Alberta Journal of Educational Research, Vol. 57, No. 4, Winter 2012, 460-478

School Resources and the Academic Achievement of Canadian Students

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This study estimates the impact of schools' physical resources and teachers' academic press on students' academic achievement in mathematics and reading when a number of important student variables are controlled. Academic press is defined as teachers' emphasis on academic excellence and upholding academic standards (McDill, Natriello, & Pallas, 1986). It is often argued that both school and teacher resources affect the educational achievement of students. But, the research literature has been inconsistent, which may be due to methodological issues. For this reason, this study attempts to correct two of the most important issues by using Canadian national data and multi-level modeling. The results reveal that, in Canada, at least, the physical resources and academic press evaluated by school principals do not significantly affect students' achievement in mathematics and reading.

Cette étude évalue l'impact des ressources physiques des écoles et la rigueur académique des enseignants sur le rendement académique des élèves en mathématiques et en lecture lorsqu'on contrôle un certain nombre de variables importants chez les élèves. On définit la rigueur académique comme l'importance que les enseignants accordent à l'excellence académique et le maintien de normes académiques (McDill, Natriello, & Pallas, 1986). On soutient souvent que tant les ressources de l'école que celles des enseignants jouent un rôle dans le rendement académique des élèves. Les publications de recherche, par contre, sont contradictoires, peut-être en raison de problèmes méthodologiques. Cette étude tente donc de rectifier deux des problèmes les plus importants en employant des données nationales canadiennes et le modelage multiniveau. Les résultats indiquent qu'au Canada du moins, les ressources physiques et la rigueur académique telles qu'évaluées par les directeurs d'école n'affectent pas de façon significative le rendement des élèves en mathématiques et en lecture.

A number of countries are generously investing in both their schools and their teachers in an attempt to improve the educational achievement of students. In Canada, for example, the national expenditure per student in public education has increased from $7,077 in 1998 to $9,040 in 2005 (in constant dollars), an increase of almost 30% (Statistics Canada, 2008). Over the same period, American expenditure per student increased from $8,118 to $10,770, an increase of almost 15% (in constant dollars) (National Center for Education Statistics, 2007). This substantial increase in educational expenditures is based on the widely accepted argument that school and teacher resources strongly affect the educational achievement of students (Dearden, Ferri, & Meghir, 2002; Earthman, 2002; Greenwald, Hedges, & Laine, 1996; Hoy & Woolfolk, 1993).

However, since the mid-1960s there has been considerable debate about the effect of school-level resources on the achievement of students, and how school resources affect students' learning is still an unresolved policy question (Henry, Fortner, & Thompson, 2010). Coleman et al. (1966) argue that generally the physical resources in schools are unrelated to the academic achievement of students. Similarly, other researchers (Hanushek, 1997, 2003; Hanushek, Rivkin, & Taylor, 1996) report that the resources spent on the physical facilities of schools and even the resources spent on improving the qualifications of teachers have virtually no consistent effect on the academic achievement of students. As a result, some researchers are beginning to say that money is often wasted when administrators spend more resources on improving the physical condition of schools, decreasing the student-teacher ratios, or increasing the qualifications of teachers (Hanushek, 1997, 2003; Palardy & Rumberger, 2008).

Moreover, a number of studies that suggest a positive relationship between the physical resources of schools and the academic achievement of students often have serious methodological problems (Hanushek, Rivkin, & Taylor, 1996; Picus, Marion, Calvo, & Glenn, 2005). Some studies, for example, include very small samples of students and schools and others use inappropriate statistical procedures in estimating the effect parameters. The small samples that are used in some studies have often been selected from one province in Canada or one state in the United States, or even from a single school district, which means that the school resources may not vary enough to affect the educational achievement of students (Berner, 1993; Lewis, 2000; Maxwell, 1999). In a number of studies, researchers have aggregated the data to the school-level ignoring the fact that this procedure reduces the variance in some variables, and more importantly, introduces significant error into the analyses (Berner, 1993; Hoy & Hannum, 1997; Lewis, 2000; Uline & Tschannen-Moran, 2008).

This study *attempts to* address these limitations by using Canadian national data and Hierarchical Linear Modeling (HLM) to estimate the effects of physical resources of schools and academic press of teachers (i.e., the independent variables measured at the school level) on the academic achievement of students in mathematics and reading (i.e., the dependent variables measured at the student level) while the students' socioeconomic status (SES), gender, and psychological dispositions (i.e., the students' individual variables measured at the student level) are controlled, in a national sample of more than 20,000 Canadian students enrolled in more than 1,000 public schools from the 10 Canadian provinces.

Review of Literature

Characteristics of Schools and Teachers

Even though schools and teachers have a major impact in shaping their students' educational experiences, it is far from conclusive how schools and teachers affect their students. Contrary to the research of Coleman et al. (1966) and Hanushek (2003), there is a growing body of research suggesting that the *physical resources* of schools, especially the physical conditions of the buildings, affect the students' attitudes toward education and their academic achievement (Berner, 1993; Hoy & Hannum, 1997; Hoy, Tarter, & Kottkamp, 1991; Schneider, 2002; Uline & Tschannen-Moran, 2008; Uline, Tschannen-Moran, & Wolsey, 2009). The findings in this research literature, however, are not consistent. Burtless (1996) found that only half of the articles he reviewed provided evidence that increasing the expenditures on physical improvements to schools and classrooms resulted in improved academic achievement of students. In a few empirical studies, the relationship between the physical resources of schools and the students' achievement was positive but weak (Cervini, 2009; Dearden et al., 2002; Picus et al., 2005; Wößmann, 2003). In at least one study, however, it was found that the physical resources of schools affected the students' academic attainments and aspirations, but not their academic achievement (Unnever, Kerckhoff, & Robinson, 2000). In fact, Picus et al. (2005) suggest that the inconsistencies in this literature may result from poor measurements of the physical facilities, using the wrong unit of analyses, and not controlling for important confounding variables. In addition, Roberts (2009) notes that it is more appropriate to measure the physical resources in schools by using the principals' and teachers' assessments instead of using the assessments of engineers that have been commonly used because engineers' assessments have little to do with the instructional functions of school.

