11 | 9908 | 4.76*** | 21405 |
| 1997-1998 | 60.56 | 26.89 | 12165 | 63.11 | 24.31 | 10422 | 7.42*** | 22585 |
| 1998-1999 | 60.36 | 27.01 | 12688 | 61.75 | 25.29 | 10655 | 4.04*** | 23341 |
| 1999-2000 | 60.69 | 27.37 | 13116 | 62.64 | 25.66 | 10933 | 5.65*** | 24047 |
| 2000-2001 | 62.76 | 26.95 | 13389 | 64.67 | 25.25 | 11555 | 5.74*** | 24942 |
| 2001-2002 | 69.18 | 20.33 | 11323 | 71.61 | 19.55 | 9653 | 8.77*** | 20974 |
| 2002-2003 | 69.81 | 20.94 | 12116 | 71.78 | 19.53 | 10600 | 7.223*** | 22714 |
| 2003-2004 | 68.31 | 18.10 | 8806 | 69.65 | 17.12 | 7860 | 4.916*** | 16664 |
| 2004-2005 | 69.51 | 18.20 | 9072 | 71.38 | 16.83 | 8127 | 6.994*** | 17197 |

Figure 4.5 graphs the mean scores for the Principles of Mathematics 12 exam for the ten school years being tested. It is important to note that the difference in mean scores favoring females over males is very minute for some school years (less than one percentage point difference) while for other school years, it can be up to three percent point difference.

Figure 4.5 Mean Scores for Principles of Mathematics 12 Exam


### 4.4.6 Physics 12 - Do boys do better than girls on the Physics 12 exam from 1995-2005?

Table 4.16 summarizes the results of the t-tests analysis comparing the mean scores of males and females for school years where significant differences were found for the Physics 12 exam. For each school year tested, nine significant differences were found in the means scores over nine years with six school years having p-values of $<.001$, and three school years with pvalues $<.05$. For one school year (2004-2005), I have to accept the null hypothesis. Based on the findings for the nine school years indicating significant differences, I have to reject the null hypothesis, the assumption that male and female exam scores are equal, and accept the alternate hypothesis, that the male student exam scores do not equal the female student exam scores. The results of the tests show that females are doing better than males in the Physics 12 exam for nine school years, from 1995-2004.

Table 4.16 Summary of T-Test results with significance for Physics 12

| Year | Gender |  |  |  |  |  | t | df |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Male |  |  | Female |  |  |  |  |
|  | M | SD | N | M | SD | N |  |  |
| 1995-1996 | 63.70 | 25.70 | 5055 | 66.82 | 22.81 | 2313 | 5.01 *** | 7366 |
| 1996-1997 | 64.39 | 26.67 | 5273 | 65.68 | 25.32 | 2159 | 1.92* | 7430 |
| 1997-1998 | 64.74 | 24.48 | 5501 | 67.06 | 22.92 | 2310 | 3.89*** | 7809 |
| 1998-1999 | 65.79 | 26.08 | 6044 | 67.93 | 24.82 | 2442 | $3.47 * * *$ | 8484 |
| 1999-2000 | 65.71 | 26.96 | 6276 | 68.97 | 24.29 | 2653 | 5.37*** | 8927 |
| 2000-2001 | 65.55 | 24.60 | 6255 | 66.84 | 23.51 | 2609 | 2.28* | 8862 |
| 2001-2002 | 68.21 | 20.45 | 6018 | 70.67 | 18.22 | 2478 | $5.19{ }^{* * *}$ | 8494 |
| 2002-2003 | 67.91 | 20.40 | 5948 | 71.68 | 19.08 | 2577 | 8.002*** | 8523 |
| 2003-2004 | 69.53 | 18.52 | 5098 | 70.64 | 17.19 | 2303 | 2.439* | 7399 |

Figure 4.6 graphs the mean scores for the Physics 12 exam for the ten school years tested. It is important to note that the difference in mean scores favoring females over males is very minute for some school years (just slightly over 1 percent difference) while for other school years, it can be up to a 4 percent difference. This is an interesting finding and one that requires a more detailed study of Physics 12.

Figure 4.6 Mean Scores for Physics 12 Exam


### 4.5 Conclusion

In this chapter, I reported findings after running 60 independent $t$-tests to examine whether there are significant differences between males and females for six provincial exams: Biology 12, Communications 12, English 12, History 12, Principles of Mathematics 12, and Physics 12. There were significant differences found in mean scores between the groups for all six subject exams. While the findings for the English 12 exam, the Communications 12 exam, the Biology 12 exam, the Physics 12 exam, and the Principles of Mathematics 12 exam can be supported by literature along with reports gathered from other nationwide standardized tests, History 12 is a unique situation where the findings are somewhat interesting. A note of caution should be mentioned again that there is always a possibility of a type 1 error due to statistical limitations, so a 95\% confidence interval is used when examining the p-values for statistical differences.

In the next chapter, I discuss more of the findings, their implications and some recommendations for educators, students and researchers.

# Chapter 5 - Summary, Discussion and Recommendations 

### 5.1 Introduction

This chapter is organized into three sections. The first section is the Summary, the key findings from this study concerning the performance of males and females within British Columbia's school system based upon the results of independent $t$-tests to answer the null hypotheses. The second section is the Discussion of the findings, with comments about what were some consistent and some unexpected findings. The third and final section is Recommendations, suggestions on what areas to focus and implications for teachers, students, and researchers along with questions for further research.

### 5.2 Summary

This study has used statistical exam data obtained from the Ministry of Education to analyze whether there are significant differences in the performance of male and female students for six provincially examable subjects over ten school years. Analyses of the data through independent $\mathbf{t}$-tests have revealed that there are significant differences in mean scores for each of the exams written: 1.Biology 12 for 5 school years, 2 . Communications 12 for 6 school years, 3 . English 12 for 10 school years, 4. History 12 for 10 school years, 5. Principles of Mathematics 12 for 10 school years, and 6 . Physics 12 for nine school years.

### 5.2.1 Biology 12 Exam

In the Biology 12 exam, of the ten school years tested, five school years were found to have significant differences between male scores and female scores. For the five school years where no significant differences were found, the null hypothesis that male scores and female
scores are equal was accepted. For the five school years where significant differences were found, the null hypothesis was rejected. The alternate hypothesis, that male scores are lower than female scores was accepted for two school years as female students scored higher than male students. However, in the remaining three school years, male students were found to be scoring higher than female students. This is an interesting finding as over a ten year period, no definitive conclusion can be made other than to report that in some years, the significant differences favor males, in other years, they favor females, and in other years, there are no significant differences.

### 5.2.2 Communications 12 Exam

In the Communications 12 exam, of the ten school years tested, six school years were found to have significant differences between male scores and female scores. For the four school years tested where no significant differences were found, the null hypothesis that male scores and female scores are equal was accepted. For the remaining six school years where significant differences were found, the alternate hypothesis, that male scores are lower than female scores was accepted as female students were found to be performing better than male students.

### 5.2.3 English 12 Exam

In the English 12 exam, of the ten school years tested, all school years were found to have significant differences between male scores and female scores. The null hypothesis that male scores and female scores are equal was rejected and the alternate hypothesis, that male scores are lower than female scores was accepted as female students were found to perform better than male students for those ten school years.

### 5.2.4 History 12 Exam

In the History 12 exam, of the ten school years tested, all school years were found to have significant differences between male scores and female scores. The null hypothesis that male scores and female scores are equal was rejected and the alternate hypothesis, that male scores are higher than female scores was accepted as male students were found to be performing higher than female students in those ten school years.

### 5.2.5 Principles of Mathematics 12 Exam

In the Principles of Mathematics 12 exam, of the ten school years tested, all school years were found to have significant differences between male scores and female scores. The null hypothesis that male scores and female scores are equal was rejected and the alternate hypothesis, that male scores and female scores are not equal was accepted. The results of the independent t-tests found female students to perform better than male students in those ten school years.

### 5.2.6 Physics 12 Exam

In the Physics 12 exam, of the ten school years tested, nine school years were found to have significant differences between male scores and female scores. For the one school year where no significant difference was found, the null hypothesis that male scores and female scores are equal was accepted. For the remaining nine school years where significant differences were found, the null hypothesis was rejected and the alternate hypothesis, that male scores and female scores are not equal was accepted. The results of the independent $t$-tests found female students performed better than male students in those nine school years.

