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# Mathematic Achievement of Canadian Private School Students

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*Very little Canadian research has examined the academic achievement of private school students. 2003 data from the Programme for International Student Assessment (PISA) were used to examine the achievement of private school students, which is similar to a recent study examining Canadian public school children's academic achievement (Wei, Clifton, & Roberts, 2011). The current study found that private school students outperformed their public school peers. In addition, the students' morale, motivation, interest in mathematics, expected education, the effort invested in doing well on the PISA test, and socioeconomic status were significantly and positively related to their academic performance. Surprisingly, the cost of their tuition fees, reported hours spent on math homework, sense of belonging, and higher ratio of instructional time on mathematics were significantly, but negatively, related to the students' math performance.*

*Au Canada, le rendement académique d'élèves dans les écoles privées a très peu fait l'objet de recherche. Nous avons étudié les données du Programme international pour le suivi des acquis des élèves (PISA) de 2003 pour évaluer le rendement des élèves dans les écoles privées; notre étude est similaire à une étude récente portant sur le rendement académique d'élèves dans les écoles publiques au Canada (Wei, Clifton, & Roberts, 2011). Nos résultats indiquent que le rendement des élèves dans les écoles privées est supérieur à celui des élèves dans les écoles publiques. De plus, nous avons trouvé plusieurs facteurs ayant un effet significatif et positif sur le rendement académique : le moral, la motivation, l'intérêt pour les mathématiques, les attentes quant à leur scolarisation, les efforts consentis pour bien réussir au PISA et le statut socioéconomique. Étonnamment, les facteurs suivants exerçaient un effet significatif, mais négatif, sur la performance des élèves en mathématiques : le cout des frais de scolarité, les heures qu'ils disaient passer à faire des devoirs en mathématiques, le sentiment d'appartenance et un rapport plus élevé d'heures d'enseignement des mathématiques.*

In Canada, about 7% of students attend private schools (Statistics Canada, 2013); however, enrolment grew 20% between 1993 and 2003—when the data for this study were collected—with academically focused schools having the most rapid growth (Davies, 2004). Over the same period, enrollment in US private schools grew by almost 40% (Fuller, 2000). Obviously, in both countries, parents increasingly choose to send their children to tuition-based private schools despite having access to free public schools that provide education with good quality. A study by Wei, Clifton, and Roberts (2011) found that in 2003, Canadian students attending public schools were among the highest performing 15-year olds in the world. Despite copious amounts of research examining students attending Canadian public schools, there is surprisingly little research examining students attending Canadian private schools even though there has been considerable research on private schools in the US (see Davies, 2004; Goldring & Phillips, 2008). The primary goal of this study is to be the first to examine students attending Canadian private schools and to compare these findings to those reported by Wei, Clifton, and Roberts (2011), who used the same dataset to examine students attending Canadian public schools.

Research in the United States has found significant differences between the students enrolled in private and public schools on a number of variables such as parental education, income, wealth, home resources, and parental involvement in their children's education (Coleman & Hoffer, 1987; Coleman, Hoffer, & Kilgore, 1982; Friedman, 1997; Goldring & Phillips, 2008; Witte, 1998; Yang & Kayaardi, 2004). Research also documents that students with high socioeconomic status (SES) measured by their parental education and income outperform their less privileged peers (Mercy & Steelman, 1982; Teachman, 1987; Watkins, 1997). As such, some researchers suggest that private school students' success, in comparison with public school students, is largely due to their higher SES and the resulting personal values and career aspirations (Sandy & Duncan, 1996) as well as other hard to measure contextual circumstances, such as having better teachers and administration in the schools, more value-oriented communities, and more stringent selection policies, making it difficult to replicate the findings of past studies (Dronkers & Avram, 2010).