When thinking of good schools, researchers, school administrators, and parents not only think of attractive, warm, and comfortable buildings that have sufficient equipment and material, they also think of excellent teachers who are capable of developing and maintaining a positive educational climate. The teachers' emphasis on academic excellence and upholding academic standards is defined as their *academic press* (McDill, Natriello, & Pallas, 1986). Excellent teachers recognize that the achievement of students is their most important educational objective, and they set high educational expectations for students. As such, the academic press of teachers is often found to have a strong positive impact on the students' academic achievement (Hallinger & Murphy, 1986; Hoy & Hannum, 1997; Murphy, Weil, Hallinger, & Mitman, 1982). Hoy et al. (1991), in fact, point out that the single best predictor of the students' academic achievement was the concern that teachers have for their success.

Similar to the research on the physical resources, the research on academic climate of schools has also produced mixed findings. Some studies show little or weak relationships between the teachers' academic press and the academic achievement of students depending on the way the variables have been measured and the statistical procedures that have been used (Cervini, 2009; Ma & Klinger, 2000; Murphy et al., 1982; Phillips, 1997). Nevertheless, it is proposed that the relationships between both the physical resources of schools and the teachers' academic press and students' academic achievement will become clearer when relevant student differences are controlled in analyses (Van de gaer et al., 2009; Van den Noortgate, Opdenakker, & Onghena, 2005).

Characteristics of Students

Considerable evidence suggests that the academic achievement of students is affected by other variables besides the characteristics of their schools and teachers. Specifically, socioeconomic status (SES), gender, and the psychological dispositions of students are important determinants of their achievement. Thus, it is necessary to control these variables in estimating the impacts of the physical resources of schools and the academic press of teachers on students' achievement.

Socioeconomic status (SES) is arguably the most widely examined variable in the educational research literature and is almost always included in analyses of academic achievement and educational attainment (Sirin, 2005; White, 1982). Families from higher SES, in comparison with families from lower SES, provide more positive learning environments and more academic and financial support for their children to participate in a variety of educational programs. They often have higher expectations for their children's academic performances, more positive interactions with teachers, and spend more money on a host of things that help children succeed in school. As a consequence, children from higher SES families, on average, outperform their peers from less-advantaged families (Sirin, 2005; White, 1982).

In addition, it is evident that adolescent girls and boys have differences in their academic achievement and the effect of *gender* is subject-specific; on average, females have superior performances in subjects that require verbal skills, while males have superior performances in subjects that require spatial and quantitative skills (Halpern, 2000; Hedges & Nowell, 1995). Thus, females most often *outperform* males in reading and writing, while males most often *outperform* females in mathematics and science (Beller & Gafni, 1996; Friedman, 1989; Hyde, Fennema, & Lamon, 1990; Hyde & Linn, 1988; Lietz, 2006).

Finally, a number of studies illustrate that the psychological dispositions of students also affect their academic achievement. One of the most important psychological dispositions is students' *instrumental motivation*, which is the extent to which they are motivated to complete their school work. Specifically, instrumental motivation represents the engagement that students have in their academic work (Gardner & MacIntyre, 1991; Miller, Greene, Montalvo, Ravindran, & Nicholls, 1996; Simons, Vansteenkiste, Lens, & Lacante, 2004). As well, the educational and occupational goals that students set for themselves are important for their educational success. It has been found that students who have higher educational expectations, even when SES, gender, and instrumental motivation are taken into consideration, often *outperform* students who have lower educational expectations (Bandura, 1986; Barron & Harackiewicz, 2000; Kaplan & Maehr, 1999; Pintrich, 2000; Utman, 1997).

In sum, the research literature shows that the students' SES, gender, instrumental motivation, and expected educational attainment affect their academic achievement. Accordingly, these variables are controlled in this study because we anticipate that they moderate the effects of the schools' physical resources and the teachers' academic press on the students' academic achievement.

Methodological Improvements

As indicated earlier, a number of studies that have assessed the effects of the school resources and the teachers' academic press on the academic achievement of students have serious methodological limitations (Cervini, 2009; Van de gaer et al., 2009; Van den Noortgate et al., 2005). A serious problem exists in a number of studies that have aggregated the students' achievement data to the classroom or school level, then regressed the mean achievement scores on the mean SES scores, school resources, and, occasionally, the mean motivation scores (Berner, 1993; Hoy & Hannum, 1997; Lewis, 2000; Uline & Tschannen-Moran, 2008). The procedure of aggregating data to the classroom- or school-level reduces the variance in variables as well as decreasing the units of analyses to the number of classrooms or schools which often results in biased coefficients (Hanushek et al., 1996; Raudenbush & Willms, 1995; Robinson, 1950). More importantly, a number of researchers have interpreted the coefficients from aggregated data at the individual student level rather than at the school or classroom level, thus committing the ecological fallacy (Alker, 1969). Ignoring this methodological problem in analyzing large and nested data sets is likely to produce biased estimates of the effects of schools and teachers on the achievement of students.

Fortunately, researchers have recently developed statistical procedures for analyzing data so that students, classrooms, and schools are assessed at distinct and nested levels which provide more reasonable estimates of the effects of schools (Nye, Konstantopoulos, & Hedges, 2004; Palardy & Rumberger, 2008; Rumberger & Palardy, 2005). For this reason, we use Hierarchical Linear Modeling (HLM) to estimate the effects of (a) physical resources of schools and (b) academic press of teachers (i.e., the independent variables measured at the school level), and (c) SES, (d) gender, and (e) psychological dispositions of students (the students' individual variables measured at the student level) on the academic achievement of students in mathematics and reading (i.e., the dependent variables measured at the student level), in a national sample of Canadian students attending public schools in 10 provinces.

Methods

Sample

The subjects for this study were selected from Canadian data collected in 2003 for the Programme for International Student Assessment (PISA), an international study of 15-year-old students from a large number of countries. In total, 27,953 15-year-old Canadian students from 1,087 schools in 10 provinces were selected using a two-stage sampling procedure.

1. First, schools with 15-year-old students were selected with probabilities proportional to the size of the schools.
2. Second, a random sample of at least 35 students was selected from each of the sampled schools; if there were fewer than 35 students in a school, all of the 15-year-olds were selected.

The 1,087 schools in the study included 1,003 public schools with 25,975 students, and 76 private and 7 other schools with 1,978 students. For this study, only students from the 1,003 public schools, representing over 92% of the sampled students, were selected. The number of students from each school varied from 1 to 211, with 83.9% of the schools having between 10 and 40 students. Ninety-eight percent of the students were in Grades 9 and 10. Table 1 presents the number of public schools and students that were sampled from each of the 10 provinces. In this table, it is observed that all 10 provinces had roughly similar numbers of participating students.