### 5.3 Discussion

This study has shown that significant differences were found in mean scores between male students and female students in six provincially examable subjects: Biology 12, Communications 12, English 12, History 12, Principles of Mathematics 12, and Physics 12. While the available data is for ten school years, the significant differences found do not completely support the argument that one gender is better than the other gender for all subjects tested.

## Biology 12

As students near the end of their secondary schooling, course selection is critical for those who aspire to enter into a science faculty at a post-secondary institution with the hope of future studies in the medical field. Entrance into a university's science faculty such as UBC will require the completion of courses such as Chemistry 12, Physics 12, Principles of Mathematics 12 or Biology 12. In the Biology 12 exam, more female students wrote it compared to male students by a 2-1 margin. However, there were only two school years where the significant differences of mean scores favored female students, while there were three school years where the significant differences of mean scores favored male students.

The findings for the Biology 12 exam are that Biology 12 is a course that depends much upon interest. Women may be more nurturing and empathetic than men (Taber, 1991). As the completion of Biology 12 would allow students to enter into the medical field, this supports the observations of women in medicine, either as nurses, doctors, or pharmacists (Statscan, 2000). A natural self selection process may take place for male students as those who are more interested
in cars and machinery are more likely to enroll in a course on automotives or welding compared to an immensely academic course such as Biology 12 (Elwood, 1999).

Another important factor to keep in mind is that because there is a self selection process for a course like Biology 12, those male students who decide to enroll in a Biology 12 course are more likely to show more interest in a subject that they are pursuing, which may result in higher scores than those who show limited interest (Robertson, 2000).

## Physics 12 \& Principles of Mathematics 12

Principles of Mathematics 12 is a course that is mandatory for students interested in entering into an applied science faculty such as engineering, the faculty of commerce, or other science related faculties (UBC Calendar, 2005). Similarly, Physics 12 is a course that is required for engineering and highly recommended for science faculties.

Findings in this research project led me to conclude that females are doing better in both Principles of Mathematics 12 and Physics 12. The idea that females are doing better than males in a course like Principles of Mathematics 12 is very surprising. Examining the number of students who wrote the Principles of Mathematics 12 exam, there were slightly more male students compared to female students enrolled in Principles of Mathematics 12. What is also important to note is that the mean scores for female students in the Principles of Mathematics 12 exam was higher than male students by an average of $2 \%$ over the ten school years.

Thompson \& Ungerleider (2004) in their research of literature from 1990-2004 found that on the topic of single sex classrooms, more emphasis was placed on improving female students' performance in the areas which were typically seen as male such as mathematics (p.4). Keeping in mind that there is a chance for a type 1 error, the $95 \%$ confidence interval, this finding that
girls are actually doing better than boys in mathematics is supported by Kimball's (1989) argument.

For Physics 12 , the finding that male students are performing lower than female students is interesting. Looking closely at the enrollment numbers for the Physics 12 exam, more male students were enrolled than female students by a 2-1 margin. Nashon (2005) argues that.there are more male students because of its prestige. Examining the mean score differences between male students and female students in the Physics 12 exam show that they are similar to the findings in the Principles of Mathematics 12 exam, an average of $2 \%$ difference in favor of female students.

Similar to Biology 12, Physics 12 is also a course that attracts students due to its post secondary implications. A self selection process takes place where only those students who are interested will enroll in this course. A student's interest in the subject matter plays a huge role in their success in the course, especially in Mathematics and Physics as Koller and Baumert (2001) argues. As Physics 12 is similar to Mathematics 12 courses with a heavy emphasis on formulas and equations, this may be a reason why fewer female students enroll in Physics 12. Girls have also been found to do better in memorization than boys. When given the choice to choose between Biology 12 and Physics 12, more girls have enrolled in Biology 12 (Ministry of Education, 2003).

## Communications 12 \& English 12

In the final two years of secondary school, the mandatory requirement for graduation is to complete either Communications 12 or English 12. While the course content for Communications 12 and English 12 may be similar to a certain degree, it is widely
acknowledged that for a student to enter into any post-secondary institution, the completion of English 12 is mandatory (UBC Calendar, 2005). The completion of Communications 12 is perceived to be far inferior and would be the requirements for a school leaving certificate instead of the Dogwood certificate.

With the findings from this research project supporting the statement that boys are scoring lower than girls for the ten school years tested for English 12 exam, this continues to support the findings in other nationwide testing such as PIRLS (2003) and NCES (2004) that girls continue to score higher than boys. As I discussed earlier, the arguments about what type of literacy being assessed (see Newkirk) and the choice of books being studied in English courses have an impact on boys (Warrington \& Younger, 2003).

In Communications 12, more boys wrote the exam compared to girls by a 2-1 margin. Frequently, male students who struggle in regular English end up taking Communications 12, as suggested by their school counselors, in order to assist them in meeting the minimum graduation requirements. A closer look at the students enrolled in Communications 12 would reveal that those who take it are students (both male and female) who are "at risk" students or have had poor success in schooling. While the number of female students enrolled is substantially smaller, the mean score differences indicate that similar to results on the English 12 exam, female students are performing better than male students.

## History 12

History 12 is an elective course and students who enroll in it generally have an interest in this subject. A closer look at the enrollment levels show that the number of boys and girls were at times almost equal with a $1-4 \%$ difference. The findings in this research project showing
significant differences in mean scores between male and female students in favor of male students, leads me to conclude that literacy in History 12 is not the same as literacy in English 12 or Communications 12. The arguments that male students are doing poorly in reading and writing (NCES, 2004) when compared to female students, may not be valid in History 12.

The curriculum for History 12 is one that encompasses both reading and writing along with the abilities to reason, discuss, and memorize. In fact, the argument could be made that there may be more to memorize in History 12 than Biology 12 as one would need to know dates, people, places and events. Gurian (2001) comments that "males tend to like abstract arguments, philosophical conundrums, and more debates about abstract principles" (p.45). Examining the interests of male students, males are more likely to be attracted to violence and strategy scenarios. Of all the academic courses for students to take, History 12 sparks the most interest for boys fascinated about history and politics.

### 5.4 Recommendations

In this section, I will present four recommendations regarding this topic of gender performance. It must be noted that some of the recommendations come from observations of classroom involvement and discussions with fellow teachers and educators from the schools where I have taught.

## Recommendation \#1: Single sex class configuration

Research and review single-sex classes in public schools.
Arguments have been made by researchers that single-sex classes do not necessarily help a gender group in improving performance (Gallagher, 1996). The opposite occurs when looking at schools in British Columbia that are single sex. Whether it is an all boys school (ie. St.

Georges) or an all girls school (ie. York House, Crofton House), students enrolled in single sex classes have seemingly performed better than those in public coed schools. It must be acknowledge that private schools do have an entrance exam and that students attending coeducational private schools perform higher than public schools.

As public schools in British Columbia aim to be inclusive, the performance of both male and female students needs to be revisited. In my own experience as an educator in the public school system, providing a single-sex class option in public schools is one method of addressing the gender performance of both boys and girls, especially in the sciences and humanities areas. While personally never having taught a single sex class, it should be noted that single-sex classes can be beneficial to both boys and girls, not exclusively to only one gender. Gillibrand et al. (1999) commented that for girls who enrolled in single-sex classes, it helped to boost their marks and confidence in their abilities for physics and mathematics. Students in senior courses at secondary schools such as Mathematics 12, Biology 12, Physics 12 or History 12, focus on entrance into university. The purpose of single sex-classes is to address the unique needs of boys and girls (Jackson, 2002).

Sax (2005) argues that males are more active and tend to have difficulties sitting still while the opposite happens for girls as they are more likely to want a quiet environment (Spencer et al., 2003). By having single-sex classes, students can learn in environments that would appeal to them as demonstrated by Jefferson Leadership Academies in Long Beach (Ritsch, 2002), and in British Columbia, Lake Trail Middle School on Vancouver Island (Philips, 2003). Both of these schools encountered success for their students after single-sex classes were offered in the core academic areas. Ferrera (2005) notes too that teachers have a critical role to play in the success of single-sex classes, as her findings from a middle school showed a drop in behavior
referrals as well as for attendance in male single-sex classrooms, important factors to contributing to a well conducive learning environment.

## Recommendation \#2: Literature taught in English classes

## Research and review materials used in English classes.

Literacy as defined by Dictionary.com is the state of being literate or the ability to read and write. As English 12 and Communications 12 are courses that are mandatory for graduation, the frequent source of contention is what types of books to read, topics to discuss, and content to ,cover for these courses. Educators have freedom to determine what to teach in their classes. What needs to be acknowledged is that there are multiple forms of literacies.