Additionally, other researchers have noticed how the academically oriented normative climates that are created in upper- and middle-class schools enhance the academic achievement of students by affecting their values, goal-orientations, and behaviour, which eventually affects their academic achievement (Hallinger & Murphy, 1986; McDill, Rigsby, & Meyers, 1969). Compared to public school students, private school students are more likely to conform to the scholastic norms of their teachers and peers, which likely have positive effects on their own academic achievement (Zimmer & Toma, 2000). In fact, the educational environment is generally considered better in schools with more financial capital compared with public schools (Grubb, 2009; Parcel & Dufur, 2001; Rutter &Maughn, 2002). Dronkers and Robert (2008a, 2008b) suggest that religious schools are more effective than public schools because they have better school climates. Robert (2010) shows that after controlling for school composition, the performance of students in religious private schools is higher than students in elite, non-religious private schools largely because of the school climate.

Some researchers suggest that private schools provide better learning environments by dedicating more time and resources to developing their students' soft skills which are important to higher-level jobs (i.e., teamwork, leadership, culture, the arts) (Dronkers & Roberts, 2008a, 2008b). These authors further conclude that the effects of private schools are, in fact, similar across 19 OECD (Organisation for Economic Co-operation and Development) countries. Besides, it has been long recognized that students' psychological dispositions are important predictors of their academic success (Judge, Higgins, Thoresen, & Barrick, 1999). For example, motivation and academic achievement are positively related when other important variables are controlled (Miller, Greene, Montalvo, Ravindran, & Nichols, 1996). In addition, it is shown that students with higher educational expectations, when SES, gender, and motivation are controlled, out-perform students with lower educational expectations (Sansone & Harackiewicz, 2000). In summary, this study examines a number of school and student variables that theoretically affect the academic achievement of private school students in Canada, particularly, achievement in mathematics. It is the first, if not the only, study to examine the academic achievement of Canadian students in private schools.

## Method

The subjects for this study were selected from the Canadian data collected in 2003 for the Programme for International Student Assessment (PISA), an international study of 15-year old students from a variety of countries. In the 2003 PISA study, the students in schools wrote an achievement test and completed questions about their social backgrounds and psychological dispositions. The school principals also answered questions about the teachers' and students' morale and commitment and the tuition fees the students pay to attend the private schools.

### The Sample

In total, 27,953 15-year-old Canadian students from 1,087 schools in ten provinces were included in the 2003 PISA study (OECD, 2005). For this study, 1,788 students from 76 private schools were examined, representing 7% of the 15-year old Canadian student population enrolled in private schools. Fifty-two students were excluded from the analyses because they had missing values on important items such as gender. The final sample consisted of 1,736 students, with slightly more males (51.5%) than females (48.5%).

### The Independent Variables

School variables (tuition, students' morale, teachers' morale) and student variables (motivation, interest in mathematics, expected education, sense of belonging at school, number of hours on completing mathematics homework each week, effort invested in preparing for the PISA test, ratio of math instructional time to total instructional time, SES, and gender) are used as the independent variables and the descriptive statistics are presented in Table 1. All scales and their explanations are reported in the OECD's PISA 2003 data analysis manual for SPSS users (OECD, 2005).

### School Variables

**Tuition.** Tuition is measured by the percentage of funding for a typical school year that comes from tuition fees, as indicated by the principals. There are missing values for 9 schools. The mean score is 51.28% with a standard deviation of 21.86%, indicating that on average, at least half of the average school's funding comes from tuition fees. It is worth noticing that some private schools receive no funding from tuition fees, whereas other schools receive 100% from tuition fees.

**Teachers' morale.** Teachers' morale is obtained from the principals' responses to four items:

- "The morale of teachers in this school is high."
- "Teachers work with enthusiasm."
- "Teachers take pride in this school."
- "Teachers value academic achievement."

The response categories are recoded as "strongly agree (0)," "agree (1)," and "disagree/strongly disagree (2)." Item Response Theory (IRT) scaling procedure has been used to recreate the scale used by the PISA researchers (OECD, 2005) so that higher scores indicate