Table 1

Number of Schools and Students from the 10 Canadian Provinces

Province	Schools		Students	
	Number	Percentage	Number	Percentage
Newfoundland and Labrador	109	10.9	2,288	8.8
Prince Edward Island	27	2.7	1,664	6.4
Nova Scotia	116	11.6	2,839	10.9
New Brunswick	74	7.4	3,730	14.4
Quebec	107	10.7	2,654	10.2
Ontario	137	13.7	3,151	12.1
Manitoba	106	10.6	2,425	9.3
Saskatchewan	107	10.7	2,199	8.5
Alberta	112	11.2	2,374	9.1
British Columbia	108	10.8	2,648	10.2
Total	1,003	100.0	25,972	100.0

Table 2

Descriptive Statistics for the Variables

Variables	Missing Data	Number of items	Actual Range	Factor loadings	Alpha	Mean	S.D.
School Variables	School Sample (1,003)						
Physical resources	13.1%	12	12–48	0.59–0.79	0.90	33.28	7.33
Academic press	7.4%	9	16–36	0.56–0.75	0.82	28.40	3.45
Dependent Variables	Student Sample (25,972)						
Mathematics							
Plausible value 1	0	-	160.33–853.44			518.70	87.30
Plausible value 2	0	-	83.14–866.83			518.26	86.74
Plausible value 3	0	-	167.66–856.47			518.60	86.75
Plausible value 4	0	-	119.75–853.28			518.34	87.18
Plausible value 5	0	-	191.03–844.48			518.48	87.25
Reading							
Plausible value 1	0	-	100.30–818.67			513.50	90.35
Plausible value 2	0	-	67.42–914.00			513.61	90.41
Plausible value 3	0	-	98.38–817.24			513.70	89.87
Plausible value 4	0	-	132.87–847.43			513.81	90.48
Plausible value 5	0	-	131.26–914.00			513.61	90.52
Student Variables							
Gender	2.6%	1	0–1				
Parental education	10.7%	1	0–14			8.68	2.04
Parental occupation	7.4%	1	16–90			50.08	15.79
Instrumental motivation	5.3%	4	-2.38–.7	0.86–0.88	0.90	.23	1.01
Expected education	5.0%	1	0–5			4.33	1.04

Instruments

In order to test the hypothesis that the physical resources of schools and the academic press of teachers affect the students' academic achievement, their achievement scores in mathematics and reading were used as dependent variables, while physical resources of schools and academic press of teachers, measured at the school level, were used as independent variables. In addition, three background and two psychological variables of the students: (a) gender, (b) parental education, and (c) parental occupation (as measures of SES), and (d) instrumental motivation, and (e) their expected educational attainment, were used as control variables.

Dependent Variables

The students selected for the PISA study were given a paper-and-pencil achievement test lasting two hours during the months of April and May in 2003. These students were randomly assigned questions in 1 of 13 test booklets, each of which included four clusters of test items from an item-pool, seven in the major domain, mathematics, and two in each of the three minor domains, reading, science, and problem solving. In the test booklets, each of the four clusters was allocated 30 minutes, and the clusters varied so that each booklet had between one and three clusters in mathematics and at least one cluster in a minor domain. 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 has five plausible values that were transformed into a common metric. Specifically, the five plausible values in each subject represent estimates of the mean achievement score for each student and prevent biased inferences resulting from using a relatively small number of test items (Organisation for Economic Co-operation and Development [OECD], 2005). Even though there were differences in the test booklets, the plausible values provide very reliable estimates of the students' academic achievement. In our analyses, we use the five plausible values for the students' achievement in mathematics and the five values in reading as the dependent variables. The final result in each subject is the average of five estimates from the plausible values.

The descriptive statistics for each of the plausible values in mathematics and reading are presented in Table 2. The means and standard deviations, as expected, are very similar for all the plausible values in each subject. The correlation between the students' achievement in mathematics and reading is very high ($r=.784$) (see Table 3). There are, however, important differences between these two subjects, which suggest that they should be treated as separate dependent variables.

School Variables

The descriptive statistics for the two independent variables, physical resources and academic press, are also presented in Table 2. *Physical resources* were obtained from the principals' questionnaire containing a 12-item, 4-point scale, ranging from *not at all* (1), to *a lot* (4). Specifically, the instrument asked: "Is your school's capacity to provide instruction hindered by a shortage or inadequacy of any of the following?" A sample of the items include: (a) instructional materials (e.g., textbooks), (b) school buildings and grounds, (c) heating/cooling and lighting systems, (d) instructional space (e.g., classrooms), (e) library materials, and (f) science laboratory equipment and materials. The responses were reverse coded so that higher values indicate more resources were available. The 12 items were factor analyzed and they loaded between 0.59 and 0.79 on a single factor indicating that they measure important aspects of the physical resources of schools. Cronbach's alpha for the physical resources scale is 0.90.

Academic press was assessed on two scales. The first scale was a 4-item, 4-point Likert scale ranging from *strongly agree* (1), to *strongly disagree* (4), and the second was a 5-item, 4-point scale ranging from *not at all* (1), to *a lot* (4), which were both included in the principals' questionnaire. In the first scale, the principals responded to the question: "Think about the teachers in your school, how much do you agree with the following statements?" The items included: (a) "the morale of teachers in this school is high," (b) "teachers work with enthusiasm," (c) "teachers take pride in this school," and (d) "teachers value academic achievement." In the second scale, the principals responded to the following questions: "In your school, to what extent is the learning of students hindered by (a) teachers' low expectations of students, (b) poor student-teacher relations, (c) teachers not meeting individual students' needs, (d) staff resisting change, and (e) students not being encouraged to achieve their full potential?" Higher values indicated more positive academic press. The nine items were factor analyzed and they loaded between 0.56 and 0.75 on a single factor indicating that they measure important aspects of academic press of teachers. Cronbach's alpha reliability coefficient for the academic press scale is 0.82. Not surprisingly, the physical resources and the academic press variables are positively correlated (.169; see Table 3).

Student Variables

Five variables were used to control for the effects of the students' individual characteristics, gender, parental education and parental occupation (as measures of SES), instrumental motivation, and expected educational attainment. The descriptive statistics for these variables are also reported in Table 2.

Gender. Female students were coded 0 and males were coded 1. Slightly over 49% of the students were female and almost 51% were male.