Newkirk (2002) argues that boys have literacy in areas that are not often tested on standardized exams. The role of English and Communications courses are to:

Provide students with the opportunity to study literary and informational (including technical) communications and the mass media and thereby experience the power of language. Students are presented with a window into the past, a complex portrayal of the present, and questions about the future. They also come to understand language as a human system of communicationdynamic and evolving, but also systematic and governed by rules. (BC Ministry of Education IRP, 1996)

To understand how to read box scores for sports, a car manual, or the schematics to fix it, are highly complex and require some critical thinking skills. In the frantic pace to cover course content, it is also important for teachers and educators to address the needs of the technologically driven students who, today, are exposed to a vastly different learning environment than previous generations of children. The Integrated Resource Package (IRP) notes that students should be exposed to different forms of communications. Teachers can incorporate more current events, stories pertaining to cars or sports related topics to generate more interest in boys towards English and Communications.

Taylor (2003) notes that boys learn better when the ethos of the school allows them to work hard without seeming 'uncool' (Van Houtte, 2004). By incorporating different materials looking at sports, cars, technology in novels or learning units into Language Arts (English) at an early age, this may provide male students with topics that spark their interest and thus allow them to grow in their enjoyment of their classes.

## Recommendation \#3: Realizing the benefits of schooling

Research the use of positive reinforcement in order to assist students in achieving their maximum potential.

Motivation is an important tool that educators can use to assist students when they encounter a difficult course. Sherman (1982) noted that confidence in oneself plays a huge role for girls in mathematics. Koller and Baumert (2001) also argued that there is a relationship between academic interest and achievement, namely in senior mathematics since senior level courses are elective courses and require more self-motivation. As Sax (2005) commented, a teacher's praise can have an impact on a child's emotional state towards a celass or subject. There are different aspects to education though as not everything is school related. Wasonga et al. (2003) commented that the non-instructional aspects of schooling have a role in how urban students perform and that there should be more activities that promote social bonding and life skills.

In light of boys having a higher number of drop outs than girls (Statscan, 2000) and the fact that there are more female teachers than male teachers in the education system (Ministry of Education, 2005), motivation is a tool that educators can use to inspire students, to view schooling and education as an environment that understands and accepts boys for who they are
(Maynard, 2002; Nichols, 2002). Through my observations as a teacher in a secondary school setting, genuine praise from teachers can inspire their students to succeed at a task at hand and reinforce teaching.

## Recommendation \#4: Professional Development for teachers to address different learning styles

Research professional development for teachers with a focus on assisting teachers in adjusting their teaching styles to better address the learning of children.

Teachers often complain about the demands of the profession and that there is very little time for them to incorporate new ideas into their teaching. With the constant struggle of school districts concerning budgetary constraints and many schools facing declining enrollment, many teachers in the public schools in British Columbia are exhausted from uncertainties in their school environment. As a practicing teacher, I too have encountered the vast demands placed on teachers today, yet in my opinion, professional development is one area that generates and provides new ideas on how to improve my teaching and interaction with students. I believe that teachers should be encouraged to test out new teaching methods and ideas.

Boys are by nature competitive and thrive on competitions (Taylor, 2003, Younger et al. 2002). Since boys are more active learners (Sax, 2005), activities that are well thought out, allow them to feel confident in their abilities. Limits do need to be set since boys respond well to teachers with "clear limits and high expectations" (Taylor, 2003, p. 7). The idea that one teaching style suits all or that all children learn the same is not supported by researchers (Gurian \& Henley, 2001; Sax, 2005; Younger et al., 2002).

Teachers shoulder a large burden today as western society has changed dramatically with the disappearance of a nuclear family, and the diversity of ethnicities found in many countries.

With these new parameters, I believe that teachers need to model and demonstrate reflective teaching and learning in order to address shortcomings in the current teaching environment. As demonstrated by the fact that there are significant differences found in the exam mean scores between boys and girls for all six subject exams, administrators, teachers along with concerned parents must work together and attempt to provide a learning environment that is not only comprehensive, but challenging to all students.

## Questions for further research

While this study has revealed that there are significant differences in the exam results between male and female students for the six provincially examable subjects of Biology 12, Communications 12, English 12, History 12, Principles of Mathematics 12, and Physics 12 for 10 school years, a number of other important questions have arisen. These questions pertain to what should teachers, educators, and policy makers do to address the different needs of students.

Do differences in performance really matter? Does the performance of students in high school exams correlate with future success in post-secondary? What about the role of families? Is there a causal effect on student performance in British Columbia, especially since there has been a huge influx of immigrants into the Lower Mainland? The change in population demographics with the increased number of immigrants and refugees has forced school districts to address non-English speaking parents. What impact do they have on the changes into our education system?

Not much has been said in this research project concerning technology, but there is no denying the fact that technology has had an impact on society and that children are less sheltered than they were 20 years ago. How does technology impact gender performance in these six
subjects? What about distance or distributed learning? How do students perform in classrooms that may not necessarily be meeting all the time?

The issue of single sex classes has been raised as a way to help improve gender performances in Physics, Mathematics along with English and Communications. Since very few public schools have promoted this as part of their course selection, perhaps the question that needs to be further examined is why teachers as a group do not feel necessarily comfortable in teaching single-sex classes? Are ideological differences playing a role in limiting the idea of single-sex classes?

Lastly, to follow along with the single-sex class theme is to dig deeper and examine how public schools perform compared to private schools. The Fraser Institute has analyzed students' performance on a school to school comparison. What would be much more interesting would be to compare the top students in public schools, students generally attending co-ed classes, to the top students in private schools, students generally attending single-sex classes. A detailed analysis of gender performance on the same six academic subjects would provide a much clearer picture about methods to address the needs of students along gender lines.

## Thesis Summary

The origins of this research came from a belief that the gender differences in academic performance in British Columbia are an area that needs further study. The Ministry of Education in British Columbia is one of the most research friendly public education ministries in Canada and with the plethora of data that are available (with a small fee of course!), statistical analyses can be completed to address questions concerning gender performance and participation for all courses at different grade levels.

As this research project only focuses on senior level courses for six provincially examable subjects, it must be noted that self-selection takes place because students often do not continue in certain courses if they do not have a favorable opinion of the course. Reasons for difficulties in a subject or course can range from a student's difficulties with a teacher, to problems in home life, to bullying. What I must emphasize is the purpose of this research project, which was to examine gender differences in performance to create dialogue and discussion on how to address the needs of students today.

The findings present to us a snapshot regarding the performance of students disaggregated by gender. What it limits and is unable to tell is the story behind the children that wrote these tests. Differences are expected as no one individual is exactly alike. In education, the focus in exams should be a celebration of learning for the betterment of society, not for individual gain. The schooling of children with an emphasis on morals and respect is what should be kept in the forefront when addressing the issue of gender differences in performance. Differences should be celebrated if the sum of the differences produces a society that values and cherishes not only the collective, but the individual.

## Bibliography

Alloway, N., \& Gilbert, P. (1997). Boys and literacy: Lessons from Australia. Gender \& Education, 9 (1), 49-61.

Bacharach, V. R., Baumeister, A. A., \& Furr, R. M. (2003). Racial and gender science achievement gaps in secondary education. Journal of Genetic Psychology, 164 (1), 115126.

Bell, J. F. (2001). Investigating gender differences in the science performance of 16-year-old pupils in the UK. International Journal of Science Education, 23 (5), 469-486.

Bearne, E., \& Warrington, M. (2003). Raising boys' achievement. Literacy Today, 35, 18-19.

Bland, J. (2005). About gender definitions. Retrieved September 24, 2007 from http://www.gender.org.uk/about/00_defin.htm .

British Columbia Teachers' Federation. (2002, December). BCTF brief to the Student Achievement Task Force. Retrieved October 19, 2005 from http://www.bctf.ca/publications/briefs/StudentAchievement.html

British Columbia Ministry of Education. (2002). Number of regular and regular honors graduates by gender and district/authority. Retrieved on October 19, 2005 from http://www.bced.gov.bc.ca/exams/trax/2002_trax5016c.txt

British Columbia Ministry of Education. (2002). Grade 12 graduates as a percentage of possible graduates by gender and district. Retrieved on October 19, 2005 from http://www.bced.gov.bc.ca/exams/trax/2002_trax1563c.txt

British Columbia Ministry of Education. (2002). Provincial scholarships by gender and district. Retrieved on October 19, 2005 from http://www.bced.gov.bc.ca/exams/trax/2002_trax2210c.txt

British Columbia Ministry of Education. (2003). Grade 7 FSA results. Retrieved October 19, 2005 from http://www.bced.gov.bc.ca/assessment/fsa/results/reports/prov.pdf

British Columbia Ministry of Education. (2003). Grade 10 FSA results.
British Columbia Ministry of Education. (2003). Coquitlam SD 043, grade 10 FSA results. Retrieved October 19, 2005 from http://www.bced.gov.bc.ca/assessment/fsa/results/2003/dist04310.pdf

British Columbia Ministry of Education. (2003). Coquitlam SD 043, grade 7 FSA results. Retrieved October 19, 2005 from http://www.bced.gov.bc.ca/assessment/fsa/results/2003/dist04307.pdf

Byfield, T. (1995). Is there gender bias in the schools? You bet: Add up the teaching staff. Newsmagazine, (22), 16.