Table 1

*Descriptive Statistics of Variables*

| Variables | Missing Data[a] | Number of Items | Actual range | Factor Loadings | Alpha | Mean | SD |
|---|---|---|---|---|---|---|---|
| | *School Sample = 76; Student Sample = 1736* | | | | | | |
| Independent Variables | | | | | | | |
| *School* | | | | | | | |
| Tuition | 9 | 1 | 0–100 | - | - | 51.28 | 21.86 |
| Teachers' Morale | 0 | 4 | -1–2 | .22–.98 | .865 | 0.77 | 0.89 |
| Students' Morale | 0 | 7 | -1–3 | .48–.82 | .802 | 1.15 | 0.90 |
| *Student* | | | | | | | |
| Motivation | 13 | 4 | -2.38–1.75 | .85–.88 | .894 | 0.39 | 1.02 |
| Interest in Mathematics | 10 | 4 | -1.78–2.37 | .83–.92 | .891 | 0.10 | 1.01 |
| Expected Education | 16 | 1 | 0–5 | - | - | 4.63 | 0.84 |
| Sense of Belonging | 14 | 6 | -3.38–2.22 | .68–.80 | .843 | 0.09 | 1.10 |
| Weekly Math Hours | 119 | 1 | 0–24 | - | - | 3.03 | 2.61 |
| Effort invested in PISA test | 51 | 1 | 1–10 | - | - | 7.68 | 1.77 |
| Math Instructional Time : Other Instructional Time | 151 | 1 | 0–1 | - | - | 0.17 | 0.14 |
| Parental Occupation | 55 | - | 16–90 | - | - | 60.05 | 15.54 |
| Gender | 0 | 1 | 1-2 | - | - | - | - |
| Dependent Variables | | | | | | | |
| Plausible Value in Math 1 | 0 | - | 169–859 | - | - | 567.86 | 85.47 |
| Plausible Value in Math 2 | 0 | - | 207–834 | - | - | 566.31 | 86.83 |
| Plausible Value in Math 3 | 0 | - | 124–840 | - | - | 567.72 | 86.00 |
| Plausible Value in Math 4 | 0 | - | 246–846 | - | - | 567.06 | 85.97 |
| Plausible Value in Math 5 | 0 | - | 225–794 | - | - | 567.76 | 84.75 |

[a] Missing data is less than 10% for all variables.

higher levels of teachers' morale. The scale ranges from -1 to 2 and the mean is 0.77 with a standard deviation of 0.89.

**Students' morale.** Student morale is obtained from the principals' responses to seven items:

- "Students enjoy being in school."
- "Students work with enthusiasm."
- "Students take pride in school."

- "Students value academic achievement."
- "Students are cooperative and respectful."
- "Students value the education they can receive in this school."
- "Students do their best to learn as much as possible."

The response categories are recoded as "strongly agree (1)," "agree (2)," and "disagree/strongly disagree (3)." IRT scaling procedure has been used to create the scale by the PISA researchers (OECD, 2005) so that higher scores indicate higher levels of student morale and commitment. The scale ranges from -1 to 3 and the mean is 1.15 with a standard deviation of 0.90.

## Student Variables

**Motivation.** Motivation is derived from the students' responses to four items:

- "Making an effort in mathematics is worth it because it will help me in the work that I want to do later on."
- "Learning mathematics is worthwhile for me because it will improve my career."
- "Mathematics is an important subject for me because I need it for what I want to study later on."
- "I will learn many things in mathematics that will help me get a job."

The response categories are coded as "Strongly agree (0)," "agree (1)," "disagree (2)" and "strongly disagree (3)." IRT scaling procedure has been used by the PISA researchers (OECD, 2005) so that higher values indicate higher motivation to learn mathematics. The scale ranges from -2.38 to 1.75 and the mean is 0.39 with a standard deviation of 1.02.

**Interest in mathematics.** Interest in mathematics is derived from students' responses to four items:

- "I enjoy reading about mathematics."
- "I look forward to my mathematics lesson."
- "I do mathematics because I enjoy it."
- "I am interested in the things I learn in mathematics."

The response categories are coded as "strongly agree (0),' "agree (1),' and "disagree (2)" and "strongly disagree (3)." IRT scaling procedure has been used by the PISA researchers (OECD, 2005) so that higher scores indicate higher levels of interest and enjoyment in mathematics. The scale ranges from -1.78 to 2.37 and the mean is 0.10 with a standard deviation of 1.01.