Parental education. The education attained by the students' parents was derived from the students' responses to items asking about both parents' education, which were coded on the International Standard Classification of Education 1997 index (OECD, 2005). The variable was created by summing both parents' scores on the index; the minimum score (0) indicated that both parents had no formal education and the maximum score (14) indicated that both parents had university degrees.

Parental occupation. We used the PISA index of highest parental occupation status obtained from two open-ended questions in the students' questionnaire inquiring about their parents' occupations. The responses were coded on the International Socio-Economic Index of Occupational Status (the scores ranged from 16 to 90; Ganzeboom, De Graaf, & Treiman, 1992), which corresponded to the higher score for either parent or to the only parent who was in the home with the children.

Instrumental motivation. The index of instrumental motivation was derived from the students' responses to a 4-item, 4-point Likert scale ranging from *strongly agree* (1), to *strongly disagree* (4), in which students were asked to respond to the following statements: (a) "Making an effort in mathematics is worth it because it will help me in the work that I want to do later on," (b) "learning mathematics is worthwhile for me because it will improve my career," (c) "mathematics is an important subject for me because I need it for what I want to study later on," and (d) "I will learn many things in mathematics that will help me get a job." These items refer to mathematics and they were used to predict students' achievement in reading because there were no items to assess students' instrumental motivation in reading. It is possible that if students are motivated to do well in mathematics they would be motivated to do well in other subjects. In fact, students' achievement in mathematics and reading were highly correlated ($r=.784$, $p<=.01$). These items were reverse coded by the PISA researchers (OECD, 2005) so that higher scores indicated higher motivation. The four items loaded between 0.86 and 0.88 on a single factor. The motivation scale was previously created and was included in the PISA 2003 Canadian data set (OECD, 2005). The scale ranges from -2.38 to 0.7, and the Cronbach's alpha reliability coefficient is 0.90.

Expected education. Finally, the students were asked about their own educational expectations, and their responses were also classified on the International Standard Classification of Education 1997 index (OECD, 2005). The scores range from 0, indicating that the students did not plan to progress any further in school, to 5, indicating that they planned to complete at least a university degree. The mean level of education that the students expected is 4.33, indicating that the majority of them planned to attend college or university.

The Analyses

The two-staged weighting procedures recommended by the OECD (2005) researchers were followed. Specifically, the student sample was weighed by the final *student weight* so that the sample would represent the population of public school students in the 10 Canadian provinces. The selection probability for student *j* attending school *i* is the product of the school selection probability multiplied by the student selection probability within that school. The *final student weight* is the selection probability for the students after adjusting for those who did not complete the questionnaire.

In preliminary analyses, we assessed the relationships between the independent variables for collinearity, and there was no evidence that this assumption was violated. In addition, missing values were examined and none of the variables violated the assumption that the missing values were random. As such, before analyzing the data, the relatively few missing values (see Table 2) in the independent and students' individual variables were replaced with linear interpolation values because the Hierarchical Linear Modeling program (HLM6.0) requires that the data matrix have no missing data. Following these preliminary analyses, we estimated a series of two-level models with students nested within schools. HLM6.0 does not report standardized coefficients, and to calculate these coefficients we used a procedure recommended by Bring (1994).

Specifically, four HLM analyses were run with various combinations of school and student variables with fixed slopes (Ma, Ma, & Bradley, 2008). In Step 1, a fully unconditional model without any predictors was estimated to test whether there was significant between-school variation in mathematics and reading. This model provides the baseline estimates of incepts, or grand means, between-school variance (τ_{00}), or the variance of mean-school scores from the grand mean, and estimates of student-level variance (σ^2), or the deviation of the mean individual scores from the school means, which are necessary information for answering the research question. Also, τ_{00} and σ^2 serve as points of comparison for the subsequent analyses in Steps 2, 3, and 4. By examining how much τ_{00} and σ^2 are reduced in each of these steps, we determine how much the within- and between-school variance in mathematics and reading are explained by the inclusion of specific independent and student variables (Ma, Ma, & Bradley, 2008; Raudenbush & Bryk, 2002).

Table 3

Correlation Coefficients Among the Variables at the Student-Level and the School-Level

Student Variables							
	Gender	Parental education	Parental occupation	Instrumental motivation	Expected education	Mathematics	Reading
Gender	1						
Parental education	.044**	1					
Parental occupation	.019**	.394**	1				
Instrumental motivation	.026**	.078**	.065**	1			
Expected education	-.164**	.231**	.207**	.263**	1		
Mathematics	.033**	.204**	.278**	.248**	.335**	1	
Reading	-.210**	.187**	.239**	.192**	.367**	.784**	1

School Variables		
	School Resources	Academic press
Physical resources	1	
Academic press	.169**	1

Note. ** p<.01

Table 4

Hierarchical Regression Coefficients (standardized coefficients are in parenthesis)

	Step 1		Step 2		Step 3		Step 4	
Variables	Math	Read	Math	Read	Math	Read	Math	Read
Intercept	529.082***	525.643***	529.395***	525.942***	519.606***	535.999***	519.794***	536.189***
School Variables								
Physical resources			0.027 (0.002)	0.009 (0.000)			0.134 (0.010)	0.065 (0.004)
Academic press			0.950 (0.038)	0.904 (0.035)			0.599 (0.024)	0.595 (0.022)
Student Variables								
Gender					14.843*** (0.086)	-25.445*** (-0.141)	14.858*** (0.086)	-25.433*** (-0.141)
Parental education					1.785*** (0.035)	2.360** (0.045)	1.780*** (0.035)	2.353** (0.045)
Parental occupation					0.780*** (0.134)	0.658*** (0.110)	0.779*** (0.134)	0.658*** (0.110)
Instrumental motivation					12.905*** (0.143)	7.297*** (0.081)	12.890*** (0.143)	7.282*** (0.081)
Expected education					23.225*** (0.269)	24.411*** (0.269)	23.234*** (0.269)	24.417*** (0.270)
Variance Estimates								
School variance (τ_{00})	1282.591	1240.015	1273.490	1230.873	924.352	871.040	920.186	866.845
Student variance (σ^2)	6306.972	6669.195	6307.250	6669.626	5373.383	5707.296	5373.520	5707.588

Note. ** p<.01, ***p<.001

Results

The bivariate correlation coefficients for both the student-level and the school-level variables are reported in Table 3. Correlations between the two school variables and between the student variables and the dependent variables, achievement in mathematics and reading have been calculated using one randomly selected plausible value in each subject. None of the coefficients are greater than .4, so collinearity is not an issue. Table 4 reports the intercepts and both the standardized and unstandardized coefficients for the four steps in the HLM analyses. Step 1 presents the grand mean estimates of the students' academic achievement in mathematics and reading. In 2003, the average mathematics score was 529.08 and the average reading score was 525.64, which indicates that Canadian students were, generally, among the highest performing 15-year-olds in the world (Statistics Canada, 2007). This analysis also illustrates that 16.90% [$\tau_{00}/(\tau_{00} + \sigma^2)$] of the variance in mathematics and 15.68% of the variance in reading are between schools. In other words, schools affected students slightly more in their mathematics achievement than in their reading achievement, which is understandable because math is almost entirely taught and practiced in schools while most 15-year-olds practice some reading outside of school.