Campbell, K. T., \& Evans, C. (1997). Gender issues in the classroom: A comparison of mathematics anxiety. Education, 117 (3), 332-339.

Cohen, J. (1977). Statistical power analysis for the behavioral sciences. New York: Academic Press.

Connell, R.W. (1995). Masculinities. Cambridge, UK: Polity Press.
Connell, R.W. (1996). Teaching the boys: New research on masculinity, and gender strategies for schools. Teacher College Record, 98 (2), 206-235.

Council of Ministers of Education, Canada (2002). School Achievement Indicators Program, report on writing assessment III. Retrieved July 25, 2007, from http://www.cmec.ca/pcap/scribe3/public/highlights.en.pdf

Eccles, J.S., \& Jacobs, J.E. (1986). Social forces shape math attitudes and performance. Signs: Journal of Women in Culture and Society, 11 (2), 367-389.

Elwood, J. (1999). Gender, achievement and the 'Gold Standard': Differential performance in the GCE A level examination. The Curriculum Journal, 10 (2), 189-208.

Extrom, R.B. (1994). Gender differences in high school grades: An exploratory study. New York: College Examination Board.

Forbes.com. (2005). The richest people in America. Retrieved on July 25, 2007 from http://www.forbes.com/richlist

Ferrara, M. (2005). The single gender middle school classroom: A close-up look at gender differences in learning. Australian Association for Research in Education. Retrieved September 23, 2007, from http://www.aare.edu.au/05pap/fer05090.pdf

Fraser Institute Report. (2005). Report card on British Columbia's secondary schools: 2005 edition - overall school rankings. Retrieved July 25, 2007 from
http://www.fraserinstitute.ca/admin/books/chapterfiles/70BCESC05RAN2.pdf\#
Gall, M., Gall, P., \& Borg, W. (2003). Educational research, ( $7^{\text {th }}$ ed.) New York: Allyn and Bacon.

Gallagher, S.A. (1996). A new look (again) at gifted girls and mathematics achievement. Journal of Secondary Gifted Education, 7 (4), 459-475.

Gillibrand, E., Robinson, P., Brawn, R,. \& Osborn, A. (1999). Girls' participation in physics in single sex classes in mixed schools in relation to confidence and achievement. International Journal of Science Education, 21 (4), 349-362.

Girls get extra school help while boys get ritalin. (2003, August 29). USA TODAY, p. 8A.
Guiran, M., \& Henley, P. (2001). Boys and girls learn differently: A guide for teachers and parents. San Francisco: Jossey-Bass Books.

Head, J. (1999). Understanding the boys: Issues of behaviour and achievement. New York: Palmer Press.

Hyde, J. S. \& Linn, M. C. (1988). Gender differences in verbal ability: A meta-analysis. Psychological Bulletin, 107, 139-153.

ITED - Iowa Testing Program (2002). Interpreting Test Scores. Retrieved September 23, 2007, from http://www.education.uiowa.edu/itp/ited/ited_interp_score.htm

Jackson, C. (2002). Can single-sex classes in co-educational schools enhance the learning experiences of girls and/or boys? An exploration of pupils' perceptions. British Educational Research Journal, 28 (1), 37-49.

Johnson, S. (1987). Early-developed sex differences in science and mathematics in the United Kingdom. The Journal of Early Adolescence, 7 (1), 21-33.

Kenway, J., Willis, S., Blackmore, J., \& Rennie, L. (1998). Answering back: girls, boys, and feminism in schools. New York: Routledge.

Kimball, M. (1989). A new perspective on women's math advancement. Psychological Bulletin, 105 (2), 198-214.

Klein, J. (2004). Who is most responsible for gender differences in scholatstic achievements: pupils or teachers? Educational Research, 46 (2), 183-193.

Koller, O., Baumert, J. \& Schnabel, K. (2001). Does interest matter? The relationship between academic interest and achievement in mathematics. Journal for Research in Mathematics Education, 32 (5), 448 - 470.

Long Beach Unified School District. (2000). Long Beach single-gender classes show gains.
Retrieved July 25, 2007 from
http://www.lbusd.k12.ca.us/public information/2000 news articles/n000519b.asp

Lupart, J.L., Cannon, E., \& Telfer, J.A. (2004). Gender differences in adolescents academic achievement, interests, values and life-role expectations. High Ability Studies, 15 (1), 2542.

Matters, G., Allen, R., Gray, K., \& Pitman, J. (1999). Can we tell the difference and does it matter? Differences in achievement between girls and boys in Australian senior secondary education. The Curriculum Journal, 10 (2), 283-302.

Maynard, T. (2002). Boys and literacy: Exploring the issues. New York: Routledge Falmer.
McGee Bailey, S. \& Campbell, P. B. (1999). The gender wars in education. Wellesley Centers for Women, Wellesley, MA.; Retrieved July 28, 2007 from $\underline{\text { http://www.wcwonline.org/joomla/index.php?option=com_content\&task=view\&id=631 }}$ \& ltemid=208

McTeer, J.H., Blanton, F.L., \& Lee, H.W. (1975). The relationship of selected variables to student interest in social studies in comparison with other academic areas. Journal of Educational Research, 68 (6), 238-40.

Nashon, S. M. (2005). Reflections from pre-service science teachers on the status of Physics 12 in British Columbia. Journal of Physics Teacher Education Online, 3(1) 25-32.

National Association for Single Sex Public Education. (2003). Single-sex schools. Retrieved July 25, 2007 from http://www.singlesexschools.org/bulletin.html

National Center for Education Statistics. (2003). National Assessment of Educational Progress - reading results. Retrieved July 25, 2007 from http://nces.ed.gov/nationsreportcard/reading/results2003/gendscoregaps.asp

National Center for Education Statistics. (2003). National Assessment of Educational Progress - math Results. Retrieved July 25, 2007 from
http://nces.ed.gov/nationsreportcard/mathematics/results2003/gendscoregaps.asp
National Centre for Educational Statistics (2004). Trends in Educational Equity of Girls \&
Women. Retrieved July 25, 2007, from http://nces.ed.gov/pubs2005/equity/Section4.asp
Newkirk, T. (2002). Misreading masculinity: boys, literacy, and popular culture. Portsmouth, NH: Heinemann.

Nichols, Sue (2002). Parents' construction of their children as gendered, literate subjects: A critical discourse analysis. Journal of Early Childhood Literacy, 2-2, 123-144.

Noble, C. \& Bradford, W. (2000). Getting it right for boys ... and girls. London: Routledge.

O'Conner, S. A., \& Miranda, K. (2002). The linkages among family structure, self-concept, effort, and performance on mathematics achievement of American high school students by race. American Secondary Education, 31 (1), 72-95.

Penner, A. M. (2003). International gender X item difficulty interactions in mathematics and science achievement tests. Journal of Educational Psychology, 95 (3), 650-655.

Peritz, I. (2003, February 1). Where the boys are. Globe and Mail, p. F8.
Philips, S. (2003). Tracking the trends - tackling the gender gap. Education Analyst - Society of the Advancement of Excellence in Education, 7(3), 6-7. Retrieved July 25, 2007 from http://www.saee.ca/analyst/C_019.2_FFH_LON.php

Preece P.F.W., Skinner N.C., \& Riall R.A.H. (1999). The gender gap and discriminating power in the National Curriculum key stage three science assessments in England and Wales. International Journal of Science Education, 21 (9), 979-987.

Programme for International Student Assessment (2003). The 2003 Canadian Report Measuring Up: Canadian results of the OECD PISA study - The performance of

Canada's youth in mathematics, reading, science and problem solving. Retrieved July 25, 2007, from http://www.pisa.gc.ca/brochur e.pdf

Robertson, I. J. (2000). Influences on choice of course made by university year 1 bioscience students--A case study. International Journal of Science Education, 22 (11), 1201-1218.