**Expected education.** Students are asked about their expected educational attainment. Possible choices are: "none (0);" "lower secondary (1);" "vocational/prevocational upper secondary (2);" "upper secondary" and "non-tertiary post-secondary (3);" "vocational tertiary (4);" "theoretically oriented tertiary and post-graduate (5)." Higher scores indicate higher levels of expected education (OECD, 2005). The scale ranges from 0 to 5 and the mean is 4.63 with a standard deviation of 0.84.

**Sense of belonging.** Sense of belonging at school is derived from students' responses to six items:

- "I feel like an outsider (or left out of things)."
- "I make friends easily."
- "I feel like I belong."
- "I feel awkward and out of place."
- "Other students seem to like me."
- "I feel lonely."

The four-point scale response categories are coded as "strongly agree (0)," "agree (1)," "disagree (2)," and "strongly disagree (3)." IRT scaling procedure has been used by the PISA researchers (OECD, 2005) and two of the items were reversed scored so that higher scores indicate students' positive feelings about school. The scale ranges from -3.38 to 2.22 and the mean is 0.09 with a standard deviation of 1.10.

**Weekly math hours.** This item is derived from the students' responses to an item measuring the time they generally spend on mathematics outside regular mathematics classes on a weekly basis. Responses range from 0 to 24 hours per week and the mean is slightly over 3 hours per week and the standard deviation is 2.61 hours per week.

**Effort invested in the test.** Students indicate on a scale from 1–10 about how much they prepared for the PISA test. The mean is 7.68 with a standard deviation of 1.77.

**Math instruction time.** Students indicate the ratio of instructional time on mathematics to the total instructional time they received. Though there are 151 missing responses, they account for less than 10% of the sample. The mean is 0.17 with a standard deviation of 0.14.

**Parental occupation.** Highest parental occupation status reflects the parents' skills and economic foundations (Yang & Kayaardi, 2004), which is obtained from an open ended question in the students' questionnaire. The responses are coded on the International Socio-Economic Index of Occupational Status (Ganzeboom, De Graaf, & Treiman, 1992), which corresponds to the higher score of either parent or the only parent who lives in the home with the children. The scale ranges from 16 to 90 and the mean is 60.05 with a standard deviation of 15.54.

**Gender.** Female students are coded 1 and males are coded 2. Almost 49% of the students are female and slightly over 51% are male.

## The Dependent Variable

**Achievement in Mathematics.** All of the students selected for the PISA study were given a paper-and-pencil test lasting two hours at set time during April and May, 2003. The students were randomly assigned to answer questions in one of 13 test booklets designed to assess their performance in mathematics (the major domain) in addition to reading, scientific literacy, and problem solving (the three minor domains). In the test booklets, each domain was allocated 30 minutes and the tests varied so that each booklet had between one and three clusters in mathematics and at least one cluster in one of the minor domains. In total, over half of the testing time was devoted to mathematics, the major domain.

In order to obtain comparable test scores for the students, each of the domains had five plausible values that were transformed into a common metric. The five plausible values for three subjects were constructed by applying weighted maximum likelihood estimates (Embretson & Reise, 2013) and standardizing the scores so they had a mean of 500 and standard deviation of

100 (Robert, 2010). Specifically, the five plausible values in each subject represented possible achievement scores for each student, and were meant to prevent biased inferences from using relatively small numbers of test items (OECD, 2005).

Even though there are differences in the test booklets, the plausible values provide very good estimates of the students' achievement in mathematics. In addition, the plausible values provide good estimates of the population parameters, which were used by the PISA researchers for the international comparisons. The descriptive statistics for each plausible value are presented in Table 1. The means and standard deviations, as expected, are similar for all five plausible values (PV). The results did not significantly vary by using any one of the five plausible values or by taking an average of all five values. Thus, only the first plausible value is used as the dependent variable in this study and the scale ranges from 169 to 859 with a mean of 567.86 and a standard deviation of 85.47.

## Analyses

Multiple regression analyses are used to test the relationships between the independent and dependent variables (Tabachnick & Fidell, 2001). An examination of the variables for normality and homoscedasticity indicate that none of the variables violate these basic assumptions. Correlation coefficients and standardized regression coefficients are calculated. Variance inflation factor coefficients (VIF) are also calculated for each independent variable and all are less than .35 indicating that collinearity is not a serious problem (Neter, Kutner, Nachtsheim, & Wasserman, 1996).