To examine whether the independent variables could explain these between-school differences, the physical resources of schools and the academic press of teachers were added as school-level predictors in Step 2. Adding these two variables explains about 1% of the between-school differences in mathematics and reading. In addition, the intercepts remain about the same and the beta coefficients for these two variables are not statistically significant.

In Step 3, the five variables measuring the students' individual characteristics were entered without the school-level variables, and as expected, they explain a substantial amount of both within- and between-school differences in the students' academic achievement. Specifically, the between-school difference now accounts for 14.68% of the variance in the students' achievement in mathematics and 13.24% of the variance in the students' achievement in reading. These results suggest that the effects of the students' characteristics are not equal across schools. As commonly known, students in some schools have, on average, different SES levels, gender distributions, motivation levels, and educational expectations, which obviously affect the schools' average student achievement.

All the individual variables have statistically significant effects on the students' achievement in both subjects. Gender has a moderate effect on reading because girls do much better than boys and a weaker effect on mathematics because boys do slightly better than girls. On average, girls score 25.45 points ($p<.001$) higher than boys in reading and boys score 14.84 points ($p<.001$) higher than girls in mathematics. Parental education also has a statistically significant effect on the students' achievement in both subjects, but the effects are rather weak ($\beta=0.035$, $p<.01$ in mathematics and $\beta=0.045$, $p<.01$ in reading). Nevertheless, parental occupation has larger effects on the students' achievement in both mathematics ($\beta=0.134$, $p<.001$) and reading ($\beta=0.110$, $p<.001$), which is consistent with the results reported in the review articles (Sirin, 2005; White, 1982). Instrumental motivation, in turn, has a statistically significant effect on the students' achievement in both mathematics and reading, but the effects are moderate in mathematics ($\beta=0.143$, $p<.001$) and smaller in reading ($\beta=0.081$, $p<.001$). The difference in the effects of motivation on the two subjects is probably caused by the fact that the questionnaire items focused on motivation in mathematics and not in reading. Nevertheless, the largest effect results from the students' expected educational attainment. Specifically, the effects of expected educational attainment on mathematics (β=0.269, p<.001) and reading (β=0.270, p<.001) are not only large, but they are very similar. In essence, a single unit increase in expected education results in increases of 23.23 points in mathematics and 24.41 points in reading.

Finally, in Step 4, the school-level independent variables were included along with the students' individual variables. The results are very similar to those presented in Steps 2 and 3. Specifically, neither the physical resources of schools nor the academic press of teachers have significant effects on mathematics or reading. Likewise, these two variables do not explain any appreciable proportion of the between-school variance in either subject. The magnitude of the teachers' academic press, however, decreased slightly in comparison with the effects in Step 2, showing that the initial estimated effects are, to a small degree, mediated by the students' individual characteristics. Moreover, the effects of the students' individual characteristics on their achievement are only marginally affected by the school resource and academic press variables. In essence, the results show that the strongest effects on the academic achievement of 15-year old students are from their individual characteristics, particularly their expected education, motivation, parental occupation, and gender. And, the school variables, physical resources and academic press, have very small, nonsignificant, effects on the students' academic achievement.

Discussion

A number of researchers have argued that improving the quality of schools and teachers has important and positive effects on their students' academic achievement (Dearden et al., 2002; Earthman, 2002; Greenwald et al., 1996; Hallinger & Murphy, 1986; Hoy & Woolfolk, 1993; Phillips, 1997; Rumberger & Palardy, 2005; Schneider, 2002; Wößmann, 2003). While these arguments are intuitively appealing, many of the research studies examining the relationship have serious methodological deficiencies. Specifically, a number of the studies use limited data and some commit the ecological fallacy because the researchers amalgamated the students' data to the school-level and interpreted the results at the individual-level rather than estimating both student- and school-level models using multilevel modeling procedures (Berner, 1993; Hoy & Hannum, 1997; Lewis, 2000; Maxwell, 1999; Uline & Tschannen-Moran, 2008). As a result, we question the validity of these studies (Hanushek et al., 1996; Raudenbush & Willms, 1995; Robinson, 1950).

In contrast, our study addresses these limitations by using HLM to examine the school effects on academic achievement using a large sample of Canadian public school students while controlling for important confounding student variables, gender, SES, instrumental motivation, and expected education. Not controlling for these important confounding variables is a significant deficiency in previous studies (Picus et al., 2005). Additionally, our study uses measures of physical resources of schools, which are more consistent with schools' instructional purposes, as contrasted with engineering measures previously used (Roberts, 2009).

This study suggests that schools' physical resources and teachers' academic press have nonsignificant effects on the students' academic achievement in mathematics and reading in Canada. These findings are consistent with what Coleman et al. (1966), Burtless (1996), and Hanushek (1997, 2003) have found in the United States, but they may be disappointing to many Canadian school administrators who think that improving the quality of their schools' physical facilities and their teachers' academic press have important influences on their students' academic achievement. Of course, students should attend safe, comfortable, and well-equipped schools with well-qualified teachers. But we suggest that spending more money on improving the physical facilities and the teachers' academic press may not result in greater academic achievement for students. In addition, we suggest that research that aggregates data to the school level may over-estimate the impact of school and teacher characteristics on students' academic achievement. Unfortunately, these questionable analyses may have contributed to costly educational policies (Burtless, 1996; Murphy et at., 1982; Schneider, 2002; Van de gaer et al., 2009).