Ritsch, M. (2002, May 28). Single-gender schools gaining favor, success. Los Angles Times. Retrieved on November 26, 2003 from http://www.middleweb.com/MWLresources/aaGender1.htmI

Sax, L. (2005). Why gender matters: What parents and teachers need to know about the emerging science of sex differences. New York: Doubleday

Schofield, H. (1982). Sex, grade level, and the relationship between mathematics attitude and achievement in children. Journal of Educational Research, 75 (5), 280-284.

School gives high marks for single-sex classes. (2002, November 24). CBC News Online. Retrieved on July 25, 2007 from http://www.cbc.ca/stories/2002/11/24/singlesex_classes021124

Sharpe, W. (2000, April). Single sex classes: Are they better? Education World.Com. Retrieved on July 25, 2007 from http://www.education-world.com/a curr/curr215.shtml

Sherman, J. (1982). Continuing in mathematics: A longitudinal study of the attitudes of high school girls. Psychology of Women Quarterly, 7 (2), 132-141.

Sherman, J., \& Fennema, E. (1977). The study of mathematics by high school girls and boys: related variables. American Educational Research Journal, 14 (2), 159-68.

Skelton, C. (2001). Schooling the boys: masculinities and primary education. Buckingham: Open University Press.

Spencer, R., Porché, M., \& Tolman, D. (2003). We've come a long way - maybe: New challenges for gender equity in education. Teachers College Record, 105 (9), 1774-1807. Statistics Canada (2000). Education in Canada. Retrieved July 25, 2007 from http://www.statcan.ca/english/freepub/81-229-XIB/0000081-229-XIB.pdf

Statistics Canada (2002). At a crossroads: first results for the 18-20 year-old cohort of the Youth in Transition Survey. Retrieved July 25, 2007 from http://www.statcan.ca/english/freepub/81-591-XIE/81-591-XIE2000001.pdf

Statistics Canada (2003). University degrees, diplomas and certificates. Retrieved July 25, 2007 from http://www.statcan.ca/Daily/English/051011/d051011d.htm

Stumpf, H., \& Stanley, J. (1996). Gender-related differences on the College Board's Advanced Placement and achievement tests, 1982-1992. Journal of Educational Psychology, 88 (2), 353-364.

Stumpf, H., \& Stanley, J. (1998). Stability and change in gender-related differences on the College Board Advanced Placement and achievement tests, Psychological Science, 7, (6):192-196.

Taber, K. S. (1991). Gender differences in science preferences on starting secondary school. Research in Science and Technological Education, 9 (2), 245-252.

Tai, R.H. \& Sadler, P. (2001). Gender differences in introductory undergraduate physics performance: university physics versus college physics in the USA. International Journal of Science Education, 23 (10), 1017-1037.

Taylor, D. (2003). The 'cool', 'uncool' influence of the school ethos on boys' achievement. Education Journal; 71,7-8.

Taylor, D., \& Lorimer, M. (2003). Helping boys succeed. Educational Leadership, Vol. 60 Issue 4, p68-69.

Tyre, P., Murr, A., Juarez, V., Underwood, A., Springen, K., Wingert, P. (2006). The trouble with boys. Newsweek, 147 (5), 44-52.

Thompson, T., \& Ungerleider, C. (2004). Single sex schooling - the final report. The Canadian Centre for Knowledge Mobilization. Retrieved on September 23, 2007 from http://www.cckm.ca/pdf/SSS\ Final\ Report.pdf

UNESCO (1994). World declaration on education for all. Retrieved July 25, 2007, from http://unesdoc.unesco.org/images/0012/001275/127583e.pdf

United States Department of Education, Office of Civil Rights. (2002). OCR guidelines regarding single sex classes and schools. Retrieved July 25, 2007 from http://www.ed.gov/about/offices/list/ocr/t9-guidelines-ss.html? $\exp =0$

UBC Calendar 2005/06. (2005). Appendix 1, enrolment statistics. Retrieved October 10, 2005 from http://students.ubc.ca/calendar/index.cfm?page=appendix 1

University of lowa. (2007) ITED - Iowa testing program. Retrieved September 24, 2007 from http://www.education.uiowa.edu/itp/ited/ited_interp_score.htm

Van Houte, M. (2004). Why boys achieve less at school than girls: the difference between boys' and girls' academic culture. Educational Studies, 30 (2), 159-173.

Warrington, M. \& Younger, M. (2000). The other side of the gender gap. Gender and Education, 12 (4), 493-508.

Warrington, M., \& Younger, M. (2003). 'We decided to give it a twirl': Single-sex teaching in English comprehensive schools. Gender and Education, 15 (4), 339-350.

Wasonga, T., Christman, D. E., \& Kilmer, L. (2003). Ethnicity, gender and age: Predicting resilience and academic achievement among urban high school students. American Secondary Education, 32 (1), 62-74.

Weaver-Hightower, M. (2003). The "Boy turn" in research on gender and education. Review of Educational Research, 23 (4), 471-498.

Weinburgh, M. H., \& Englehard, G. (1994). Gender, prior academic performance and beliefs as predictors of attitudes toward biology laboratory experiences. School Science and Mathematics, 94 (3), 118-123.

Wiener, G. (Ed.) \& Arnot, M. (Ed.). (1987). Gender under scrutiny: New inquires in education. London: Open University.

Wilkins, J. (2004). Mathematics and science self-concept: An international investigation. The Journal of Experimental Education, 72 (4), 331-346.

Wooldridge, P. \& Richman, C.L. (1985). Teachers' choice of punishment as a function of a student's gender, age, race, and IQ level. Journal of School Psychology, 23 (1), 19-29.

Younger, M., Warrington, M., \& McLellan, R. (2002). The 'Problem' of 'Under-achieving boys': some responses from English secondary schools. School Leadership \& Management, 22 (4), 389-405.

## APPENDIX B: UBC ETHICS RENEWAL APPROVAL FORM

The University of British Columbia
Office of Research Services
Behavioural Research Ethics Board
Suite 102, 6190 Agronomy Road, Vancouver, B.C. V6T 123

## CERTIFICATE OF APPROVAL- MINIMAL RISK RENEWAL

| PRINCIPAL INVESTIGATOR: <br> Stephen Petrina | DEPARTMENT: <br> UBC/Education/Curriculum Studies | $\begin{aligned} & \text { UBC BREB NUMBER: } \\ & \text { HO6-80173 } \end{aligned}$ |
| :---: | :---: | :---: |
| INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT: |  |  |
| Institutio |  | Site |
| UBCOther locations where the research will be conducted: Point Grey Site N/A |  |  |
| CO-INVESTIGATOR(S): |  |  |
| SPONSORING AGENCIES: <br> N/A |  |  |
| PROJECT TITLE: <br> An Analysis of Adolescent Boy | $C$ and Their Struggles in Academi | 1995-2006 |

EXPIRY DATE OF THIS APPROVAL: January 30, 2008
APPROVAL DATE: January 30, 2007

The Annual Renewal for Study have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

## Approval is issued on behalf of the Behavioural Research Ethics Board

 and signed electronically by one of the following:
# APPENDIX C: RESEARCH AGREEMENT WITH MINISTRY OF EDUCATION 

RESEARCH AGREEMENT<br>MINISTRY OF EDUCATION<br>TERMS AND CONDITIONS

RELATING TO<br>THE DISCLOSURE OF PERSONAL INFORMATION FOR<br>RESEARCH OR STATISTICAL PURPOSES

Contents<br>General Information: Introduction; Personal Information; Disclosure for Research or Statistical Purposes.<br>Application and Agreement: Part A - Identification of researcher<br>Part B - Description of research project<br>Part C - Records requested<br>Part D - Agreement - terms and conditions of access<br>Part E-Approval of terms and conditions

## DEFINITIONS:

## Ministry:

Personal Information: means recorded information about an identifiable individual other than contact information.

Personal Information may include:
(a) the individual's name (in contexts other than for purposes of contact),
(b) the individual's race, national or ethnic origin, colour, or religious or political beliefs or associations,
(c) the individual's age, sex, sexual orientation, marital status or family status,
(d) an identifying number, symbol or other particular assigned to the individual,
(e) the individual's fingerprints, blood type or inheritable characteristics,
(f) information about the individual's health care history, including a physical or mental disability,
(g) information about the individual's educational, financial, criminal or employment history,
(h) anyone else's opinions about the individual, and
(i) the individual's personal views or opinions, except if they are about someone else.