## Results

Table 1 shows that the mean achievement scores in mathematics range from 566.31 to 567.86 with standard deviations that range from 84.75 to 86.83. The mean scores are about 9% higher than the public school students (see Wei et al., 2011) confirming that, in general, private school students outperform public school students (Coleman & Hoffer, 1987; Coleman et al., 1982; Friedman, 1997). Not surprisingly, the mean parental occupation level ($M$ = 60.05, $S.D.$ = 15.54) is about 20% higher than the SES of the public school students in this data set (see Wei et al., 2011).

Table 2 reports the regression analyses of the students' achievement in mathematics. Model 1 shows the effects of school-level variables (tuition, students' morale, teachers' morale) when no other variables are included. Model 2 includes both the school-level and student-level variables (motivation, interest in mathematics, expected education, sense of belonging, weekly math hours, effort invested in the test, math to other instructional time). Finally, Model 3 includes the school-level and student-level, variables plus the students' SES and gender.

In Model 1, the school level variables explain 5.1% of the variance in the students' achievement. More specifically, students' morale ($\beta$ = .20, $\rho$ <.001), as assessed by the principals, is positively associated with the students' achievement. Counter-intuitively, tuition ($\beta$ = -.18, $\rho$ < .001) is negatively related to achievement, but confirms findings by Robert (2010) and Dronkers and Robert (2008a, 2008b) that more expensive private schools have lower performing students than less expensive schools. Finally, teachers' morale is not significantly related to students' math achievement.

Table 2

*Standardized and Unstandardized Regression Coefficients and $R^2$ for Achievement in Mathematics*

| Independent Variables | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | Std. | Unstd. | Std. | Unstd. | Std. | Unstd. |
| School Variables | | | | | | |
| Tuition | -.18*** | -.66*** | -.17*** | -.63*** | -.19*** | -.70*** |
| Teachers' Morale | -.02 | -.88 | -.01 | -.67 | -.00 | .31 |
| Students' Morale | .20*** | 19.35*** | .18*** | 16.35*** | .17*** | 15.45*** |
| Student Variables | | | | | | |
| Motivation | | | .08** | 6.76** | .08** | 6.55** |
| Interest in Mathematics | | | .19*** | 15.78*** | .19*** | 15.53*** |
| Expected Education | | | .20*** | 19.26*** | .18*** | 16.91*** |
| Sense of Belonging | | | -.10*** | -7.56*** | -.10*** | -7.26*** |
| Weekly Math Hours | | | -.11*** | -3.46*** | -.10*** | -2.98*** |
| Effort invested in PISA test | | | .12*** | 5.62*** | .12*** | 5.74*** |
| Math Instructional Time : Other Instructional Time | | | -.14*** | -85.16*** | -.13*** | -81.59*** |
| Parental Occupation | | | | | .14*** | .73*** |
| Gender | | | | | .06* | 9.88* |
| $R^2$ | .051 | | .197 | | .209 | |

* p ≤ .05; **p ≤ .01; *** p ≤ .001 (two-tailed tests)
*Note*. Std. = Standardized; Unstd. = Unstandardized

As expected, adding the students' individual variables in Model 2 substantially improves the explained variance (19.7%). The students' expected educational attainment has the largest effect ($\beta$ =.20, $\rho$ <.001), and interest in math has a slightly lower effect ($\beta$ =.19, $\rho$ <.001), as does the effort students invested in preparing for the math test ($\beta$ =.12, $\rho$ <.001), and their motivation ($\beta$ = .08, $\rho$ <.01). Surprisingly, the ratio of the instructional time the students received on math to their total instructional time ($\beta$ = -.14, $\rho$ < .001) has a significant negative relationship. In other words, the more time that the students spent on mathematics, the lower their average scores. Weekly math homework ($\beta$ = -.11, $\rho$ <.001) and sense of belonging ($\beta$ =-.10, $\rho$ <.001) also have significant negative impacts on the students' math achievement.