Even so, we need to interpret the finding that the teachers' academic press has little effect on students' achievement with caution. Unlike the schools' physical facilities, which are likely to be relatively evenly distributed across students and classrooms, the teachers' academic press probably varies considerably within schools (Murphy et al., 1982; Odden, Borman, & Fermanich, 2004). Unfortunately, principals did not comment on the specific teachers who taught mathematics and reading to these students; instead, they assessed the academic press of all teachers in their schools. As such, the conclusion that the academic press of teachers has virtually no effect on students' achievement is tentative at best.

There are, however, important differences between schools that, in fact, have significant effects on the academic achievement of students. Overall, our evidence suggests that the between-school variation represents close to 20% of the student variation in mathematics and reading achievement while the individual variation between students represents more than 80%, which is similar to the results of a few other studies that used multilevel analyses (Ma & Klinger, 2000; Nye et al., 2004; Palardy & Rumberger, 2008; Rumberger & Palardy, 2005). More importantly, these results suggest that the school-level effects are largely independent of the student-level effects. Administrators may be encouraged by this finding because it suggests that the way schools are organized and managed has an important impact on the academic achievement of students, and these effects are independent of students' individual characteristics. In other words, good school administrators can make a substantial difference in schools with both boys and girls from both low and high SES families.

Other than providing a better estimate of school-level effects, our study supports previous research suggesting that the individual characteristics of students have the strongest effects on their academic achievement. In fact, our research helps clarify some of the ambiguities in previous research because the effects of the students' individual variables are computed when important school-level variables are controlled. Specifically, the evidence shows that (a) gender, (b) parental occupation, (c) instrumental motivation, and (d) expected educational attainment affect students' achievement in both mathematics and reading when both school and teacher variables are controlled. In this respect, our results are consistent with the findings from a number of other studies. We show, for example, that boys generally do better in mathematics and girls generally do better in reading (Beller & Gafni, 1996; Friedman, 1989; Hedges & Nowell, 1995; Lietz, 2006). Students with parents with higher occupational status, higher instrumental motivation, and higher educational expectations have considerably higher academic achievement than other students. Compared with parental occupation, parental education is less important in promoting the students' academic achievement, which is generally consistent with the estimates using data gathered at the student level (Sirin, 2005; White, 1982).

Not surprisingly, a powerful predictor of students' academic achievement is their expected educational attainment. Specifically, when other important individual characteristics and school characteristics are controlled, the level of education that students expect to attain has the largest effect on their academic achievement in both mathematics and reading. These results may help to explain why some under-privileged parents have academically successful children even when they attend rather poorly resourced schools. In light of recent theories of (a) motivations (Bandura, 1986; Miller et al., 1996), and (b) goals (Barron & Harackiewicz, 2000; Kaplan & Maehr, 1999; Pintrich, 2000; Utman, 1997), it is likely that these parents help their children develop the psychological dispositions that assist them in learning regardless of their SES or the resources available in their schools.

Like all research, this study has limitations that must be acknowledged. In general, variables at all relevant levels that affect the academic achievement process of students should be included in the analyses (Cervini, 2009; Van den Noortgate et al., 2005). In Canada, the provinces differ in a number of important ways (e.g., funding policies, educational priorities, and teachers' certification). However, in a previous exploratory analysis we found that provincial differences only accounted for about 1% of the variation in the students' achievement in the PISA data. For this reason, the provincial-level was not included in this study. Consequently, we suggest that the school is the level where educational policies are most effective. Unfortunately, PISA does not have information on classroom differences that may account for variation in students' learning. In the future, the problem examined in this study should be investigated with teacher- and classroom-level data in more complex multilevel analyses.

Another important issue that needs further investigation is the relationship between the two school-level variables (physical resources and teachers' academic press) and other important educational outcomes such as the students' higher-order thinking and problem-solving skills. In fact, it has been suggested that schools have considerable effects on students' non-cognitive dispositions (Van de gaer et al., 2009). In addition, interaction effects resulting from school resources and students' individual characters may also affect their academic achievement in more dynamic ways (Bryk & Raudenbush, 1988; Unnever et al., 2000). As such, future research should be directed at examining these more complex models.

In conclusion, the findings of this study are encouraging because, after controlling the students' individual characteristics, the evidence suggests that schools are not insignificant. Now, the question arises for both researchers and administrators, what are the organizational, management, and teaching characteristics of effective schools? Obviously, our study suggests that teachers and principals can work on increasing the students' instrumental motivation and educational expectations so that they begin taking their academic work more seriously, spending more time and effort doing school work, and developing more efficient learning strategies. Encouragement is provided by the students' families, but teachers and principals can have an effect on the students' motivation too. While not being able to identify the specific organizational characteristics of schools and teaching strategies that positively affect the academic achievement of these Canadian adolescents, this study suggests that school administrators and teachers can have substantial and positive effects on students' academic achievement. Further research, however, is needed to identify the ways that they are important.

References

Alker, H. R. (1969). A typology of ecological fallacies. In M. Dogan & S. Rokkan (Eds.), *Quantitative ecological analysis in the social sciences* (pp. 69-86). Cambridge, MA: The MIT Press.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Barron, K. E., & Harackiewicz, J. M. (2000). Achievement goals and optimal motivation: A multiple goals approach. In C. Sansone & J. M. Harackiewicz (Eds.), *Intrinsic and extrinsic motivation: The search for optimal motivation and performance* (pp. 229–254). New York: Academic Press.

Beller, M., & Gafni, N. (1996). The 1991 international assessment of educational progress in mathematics and sciences: The gender differences perspective. *Journal of Educational Psychology, 88*(2), 365–377.

Berner, M. M. (1993). Building conditions, parental involvement, and student achievement in the District of Columbia public school system. *Urban Education, 28*(1), 6–29.

Bring, J. (1994). How to standardize regression coefficients. *The American Statistician, 48*(3), 209–213.

Bryk, A. S., & Raudenbush, S. W. (1988). Toward a more appropriate conceptualization of research on school effects: A three-level hierarchical linear model. *American Journal of Education, 97*(1), 65–108.

Burtless, G. E. (1996). *Does money matter? The effect of school resources on student achievement and adult success*. Washington, DC: Brookings Institution Press.

Cervini, R. A. (2009). Class, school, municipal, and state effects on mathematics achievement in Argentina: A multilevel analysis. *School Effectiveness and School Improvement, 20*(3), 319 –340.

Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfeld, F. D., & York, R. L. (1966). *Equality of educational opportunity*. Washington, DC: U.S. Government Printing Office.

