Middle School or Junior High?
How Grade Level Configurations Affect Academic Achievement

July 2011

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Abstract

Does the grade level configuration of a school affect student achievement? Despite being a popular education reform, little research exists regarding the effect of grade level configurations. This research examines the effect of attending a middle or junior high school on achievement growth from 4th to 7th grade in British Columbia relative to attending a school from kindergarten through 8th grade. Using an OLS strategy, I find a large negative effect, with a magnitude of 0.125–0.187 standard deviations on math achievement gains. Smaller but still economically significant effects are found for reading achievement. Similar sized estimates are found for math using a two stage least squares estimation strategy. In addition, students on the bottom half of the ability distribution are affected the most by attending a middle or junior high school.

I. Introduction

Over the past century, grade level configurations in schools have been in a constant state of flux—schools serving all grades transition to self-contained middle and junior high schools, and then back again. Currently, there is a push to merge middle and junior high schools with their elementary counterparts to create kindergarten through 8th grade schools (Schwartz et al. forthcoming). This paper examines the effect of different grade level configurations on student achievement in British Columbia, Canada, by testing whether students who attend a middle or junior high school have different academic achievement gains from grade 4 to grade 7 than do students who attend one school from kindergarten until the beginning of high school.

Understanding the impact of grade level configuration on academic achievement is important, as rearranging grade level configurations within schools may be a comparatively inexpensive policy lever compared to other school reforms, and it is something over which individual districts often have control. Grade level configuration may have an effect on student achievement as it can impact schools' practices and policies such as curriculum development and delivery. It can also have an effect on school and cohort size, and it determines the number and timing of structural transitions a student takes during his or her educational career. Finally, it can affect peer composition and age distribution within schools. All of these factors can greatly influence student achievement. However, despite the extensive research that has been conducted on other factors that may affect achievement growth—such as teacher quality, class size, and school resources—very little attention has been paid to the effect of grade level configurations.

During the early 1900s in the United States, education reformers experimented with splitting the elementary school grades into two school types, one for the early elementary grades and one for the later grades, termed junior high school. Educators during that time believed that the kindergarten through 8th grade schooling structure was unsupported by psychological research and ignored the developmental needs of the students (Fleming and Toutant 1995). During this time period, the development of junior high schools in Canada generally lagged behind the United States by more than a decade. However, by 1920, two junior high schools opened in Canada - one in Winnipeg, Manitoba, and one in Edmonton, Alberta (Johnson 1968). British Columbia's first junior high school, which served grades 7 through 9, opened in Penticton, in 1926 (Fleming and Toutant 1995). By 1950, many junior high schools existed in British Columbia, and over 5000 junior high schools existed in the United States (Lounsbury 1960). Despite this trend, the British Columbia Ministry of Education decided to return grade 7 to the elementary system, and during the 1950s reorganized all provincial schools into kindergarten through 7th grade schools, 8th through 10th grade schools, and 11th through 12th grade schools. However, even after this reorganization the debate continued in British Columbia regarding the "best" grade level configuration. In the 1960s, education reformers began to advocate for middle schools—i.e., schools that started in 6th grade. By the 1980s, many middle schools existed in British Columbia. Currently, local school districts in British Columbia are allowed to determine the nature of the grade level configurations in their own district. However, the British Columbia Ministry of Education does not officially recognize institutions as middle or junior high schools.[1]

I use panel data from the province of British Columbia, which has a variety of grade level configurations by district and within districts, to measure the effects of alternative grade level configurations on math and reading test score gains. Approximately 16 percent of students in British Columbia attend a middle school that begins in 6th grade, and another 16 percent of

[1] Middle school refers to a school that starts in 6th grade, and junior high school refers to a school that starts in 7th grade.

students attend a junior high school that begins in 7th grade. Therefore, about 32 percent of students attend a stand-alone middle or junior high school, and the other 68 percent attend a school whose grades extend through 7th grade and higher. I find that math and reading scores are significantly negatively affected by middle or junior high school attendance. Specifically, I find that math scores of students who attended a middle or junior high school were between 0.125–0.187 standard deviations lower than students who attended a kindergarten through 7th grade or higher school, and reading scores were 0.055–0.108 standard deviations lower. In addition, the effect was similar between students who entered in a middle school in 6th grade and students who entered a junior high school in 7th grade.

The choice to attend middle or junior high school in upper elementary grade levels may be endogenous and may be related to time-varying factors that are uncontrolled for in this analysis. However, this may not be a large issue as students are generally restricted to attending the school in their catchment area, so the choice of schools is based on residential relocation instead of other unobservable factors. Nevertheless, following Rockoff and Lockwood (2010), I construct an instrumental variable using the terminal grade of the school the student attended in 4th grade for middle or junior high school entry. The subsequent results using a two-stage least squares regression strategy find that students who attended middle or junior high school scored 0.116–0.215 standard deviations lower in math than the students who did not.