## General Information

The Freedom of Information and Protection of Privacy Act, RSBC 1996, c. 165 (the Act) provides public access to government records and protects the privacy of individuals identified in these records. All disclosures or uses of records containing personal information in the custody or under the control of the Ministry of Education must be in accordance with the provisions of the Act.

Section 33.2(k) of the Act permits British Columbia public bodies to disclose personal information in their custody or control for research or statistical purposes. Such disclosures must meet the conditions specified is section 35 (disclosure of research or statistical purposes). Section 35 requires that researchers requesting access to personal information to enter into a legal research agreement which governs the conditions for use of records containing personal information.

A research agreement, once approved, gives the researcher timely access to the desired records, and permits Ministry of Education to make materials available to the researcher without substantial costs and possible delays caused by the need to examine and sever personal information from large numbers of documents.

Research agreements can only be granted for a bona fide research project, therefore, it is important that the applicant carefully complete a research proposal that responds in substantial detail to all elements in Part C of the application. The applicant must provide a curriculum vita and three references.

A research agreement is a binding legal document, granting access only to those records specified in Part B of the agreement to those individuals noted in Parts A, B, and D of the agreement. Any changes or additions to the agreement must be made in writing and be approved in writing by Ministry of Education.

The Ministry of Education will consider the date when all amendments and/or corrections to the research agreement are completed as the date of receipt of the research request. Proper completion of the form will hasten the process by which access to the records can be granted.

## FOIPPA Section Reference

Section 35 - disclosure for research or statistical purposes

35 A public body may disclose personal information or may cause personal information in its custody or under its control to be disclosed for a research purpose, including statistical research, only if
(a) the research purpose cannot reasonably be accomplished unless that information is provided in individually identifiable form or the research purpose has been approved by the commissioner,
(a.1) the information is disclosed on condition that it not be used for the purpose of contacting a person to participate in the research,
(b) any record linkage is not harmful to the individuals that information is about and the benefits to be derived from the record linkage are clearly in the public interest,
(c) the head of the public body concerned has approved conditions relating to the following:
(i) security and confidentiality;
(ii) the removal or destruction of individual identifiers at the earliest reasonable time;
(iii) the prohibition of any subsequent use or disclosure of that information in individually identifiable form without the express authorization of that public body, and
(d) the person to whom that information is disclosed has signed an agreement to comply with the approved conditions, this Act and any of the public body's policies and procedures relating to the confidentiality of personal information.

PART B - Records Requested (Add additional lines as required)
Please list all personal information to which access is requested (include justification for each requested item). Access will be given only to records/information listed below. Any changes or additions to this list after the application is submitted should be made in writing and will require approval in writing from Mịnistry of Education.

1. Individual standardised scores obtained by any student who completed any of the following subjects in the following school years: Communications 12, English 12, History 12, Principles of Math 12, Biology 12, Physics 12 in 1995/1996, 1996/1997, 1997/1998, 1998/1999, 1999/2000, 2000/2001, 2001/2002, 2002/2003, 2003/2004, and for 2004/2005 (in the instance in which someone wrote the same examination more than once in a given school year, I would like that student's best score).

- provincial exam marks
(I am requesting ONLY the provincial exam marks since the provincial exam is the only document that all students enrolled in the courses must write in order to complete the course.)

2. For each of the individual records, I also require a "gender" flag.
(The gender flag is requested as my research is a comparison of gender performance for each of the courses and years that I have requested.)
3. For each of the individual records, I also require a "school year" flag. (The school year flag is requested as it is the method through which I can categorize and group students according to the year that they wrote the exam. This would then allow me to compare any gender differences in performances)
4. For each individual, I also require an arbitrary "case number" in lieu of the PEN. (An arbitrary case number is requested since it protects the student's identity and confidentiality.)
5. For each individual, I also require the "Public/Independent School" flag. (I am also interested in comparing the performances between students enrolled in public schools and independent schools.)

## PART C - Description of Research Project

Please provide the following information:

1) A general description of the research project (include the objectives of the project and the proposed method(s) of analysis).

The problem is to investigate the academic performance of male and female students in British Columbia to determine whether there are statistically significant differences between male and female performance in various academic subjects. The purpose of this research is to collect the information about the performance of boys and girls in British Columbia's secondary schools with a specific eye towards creating discussion and dialogue concerning both genders.

The research methodology is two fold. First is a comparison of the subjects for each of the academic years to be examined. Independent sample T-tests with gender as the independent variable and the standardised score as the dependent variables will be performed to see whether there is significant difference in performance between genders for each of the 6 subjects in each of the academic calendar years that the exams are written in. After completing the $t$-tests, another more descriptive-type comparison will be made to see whether there is a trend in marks between genders over the 10 academic years for each of the 6 subjects.
A separate comparison will also be made for performances in gender between independent schools and public schools.
2) An explanation of why the research project cannot reasonably be accomplished without access to personal information in individually identifiable forms (i.e., personal information about named or identifiable individuals).

Individual level information is required, so that I can perform the relevant statistical analyses. Although I am requesting individual level information, the focus is on the aggregate scores and results. Absolutely no individual level data will ever be reported. The data, although requested at the individual student level, are very benign however, given that it would be impossible for me to identify individual children, because there is no true PEN or school number, etc.
3) Benefits to the public and/or educational system that will be derived from the research project.
The purpose of this research is to collect the information about the performance of boys and girls in British Columbia's secondary schools with an eye towards creating discussion and dialogue about how to better help male students achieve à higher level of performance in their academic subjects.
4) How will the personal information be collected?

Individual level data will be obtained by Edudata Canada.
5) Will any record linkage or data matching be conducted? If none, please state that no data matching or record linkage is contemplated. If yes, provide an explanation of how the personal information will be used, including a description of any proposed linkages to be made between personal information in the records requested and any other personal information and describe how the benefits to be derived from the record linkage or data matching are clearly in the public/and or education system interest and not harmful to the individual that the information is about.

No data matching or record linkage will be necessary.
6) What disclosure of personal information, if any, are contemplated, and to whom?

Individual students will not be identified (and, moreover, there would be no way of possibly doing so). The focus is on the aggregate scores of boys and girls.
7) Please attach proof/documentation that the project been reviewed by an ethics committee or a peer committee at a recognized educational institution or grant funding agency.

I will forward a copy of my Ethics approval to the Ministry of Education, via Jennifer Lloyd at Edudata Canada.

## PART D - Agreement on Terms and Conditions of Access

If the researcher is granted access to the records listed in Part B , the researcher understands and will abide with the following terms and conditions:

## Security and Confidentiality

Section 30 of the Act requires that a public body must protect personal information by making reasonable security arrangements against such risks as unauthorized access, collection, use, disclosure or disposal. These obligations are passed on to the researcher(s) their colleagues and employees, and all other $3^{\text {rd }}$ parties who may obtain access to the personal information under this agreement.

Reasonable security requirements under FOIPPA are those that a fair and rational person would think were appropriate to the sensitivity of the information and to the medium in which it is stored, transmitted, handled, or transferred.

1) I understand that I am responsible for maintaining the security and confidentiality of all personal information found in or taken from these records.
2) If a request for access to the personal under this agreement is received from a person or entity other than the Ministry of Education, and this agreement does not require or authorize me to provide such access, I will advise the person/entity to make the request to the Ministry of Education.
3) I will not subcontract any of my obligations under this agreement other than to persons listed below, in item number four, without the prior written consent of the Ministry of Education. No subcontract, whether consented to or not, relieves me from any obligations under this agreement. I will ensure that any subcontractor I retain fully complies with this agreement in performing the subcontracted obligations.
4) Apart from myself, only the following persons/entities will have access to this personal information in a form which identifies or could be used to identify the individual(s) to whom it relates:
1. Chung-Yan Ip, MA Student
2. Dr. Stephen Petrina, Department of Curriculum Studies, UBC
3. Jennifer Lloyd - Edudata Canada (may assist in some data analysis)