In Model 3, parental occupation ($\beta$ =.14, $\rho$ < .001) and gender ($\beta$ =.06, $\rho$ <.05) are added to the analyses, and the model explains slightly more variance in the students' achievement ($R^2$ =20.9%). The positive effect of gender indicates that boys outperform girls in math which reflects previous findings (Hedges & Nowell, 1995). Parental occupation, as an indicator of the students' SES, has a strong positive effect ($\beta$ = .14, p < .001) which also reflects previous findings (Coleman & Hoffer, 1987; Coleman et al., 1982). Tuition has a stronger negative influence ($\beta$ = -.19, $\rho$ <.001). The effect of students' morale decreases slightly ($\beta$ = .17, $\rho$ <.001), as does the effect of expected education ($\beta$ = .18, $\rho$ <.001), and the effect of math instruction time ($\beta$ = -.13,

$\rho$ <.001). It is obvious that students who expect to study mathematics at advanced levels attain higher achievement compared to students who do not expect to study this subject at higher levels. In sum, all of the student variables, students' morale, gender, and SES are positively related to the students' achievement in mathematics while higher tuition is negatively related. In addition, the school and student variables are orthogonal, with each group having effects that are independent of each other.

## Discussion

It is found in this study that school and student variables account for almost 21% of the variance in the private school students' math achievement. The amount of variance explained is similar to the amount explained for public school students reported by Wei, Clifton, and Robert (2011) ($R^2$ = 23%), which is also similar to finding of other North American studies (see Ma & Klinger, 2000; Nye, Konstantopoulos, & Hedges, 2004; Palardy & Rumberger, 2008; Rumberger & Palardy, 2005).

Like the private school students in the US, this study shows that Canadian private school students generally have higher SES than public school students. More importantly, these students generally outperform public school students (Coleman & Hoffer, 1987; Coleman et al., 1982; Figlio & Stone, 2012; Friedman, 1997). Parents often use this evidence to justify spending money on sending their children to private schools despite having access to free public schools. More specifically, about 7% of Canadian parents are willing to pay to have their children attend private schools with better resources, better teachers, and smaller classes (e.g. Jencks, 1985; Witte 1998). In fact, private education is frequently a priority for families with the financial resources to pay for it (Buddin, Cordes, & Kirby, 1998; Figlio & Stone, 2012; Lankford & Wyckoff, 1992). Many parents who move their children from one school to another say that academic priorities are their major concern (Kleitz, Weiher, Tedin, & Matland, 2000) giving private schools both social and academic advantages.

However, the evidence presented here suggests that the tuition fee is negatively related to the children's academic achievement. Though this finding is contrary to the marketing campaigns of many private schools who claim that parents get a better education for their children when they pay tuition fees, it supports the findings of Dronkers and Robert (2008a, 2008b) and Robert (2010), who suggest that higher tuition fees are related to worse academic performances by students. This may indicate that some other school variables are playing a more important role than the monetary resources of the students' parents. However, the negative effect of tuition fees may result because some expensive private schools are accepting students who are less able or less motivated, but are coming from families who think they can buy a good education by paying higher fees. To these parents, the good news is that private schools students are generally motivated to do well and most, if not all, of them intend to progress on to higher education. A counter-intuitive finding is that more reported hours private school students' spent on completing homework and the higher reported ratio of instructional time in mathematics are both negatively related to their academic performances. This may result because the students who do less well need to spend more time learning mathematics and complete their assignments. In other words, students who are doing well in mathematics need less time to complete their school assignments.

There are several limitations of this study. First, this study did not investigate the relationship between the school and student variables and other important educational outcomes such as the students' higher-order thinking and problem-solving skills. It has been suggested that schools have considerable effects on students' non-cognitive dispositions (Van de gaer, De Fraine, Pustjens, Van Damme, De Munter, & Onghena, 2009) and future research should examine these other important educational outcomes for private school students. Second, in this study it was not possible to separate religious from non-religious private schools: this is an important distinction in the research literature, and should be considered in future research. Such a study would be able to tell if the higher scholastic achievement of students in religious private schools in the US is also true in Canada. Finally, we intend to examine more recent PISA data to see if it is possible to compare differences in the academic achievement of students attending different types of private schools with their public school peers.

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