Finally, I find no relationship between the effect of grade level configuration and either gender, special education status, being aboriginal, or being a student with English as a second language. However, students on the bottom half of the test score distribution were disproportionately negatively affected by attending a middle or junior high school.

II. Related Literature

Relatively few studies have examined the impact of grade level configuration on student achievement, despite its potential importance. Earlier education work used cross-sectional data to examine this issue, and generally found that there was a relationship between attending middle or junior high school and lower academic performance.[2] Due to the cross-sectional nature of the data, these studies were unable to conclude whether these differences were due to differences in grade level configurations or due to differences in student characteristics across these different configurations.

More recent work by Cook et al. (2008) and Weiss and Kipnes (2006) examined non-academic outcomes such as suspensions, school safety, and self-esteem. They found lower levels of self-esteem and perceived school safety, and higher levels of student misconduct among students who attended middle schools.

The research most relevant to our study includes Bedard and Do (2005), Schwartz et al. (forthcoming), and Rockoff and Lockwood (2010). All three examine the effect of grade level configuration using longitudinal data. Bedard and Do (2005) estimated the effect on on-time high school graduation of moving from a junior high school system, where students stay in elementary school longer, to a middle school system. They found that moving to a middle school system decreases on-time high school graduation by 1–3 percent. Rockoff and Lockwood (2010) used a two-stage least squares approach and Schwartz et al. (forthcoming) used an ordinary least squares approach using the same longitudinal data from New York City. Both found that moving students from elementary to middle school in 6th or 7th grade causes significant drops in both math and English test scores.

[2] See, for example, Alspaugh 1998a,b; Byrnes and Ruby 2007; Franklin and Glascock 1998; Wihry, Coladarci, and Meadow 1992.

Using an instrumental variables estimation strategy similar to Rockoff and Lockwood (2010), this paper explores the issue of middle and junior high schools in a Canadian context. In addition, this paper uses longitudinal data from an entire province versus a single city. This is an important exercise as New York City has a unique educational environment, and results from that city may not be generalizable to other settings and locations. For instance, unlike New York City, British Columbia has a wide variety of urban and rural schools over a very large geographic area. In addition, the per pupil funding in New York is approximately twice as large as the per pupil funding in British Columba. These along with many other institutional differences make it important to examine the effect of grade level configurations in British Columbia.

III. Methodology

The analysis uses a value-added specification of achievement growth in math and reading from grade 4 to grade 7. This strategy uses the variation of grade level configurations across the province of British Columbia to estimate the effect on student achievement gains of attending a middle or junior high school. The initial estimation strategy is as follows:

$$y_{ist}^{7} = \beta_0 + \beta_1 y_{ist}^{4} + \beta_2 \mathrm{M}_i + x_{it}^{'}\beta_3 + s_{st}^{'}\beta_4 + c_{st}^{'}\beta_5 + \varepsilon_{ist} \qquad (1)$$

where y_{ist}^{7} is the grade 7 math or reading score for student *i*, in school *s*, in year *t*; y_{ist}^{4} is the student's corresponding grade 4 score; M_i is an indicator equal to one if the student changed from an elementary school to a middle or junior high school between grade 4 and grade 7; $x_{it}^{'}$ is a vector of student-level demographic characteristics, $s_{st}^{'}$ is a vector of school-level characteristics, and $c_{st}^{'}$ is a vector of community-level characteristics; and ε_{ist} is an idiosyncratic error term. In addition, some specifications will include city or district fixed effects because middle/junior high school geographic locations may not be orthogonal to unobserved factors. Therefore, the city or district fixed effects force the identifying variation to come from within a particular city or district. Other specifications that allow for differences in the effect based on whether the student attended a middle or junior high school will be explored in Section V, Part A.

The coefficient of interest is β_2, which measures the differential effect on a student's test score growth of attending a middle or junior high school compared to staying in an elementary school from kindergarten through 7th grade or higher. This coefficient measures whether the trajectories of student achievement from grade 4 to grade 7 for students entering middle and junior high schools are different than for students who never attended a middle or junior high school.

An ordinary least squares identification strategy may not produce causal estimates because the choice to attend a middle or junior high school in upper elementary grades may be related to time-varying factors that are unobservable. For instance, a student who is currently in a kindergarten through 7th grade school may move to a middle school in 6th grade due to unobservable factors related to achievement such as a residential move or a family disruption. The ordinary least squares estimate would not be able to untangle the effect of moving to middle school from the effect of these factors.