Before any personal information is disclosed to these persons, I will obtain a written undertaking from each of them to ensure that they will not disclose that information to any
13) Reports, papers or any other works which describe the results of the research undertaken will be written and/or presented in such a way that no individuals in the requested records can be identified and no linkages can be made between any personal information found in the requested records and personal information that is publicly available from other sources. There will be no exceptions to this rule without prior and specific written permission from the Ministry of Education.
14) Any case file numbers or other individual identifiers to be recorded on computer will be created by myself or one of the persons/entities listed in paragraph 4) and will not relate to any real case numbers found in the records. Any such identifiers are to be used for statistical purposes only.
15) No case file numbers or other individual identifiers assigned for the purposes of the research project described in Part C will appear in any other work.
16) It is preferred that, no personal information which identifies or could be used to identify the individual(s) to whom it relates will be transmitted by means of any telecommunications device, including telephone, fax or modem. If personal information is transferred electronically, the personal information will be encrypted (to 128 bit encryption SSL standards) or a dedicated line will be used. In addition, if facsimile (fax) is used, it will be a secure fax.
17) Unless expressly authorized in writing by the Ministry of Education, no direct or indirect contact will be made with the individuals to whom the personal information relates.
18) Individual identifiers associated with the records described in Part B, or contained in copies of them, will be removed or destroyed at the earliest time at which removal or destruction can be accomplished consistent with the research purpose described in Part C. At the latest (maximum 2 years), this will occur by:

2007/01/01
(year / month / day)
19) The removal of individual identifiers will be done in a manner that ensures that remaining personal information (including any found in research notes) cannot be used to identify the individual to whom it relates. If necessary, this will be done by destroying copies of records or pages of notes in their entirety. Destruction or removal of individual identifiers (including all copies) will be confidential and complete regardless of format so at to ensure the information is rendered unrecoverable.

Describe method of destruction.
erasing of data from hard drive, shattering the CD on which the data are given to me, shredding of all printed documents

## Audit and Inspection

20) In addition to any other rights of inspection the Province may have under this Agreement or at law or pursuant to any legislation, regulation or order, the Ministry of Education will, at any time and upon reasonable prior notice and during normal business hours (other than in situations where the public body determines in its sole discretion that there is a material risk of disclosure of Personal Information databases, in which case no notice is required) be permitted to carry out on-site visits and such other inspection or investigations that it deems necessary to ensure compliance with the conditions of this agreement. Such measures may include, but are not limited to:

- on-site inspection of premises or computer databases to confirm that stated security precautions are in effect;
- requiring the Researcher to produce an annual or periodic certificate of privacy/security compliance in a form acceptable to the Ministry of Education;
- requiring the Researcher to submit copies of signed employee non-disclosure agreements


## Verification of Destruction of Personal Identifiers and Information

21) The Researcher shall provide the Ministry of Education with written verification from that the confidential and permanent destruction of all information about identifiable individuals has been carried out by the date specified in this agreement. The verification must be in the form prescribed in Appendix 4.

## Submission of Copy of Research Work

22) The Researcher will submit in a timely manner and in a format agreeable to the Ministry of Education a copy of any written work based on research carried out under the terms of this agreement. A copy of this work must be submitted to the Ministry of Education upon completion and prior to distribution or submission for publication for review to ensure compliance with the terms of this agreement and to comment on / amend any possible misinterpretation. The Ministry of Education reserves the right to veto publication or distribution. The Ministry of Education will make every effort to review the research material within 30 days but until Ministry approval has been received, the researcher will not release the materials. In the case of incomplete projects, the latest draft must be submitted to the Ministry of Education.
23) The researcher will make available, upon request, written procedures for processing, accessing, transmitting, storing and disposing of personal information

## Ownership

24) The records described in Part B will:
(a) be the exclusive property of the Ministry of Education; and
(b) be delivered by the Researcher to the Ministry of Education in a timely manner after the Researcher receives a written request from the Province for the delivery of the Material.

A copyright notice outlining document protections under the federal Copyright Act is attached as Appendix 3.

## Agreement to the Terms and Conditions

24) I understand that I am responsible for ensuring complete compliance with these terms and conditions. In the event that I become aware of a breach of any of the conditions of this agreement, I will immediately notify the Ministry of Education in writing.

Contravention of the terms and conditions of this agreement may lead to the withdrawal of research privileges; the Ministry of Education may also take legal action to prevent any further disclosure of the personal information concerned.

The Ministry of Education reserves the right to demand the immediate return of all records and to withdraw access to records without prior notice if this becomes necessary under the Act.

I accept that the expiry date for access to the records in Part B is the date as listed by the Ministry of Education below.

Signed at $\qquad$ , this $\qquad$ day of $\qquad$ , 20 $\qquad$ .

[^0]PART E - Approval of Terms and Conditions (to be completed by Ministry of Education staff)

The Ministry of Education approves the terms and conditions of this agreement under which the Ministry of Education grants access to the researcher.

The expiry date for access to the records listed in Part C is:


Signature

Position

Date

## Appendix 1

## BREACH OF PRIVACY PROTOCOL

## PURPOSE:

The purpose of this protocol is to outline the steps that must be followed after a breach of personal privacy has been discovered.

## APPLICATION:

This protocol applies to all personal information in the custody or under the control of the Ministry, including personal information in the custody of researchers and contracted services providers and/or their agents and subcontractors.

## AUTHORIZATION:

Freedom of Information and Protection of Privacy Act (RSBC 1996) c. 165
Section 30 - Protection of personal information
"The Head of a public body must protect personal information by making reasonable security arrangements against such risks as unauthorized access, collection, use, disclosure or disposal."

Section 30.2 - Obligation to report foreign demand for disclosure
"If a public body, an employee of a public body or an employee or associate of a service provider receives a foreign demand for disclosure, the head of the public body, the employee or other person must immediately notify the minister for this Act"

## Core Policy Manual - Chapter 15, Security, Section 15.3.10 "Security Incidents."

"Each ministry must review security each time a real or imminent threat occurs or circumstances indicate a changed or new exposure and apply corrective measures to reduce the risk of future occurrence."

## BACKGROUND:

Section 30 (Protection of Personal Information) of the Freedom of Information and Protection of Privacy Act (the Act) requires public bodies to make "reasonable security arrangements to protect against such risks as the unauthorized access, collection, use, disclosure or disposal of personal information, including the risk of seizure or disclosure by foreign demand. This protocol will assist public bodies and researchers in meeting these requirements by ensuring that:

- steps are place to contain and control damage, and
- procedures exist to prevent similar breaches from occurring again.


## PROCEDURES:

STEP 1. CONTAINMENT: Identify the scope of the alleged breach and take initial steps to contain the damage. Containing the damage may involve the following:

- determining whether the privacy breach would allow unauthorized access to an electronic information system
- recalling e-mails
- notifying systems security staff
- shutting down a system
- stopping the fax machine
- calling the police if a stranger who entered the building removed material.

STEP 2. REPORT: When the Researcher or their staff becomes aware of an actual or alleged breach of privacy, they must report it immediately to the Director, Information Department, and the Director, Privacy \& Records Management, Ministry of Education. This report should indicate whose personal information was disclosed, to whom it was disclosed, when it was disclosed, how it was disclosed, and what steps have been taken in response to the disclosure.

STEP 3. RETRIEVE: Any documents that have been disclosed to, or taken by, an unauthorized recipient should immediately be retrieved or destroyed (especially in cases where information has been sent by fax or electronic mail). This may require personal attention, by the Researcher or their staff, to secure the documents and return them to their original location or send them to the intended authorized recipient. (NOTE: Whenever time permits this step should be coordinated with the Director, Privacy \& Records Management Branch, Ministry of Education)

STEP 4. INVESTIGATE: The Director, Privacy \& Records Management Branch, Ministry of Education will investigate the details of any breach, for the purpose of determining and recording all the relevant facts concerning the breach.

STEP 5. INFORM: In cases where the breach may result in consequences that would directly affect the person whose information has been disclosed, that person should be informed of the details of the breach. They should also be informed of the Researcher's efforts to retrieve this information and prevent a similar breach from reoccurring. These steps should be taken in cooperation with the Privacy \& Records Management Branch, Ministry of Education.

STEP 6. MANAGEMENT REVIEW: The Director, Privacy \& Records Management Branch will report the detail of the breach of privacy and remedial steps to the ADM, Management Services Division. The ADM may direct the program area to review and implement the report's recommendations.

## AFFECTED PUBLIC BODY PERSONNEL, RESEARCHERS AND AGENTS:

This protocol applies to all public body staff, researchers (including outside researchers) and any individuals working as volunteers or under contract as an agent of the public body. (NOTE: This
protocol applies to contracted agents during the period of their respective contracts, survives the expiry of those contracts and applies only to records and information supplied to, or that result from the contracted services.)

## CONCLUSION:

A breach of privacy is a serious matter. Public body staff must make every reasonable effort to prevent breaches from occurring. If one does occur, staff must ensure that the procedures outlined in this protocol are implemented and that the Information and Privacy Branch is fully informed.