Dearden, L., Ferri, J., & Meghir, C. (2002). The effect of school quality on educational attainment and wages. *The Review of Economics and Statistics, 84*(1), 1–20. Retrieved January 02, 2012, from http://faculty.smu.edu/millimet/classes/eco7321/papers/dearden%20et%20al.pdf

Earthman, G. I. (2002). *School facility conditions and student academic achievement*. Los Angeles, CA: UCLA's Institute for Democracy, Education, & Access. Retrieved January 02, 2011, from UCLA's Institute for Democracy, Education, & Access Web site: http://escholarship.org/uc/item/5sw56439#page-1

Friedman, L. (1989). Mathematics and the gender gap: A meta-analysis of recent studies on sex differences in mathematical tasks. *Review of Educational Research, 59*(2), 185–213.

Ganzeboom, H. B. G., De Graaf, P. M., & Treiman, D. J. (1992). A standard international socio-economic index of occupational status. *Social Science Research, 21*(1), 1–56.

Gardner, R. C., & MacIntyre, P. D. (1991). An instrumental motivation in language study: Who says it isn't effective? *Studies in Second Language Acquisition, 13*(1), 57–72. Retrieved January 02, 2012, from http://faculty.uccb.ns.ca/pmacintyre/research_pages/journals/motivation_language1991.pdf

Greenwald, R., Hedges, L. V., & Laine, R. D. (1996). The effect of school resources on student achievement. *Review of Educational Research, 66*(3), 361–396.

Hallinger, P., & Murphy, J. F. (1986). The social context of effective schools. *American Journal of Education, 94*(3), 328–355.

Halpern, D. F. (2000). *Sex differences in cognitive abilities* (3rd ed.). Philadelphia, PA: Lawrence Erlbaum Associates.

Hanushek, E. A. (1997). Assessing the effects of school resources on student performance: An update. *Educational Evaluation and Policy Analysis, 19*(2), 141–164.

Hanushek, E. A. (2003). The failure of input-based schooling policies. *The Economic Journal, 113*, 64–98. Retrieved January 02, 2012, from http://web.missouri.edu/~podgurskym/Econ_4345/syl_articles/hanushek_failure_of_input_EJ_2003.pdf

Hanushek, E. A., Rivkin, S. G., & Taylor, L. L. (1996). Aggregation and the estimated effects of school resources. *Review of Economics and Statistics, 78*(4), 611–627. Retrieved January 02, 2012, from http://edpro.stanford.edu/Hanushek/admin/pages/files/uploads/aggregation.REStat.pdf

Hedges, L. V., & Nowell, A. (1995). Sex differences in mental test scores, variability, and numbers of high-scoring individuals. *Science, 269*(5220), 41–45.

Henry, G. T., Fortner, C. K., & Thompson, C. L. (2010). Targeted funding for educationally disadvantaged students: A regression discontinuity estimate of the impact on high school student achievement. *Educational Evaluation and Policy Analysis, 32*(2), 183–204. Retrieved January 02, 2012, from http://epa.sagepub.com/content/32/2/183.full.pdf

Hoy, W., & Hannum, J. (1997). Middle school climate: An empirical assessment of organizational health and student achievement. *Educational Administration Quarterly, 33*(3), 290–311.

Hoy, W., Tarter, C. J., & Kottkamp, R. (1991). *Open schools/healthy schools: Measuring organizational climate*. Newbury Park, CA: Sage Publications. Retrieved January 02, 2012, from http://www.waynekhoy.com/open_schools.html http://www.waynekhoy.com/pdfs/open_schools_healthy_schools_book.pdf

Hoy, W., & Woolfolk, A. E. (1993). Teachers' sense of efficacy and the organizational health of schools. *The Elementary School Journal, 93*(4), 355–372.

Hyde, J. S., Fennema, E., & Lamon, S. J. (1990). Gender differences in mathematics performance: A meta-analysis. *Psychological Bulletin, 107*(2), 139–155.

Hyde, J. S., & Linn, M. C. (1988). Gender differences in verbal ability: A meta-analysis. *Psychological Bulletin, 104*(1), 53–69. (ERIC Document Reproduction Service No. ED294919). Retrieved January 02, 2012, from the Education Resources Information Center (ERIC) Web site: http://www.eric.ed.gov/PDFS/ED294919.pdf

Kaplan, A., & Maehr, M. L. (1999). Achievement goals and student well-being. *Contemporary Educational Psychology, 24*(4), 330–358. Retrieved January 02, 2012, from http://condor.depaul.edu/hstein/NALPAK.pdf

Lewis, M. (2000). *Facility conditions and student test performance in Milwaukee public schools*. Scottsdale, AZ: Council of Educational Facility Planners, International. (ERIC Document Production Service No. ED459593). Retrieved January 02, 2012, from the Education Resources Information Center (ERIC) Web site: http://www.eric.ed.gov/PDFS/ED459593.pdf

Lietz, P. (2006). A meta-analysis of gender differences in reading achievement at the secondary school level. *Studies in Educational Evaluation, 32*(4), 317–344.

Ma, X., & Klinger, D. (2000). Hierarchical linear modeling of student and school effects on academic achievement. *Canadian Journal of Education, 25*(1), 41–55. Retrieved January 02, 2012, from the Canadian Society for the Study of Education (CSSE) Web site: http://www.csse-scee.ca/CJE/Articles/FullText/CJE25-1/CJE25-1-ma.pdf

Ma, X., Ma, L., & Bradley, K. (2008). Using multilevel modeling to investigate school effects. In A. A. O'Connell & D. B. McCoach (Eds.), *Multilevel modeling of educational data* (pp. 59-110). Charlotte, NC: Information Age Publishing.

Maxwell, L. (1999). *School building renovation and student performance: One district's experience*. Scottsdale, AZ: Council of Educational Facility Planners, International. (ERIC Document Reproduction Service No. ED443272) Retrieved January 02, 2012, from the Education Resources Information Center (ERIC) Web site: http://www.eric.ed.gov/PDFS/ED443272.pdf

McDill, E. L., Natriello, G., & Pallas, A. (1986). A population at risk: Potential consequences of tougher school standards for student dropouts. *American Journal of Education, 94*(2), 135—181.

Miller, R. B., Greene, B. A., Montalvo, G. P., Ravindran, B., & Nicholls, J. D. (1996). Engagement in academic work: The role of learning goals, future consequences, pleasing others, and perceived ability. *Contemporary Educational Psychology, 21*(4), 388–422.

Murphy, J., Weil, M., Hallinger, P., & Mitman, A. (1982). Academic press: Translating high expectations into school policies and classroom practices. *Educational Leadership, 40*(3), 22–26. Retrieved January 02, 2012, from http://www.ascd.org/ASCD/pdf/journals/ed_lead/el_198212_murphy.pdf

National Center for Education Statistics. (2007). *Table 171. Total and current expenditures per pupil in public elementary and secondary schools: Selected years, 1919-20 through 2004-05*. Retrieved November 4, 2008, from http://nces.ed.gov/programs/digest/d07/tables/dt07_171.asp

Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis, 26*(3), 237–257. Retrieved January 02, 2012, from http://steinhardt.nyu.edu/scmsAdmin/uploads/002/834/127%20-%20Nye%20B%20%20Hedges%20L%20%20V%20%20%20Konstantopoulos%20S%20%20%282004%29.pdf

Odden., A, Borman., G., & Fermanich, M. (2004). Assessing teacher, classroom, and school effects, including fiscal effects. *Peabody Journal of Education, 79*(4), 4–32.

Organisation for Economic Co-operation and Development. (2005). *PISA 2003 data analysis manual: SPSS users*. Paris, France: Author. Retrieved January 02, 2012, from http://www.oecd.org/dataoecd/35/51/35004299.pdf

Palardy, G. J., & Rumberger, R. W. (2008). Teacher effectiveness in first grade: The importance of background qualifications, attitudes, and instructional practices for student learning. *Educational Evaluation and Policy Analysis, 30*(2), 111–140.

Phillips, M. (1997). What makes schools effective? A comparison of the relationships of communitarian climate and academic climate to mathematics achievement and attendance during middle school. *American Educational Research Journal, 34*(4), 633–662.

Picus, L. O., Marion, S. F., Calvo, N., & Glenn, W. J. (2005). Understanding the relationship between student achievement and the quality of educational facilities: Evidence from Wyoming. *Peabody Journal of Education, 80*(3), 71–95.

Pintrich, P. R. (2000). An achievement goal theory perspective on issues in motivation terminology, theory, and research. *Contemporary Educational Psychology, 25*(1), 92–104. Retrieved January 02, 2012, from http://www.unco.edu/cebs/psychology/kevinpugh/motivation_project/resources/pintrich00.pdf

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Newbury Park, CA: Sage Publications.

Raudenbush, S. W., & Willms, J. D. (1995). The estimation of school effects. *Journal of Educational and Behavioral Statistics, 20*(4), 307–335. Retrieved January 02, 2012, from http://www.unb.ca/crisp/pdf/9501.pdf

Roberts, L. W. (2009). Measuring school facility conditions: An illustration of the importance of purpose. *Journal of Educational Administration, 47*(3), 368–380.

Robinson, W. S. (1950). Ecological correlations and the behavior of individuals. *American Sociological Review, 15*(3), 351–357. Retrieved January 02, 2012, from http://cooley.libarts.wsu.edu/schwartj/pdf/Robinson.pdf

Rumberger, R. W., & Palardy, G. J. (2005). Test scores, dropout rates, and transfer rates as alternative measures of school performance. *American Educational Research Journal, 42*(1), 3–42. Retrieved January 02, 2012, from http://education.ucsb.edu/rumberger/internet%20pages/Papers/Rumberger%20&%20Palardy--Test%20Scores,%20Dropout%20Rates...%28AERJ%202005%29.pdf

Schneider, M. (2002). *Do school facilities affect academic outcomes?* Washington, DC: National Clearinghouse for Educational Facilities. Retrieved January 02, 2012, from http://www.ncef.org/pubs/outcomes.pdf

Simons, J., Vansteenkiste, M., Lens, W., & Lacante. M. (2004). Placing motivation and future time perspective theory in a temporal perspective. *Educational Psychology Review, 16*(2), 121–139.

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research, 75*(3), 417–453.
Statistics Canada. (2007). *Measuring up: Canadian results of the OECD PISA study. The performance of Canada's youth in science, reading and mathematics. 2006 First results for Canadians aged 15*. Ottawa, ON: Minister of Industry. Retrieved November 4, 2008, from http://www.statcan.ca/english/freepub/81-590-XIE/81-590-XIE2007001.pdf
Statistics Canada. (2008). *Summary public school indicators for the provinces and territories, 1998-1999 to 2004-2005.* Retrieved January 18, 2012, from http://www.statcan.gc.ca/pub/81-595-m/81-595-m2007050-eng.htm
Uline, C., & Tschannen-Moran, M. (2008). The walls speak: The interplay of quality facilities, school climate, and student achievement. *Journal of Educational Administration, 46*(1), 55–73.
Uline, C., Tschannen-Moran, M., & Wolsey, T. D. (2009). The walls still speak: the stories occupants tell. *Journal of Educational Administration, 47*(3), 400–426.
Unnever, J. D., Kerckhoff, A. C., & Robinson, T. J. (2000). District variations in educational resources and student outcomes. *Economics of Education Review, 19*(3), 245–259. Retrieved January 02, 2012, from http://elmu.umm.ac.id/file.php/1/jurnal/E/Economics%20of%20Education%20Review/Vol19.Issue3.Jun2000/350.pdf
Utman, C. H. (1997). Performance effects of motivational state: A meta-analysis. *Personality and Social Psychology Review, 1*(2), 170–182.
Van de gaer, E., De Fraine, B., Pustjens, H., Van Damme, J., De Munter, A., & Onghena, P. (2009). School effects on the development of motivation toward learning tasks and the development of academic self-concept in secondary education: A multivariate latent growth curve approach. *School Effectiveness and School Improvement, 20*(2), 235–253.
Van den Noortgate, W., Opdenakker, M., & Onghena, P. (2005) The effects of ignoring a level in multilevel analysis. *School Effectiveness and School Improvement, 16*(3), 281–303.
White, K. R. (1982). The relation between socioeconomic status and academic achievement. *Psychological Bulletin, 91*(3), 461–481.
Wößmann, L. (2003). Schooling resources, educational institutions and student performance: The international evidence. *Oxford Bulletin of Economics & Statistics, 65*(2), 117–170. Retrieved January 02, 2012, from http://www.ln.edu.hk/econ/staff/xdwei/docs/edman/wobmann.pdf

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