## Appendix 2

## NON-DISCLOSURE AGREEMENT

I, $\qquad$ solemnly declare that I will not disclose to any person, company or organization/entity any personal information (the information) disclosed to (project name and date) or that I may come in contact with as a result of my participation with the (project name and date) except as expressly authorized in writing by the Ministry of Education.

I acknowledge that I have read and will abide by the terms and conditions respecting the use and security of the information contained in the Research Agreement between ("The Researcher") and the Ministry for the project entitled: (project name and date).

I will report any and all requests, demands or requirements by foreign entities made upon me or my employer for disclosure of the information to which I may have access to the Director, Privacy and Records Management, the Ministry of Education and the Office of the Information and Privacy Commissioner for BC.

I have read, acknowledge and understand the provisions of sections 30, 30.1, 30.2, 30.3 and 30.4 of the Freedom of Information and Protection of Privacy Act and, by my signature, agree to adhere to these provisions. I acknowledge that a breach by me of any of those sections could result in the penalties as outlined in section 74 being applied against myself or the Researcher as may be appropriate through process of law. I also acknowledge that a breach by me of these sections 30 through 30.4 will also be deemed a breach of the Research Agreement and may result in its immediate termination.

I make this declaration knowing it is of the same legal force and effect as if made under oath.

Chung-Yan Ip

| Name (Type or Print) | Signature |
| :--- | :--- |
| MA Student |  |

Organization:

## Appendix 2

## NON-DISCLOSURE AGREEMENT

I,
Dr. Stephen Petrina $\qquad$ solemnly declare that I will not disclose to any person, company or organization/entity any personal information (the information) disclosed to (project name and date) or that I may come in contact with as a result of my participation with the (project name and date) except as expressly authorized in writing by the Ministry of Education.

I acknowledge that I have read and will abide by the terms and conditions respecting the use and security of the information contained in the Research Agreement between ("The Researcher") and the Ministry for the project entitled: (project name and date).

I will report any and all requests, demands or requirements by foreign entities made upon me or my employer for disclosure of the information to which I may have access to the Director, Privacy and Records Management, the Ministry of Education and the Office of the Information and Privacy Commissioner for BC.

I have read, acknowledge and understand the provisions of sections $30,30.1,30.2,30.3$ and 30.4 of the Freedom of Information and Protection of Privacy Act and, by my signature, agree to adhere to these provisions. I acknowledge that a breach by me of any of those sections could result in the penalties as outlined in section 74 being applied against myself or the Researcher as may be appropriate through process of law. I also acknowledge that a breach by me of these sections 30 through 30.4 will also be deemed a breach of the Research Agreement and may result in its immediate termination.

I make this declaration knowing it is of the same legal force and effect as if made under oath.
Dr. Stephen Petrina
Name (Type or Print) Signature

Title
Date

Organization:

Witness Name
Witness Signature

Witness Position and Organization
Date

## Appendix 4

## Certification of Destruction

I, $\qquad$ solemnly declare and certify that all personal identifiers and personally identifiable information (the information) disclosed to (project name and date) or that was generated as a result of (project name and date) has been confidentially and permanently destroyed in accordance with the standards below.

## Paper Records

Paper records must be destroyed in a manner that ensures the information cannot be read, deduced or reconstructed in any way.

Shredding is the most common method of destroying paper records. Records should be shredded in strips of 1 centimeter wide or less. Records may also be crosscut, re-shredded or mixed to ensure information cannot be reconstructed and read. After shredding or crosscutting, the resulting material may be recycled or pulped. Paper records may also be burned as a destruction method.

Paper records containing personal information must not be destroyed using office recycling,

## Microforms and Computer Magnetic Media

Microfilm, microfiche, magnetic computer tapes, compact disks and diskettes must be destroyed in a manner that ensures the information contained in the media cannot be reconstructed.

Burning is considered the most effective method of destroying microforms, magnetic tapes and compact disks and diskettes. Information on magnetic media may also be destroyed by overwriting or degaussing.

## Online Electronic Data

Electronic data located online (on a database or network) should be deleted, including all backups in all formats and the storage medium reformatted or "wiped" such that the data cannot be reconstructed.

Electronic data includes: data located in applications files (such as word processing documents, spreadsheet workbooks, presentation slides, and so on); textual or imaged data maintained on databases; data in typographical, video, and/or audio formats contained on web-sites; and any other type of online electronic data.

When maintenance requires equipment containing personal information to be released to an outside service provider or vendor, all personal information should first be securely erased or encrypted.

I make this declaration knowing it is of the same legal force and effect as if made under oath.

Chung-Yan Ip
Name (Type or Print)
Signature
MA Student
Title
$\qquad$ Date

Organization:

Witness Name
Witness Signature

Witness Position and Organization
Date

## Appendix 4

## Certification of Destruction

I, Dr. Stephen Petrina $\qquad$ solemnly declare and certify that all personal identifiers and personally identifiable information (the information) disclosed to (project name and date) or that was generated as a result of (project name and date) has been confidentially and permanently destroyed in accordance with the standards below.

## Paper Records

Paper records must be destroyed in a manner that ensures the information cannot be read, deduced or reconstructed in any way.

Shredding is the most common method of destroying paper records. Records should be shredded in strips of 1 centimeter wide or less. Records may also be crosscut, re-shredded or mixed to ensure information cannot be reconstructed and read. After shredding or crosscutting, the resulting material may be recycled or pulped. Paper records may also be burned as a destruction method.

Paper records containing personal information must not be destroyed using office recycling,

## Microforms and Computer Magnetic Media

Microfilm, microfiche, magnetic computer tapes, compact disks and diskettes must be destroyed in a manner that ensures the information contained in the media cannot be reconstructed.

Burning is considered the most effective method of destroying microforms, magnetic tapes and compact disks and diskettes. Information on magnetic media may also be destroyed by overwriting or degaussing.

## Online Electronic Data

Electronic data located online (on a database or network) should be deleted, including all backups in all formats and the storage medium reformatted or "wiped" such that the data cannot be reconstructed.

Electronic data includes: data located in applications files (such as word processing documents, spreadsheet workbooks, presentation slides, and so on); textual or imaged data maintained on databases; data in typographical, video, and/or audio formats contained on web-sites; and any other type of online electronic data.

When maintenance requires equipment containing personal information to be released to an outside service provider or vendor, all personal information should first be securely erased or encrypted.

I make this declaration knowing it is of the same legal force and effect as if made under oath.
Dr. Stephen Petrina
Name (Type or Print)
Signature

Title
Date

Organization:

Witness Name
Witness Signature

Witness Position and Organization
Date

# APPENDIX D: REVISED RESEARCH AGREEMENT WITH MINISTRY OF EDUCATION 

## FOR MINISTRY USE

File number:
Opened date ("Submission date"):
Date of receipt of amendment request:

# REQUEST TO AMEND RESEARCH AGREEMENT <br> Between 

Ministry of Education
and
(Ip, Chung-Yan, MA Student)
TITLE: An Analysis of Adolescent Boys in BC and Their Struggles in Academic Courses, 1995-2006

First approved: April 30, 2006
Amendment approval: January, 2007
Amendment \#1: Records date (amendment to the amendment)
Amendment \#1 type: Destruction of Records date

SECTION(S) AFFECTED BY AMENDMENT \#I
Part A - Identification of Researcher
Part B - Records Requested
Part C - Description of Research Project
Part D - Agreement on Terms and Conditions of Access
Part E - Approval of Terms and Conditions

## DETAILS OF AMENDMENT

We would like to amend the 'date of destruction' on our Ministry of Education Research Agreement amendment from February 28, 2007 to January 30, 2008. This newer date matches the date of expiry for our revised UBC Ethics certificate.

We request this extension because we have not yet completed the proposed data analyses. There was an error in the previous amendment as the date of destruction was too close to when the data sets would be
provided in order to complete the necessary analyses.
We sign this Agreement still bound to all of the details provided in our approved Research Agreement.

## AGREEMENT TO THE TERMS AND CONDITIONS

I sign this Agreement still bound to all of the details provided in my approved Research Agreement.

| Name and Position of Researcher (as indicated in Part A of original research agreement) |
| :--- |
| Chung-Yan Ip (MA Student) |
| Advisor - Dr. Stephen Petrina (UBC, Curriculum Studies Department, Associate Professor) |
| Signature of Researcher |

Name and Position of Witness

Signature of Witness
Date Signed:

Name and Position of Ministry Representative


[^0]:    Name and Position of Witness