Therefore, following Rockoff and Lockwood (2010), I created an instrument for middle or junior high school entry using the grade level configuration of the school attended in grade 4. If the student attends a school that ends in grade 5 or grade 6 when they are in grade 4, I create an indicator variable that indicates the student should enter a middle or junior high school in grade 6 or 7.[3] A threat to the validity of this instrument would be if the configuration of the school attended in grade 4 is related to something unobserved that affects test score growth from grade 4 to grade 7 that is not controlled for by the inclusion of the grade 4 test score along with the large quantity of student, school, and community characteristics. The estimates produced using this estimation strategy can be interpreted as local average treatment effects. The estimates apply to students who are induced to move into a middle or junior high school because they attended a school ending in grade 5 or 6. This may be very different than the average treatment effect.

A possible concern with this analysis is the potential for non-random attrition from public schools in British Columbia. This could cause a bias in an unknown direction. Only 10 percent of students in British Columbia attend private schools, but it is possible that a high-achieving child who was initially sent to a school that ended in 5th or 6th grade may be sent to a private middle school. It is also equally possible that a child who was low achieving during the early elementary years may be sent to a private middle school. Therefore, in this analysis, a balanced panel of students who were in the public school system in British Columbia in both 4th and 7th grade is used. Hence, the interpretation of the results pertains only to those students.

IV. Data and Analysis Sample

A. Data Sources

The main datasets used in this study were three linked files obtained from the Ministry of Education in British Columbia. The first contains observations on all students writing the Foundation

[3] Some schools changed their grade level configuration during this sample period. Therefore, the instrument reflects these changes when they occur. In addition, in Section V, Part A, the analysis is broken up into whether the student attended a middle school versus a junior high school. Therefore, one instrument was created for students in 4th grade whose school ended in 5th grade, and another instrument was created for students in 4th grade whose school ended in 6th grade.

Skills Assessment, an annual low-stakes standardized test in the areas of mathematics, reading, and writing for students in grades 4 and 7. Data from 1999 through 2006 was used. For these students, the percentage score on each test, the school in which the test was written, and whether the student was excused from the test are known.[4] Student scores are linked over time via an encrypted student identifier.

Student test scores are linked via the student identifier to the second file, which contains the administrative records of all public school students in British Columbia from 1999–2006 in grades 4 to 7. These data include demographic information such as gender, aboriginal status, date of birth, and home language, along with information on whether they participate in special education or English as a second language (ESL) programs. Finally, the 6-digit postal code of their home residence is included. In urban areas, this is a very small area consisting sometimes of one side of a city block. In less-populated areas, it can coincide with part or all of a town.

The third file contains information on all public schools in British Columbia. For each school, the following are known: which grades are offered, the number of teachers, whether school is standard or other type, and the year of opening and/or closing. Each school's exact address and postal code are included, which give its precise location.

Data from the Canada Census is appended to this main set of files. To proxy for student-level socioeconomic status characteristics (SES), various census variables at the Dissemination/Enumeration Area (DA) level are attached using the students' residential postal codes.[5] DAs are relatively small areas designed to contain roughly 400–700 people, and as such act as a reasonable proxy for a student's SES characteristics. Information on household income, education levels, unemployment rates, ethnic and immigrant composition, and the age distribution of each DA is attached to the data.

[4] Students with poor English abilities and some students with severe disabilities are excused from writing provincial exams.
[5] This process is described in detail in a data appendix that is available from the author upon request.

Therefore, the demographic, school, and community control variables included in the analysis are dummy variables for whether the student is male, aboriginal, ESL, in special education, or has moved schools. Also included is the percentage in the school of male students, aboriginal students, ESL students, special education students, students excused from the math test, and students excused from the reading test. In addition, the teacher–pupil ratio and whether the school is in a rural location are included. Finally, the census DA-level community control variables include the average household income, average dwelling value, the percentage of individuals with no high school degree, the percentage of individuals with a high school degree, the percentage of individuals with a university degree, the unemployment rate, the percentage of immigrants, the percentage of visible minorities, and the percentage of the population over 65 years old.

B. Regression Sample

Because a value-added model in test scores is estimated, the sample is restricted to students who wrote both the 4th- and 7th-grade mathematics and reading exams. Since test scores were observed between 1999 and 2006, and since three years pass between each test, most such students were observed between 2002 and 2006. There were 229,337 students observed writing the grade 7 test between 2002 and 2006. Of these students, 27,286 (11.9 percent) who were not observed in all years between grades 4 and 7 were dropped from the sample, and a further 14,692 students (6.5 percent) who did not have a valid test score in both years were also dropped. Additionally, 657 students (<1 percent) who were missing school information in grades 5 or 6 were dropped, as were 1532 students (<1 percent) who attended schools with irregular grade level configurations.[6] The final analysis sample consists of 185,170 student observations.

[6] Irregular grade level configurations generally occur in special types of schools such as online distance education schools or schools with other special characteristics.

C. Descriptive Statistics

The summary statistics in Table 1 for test scores and demographics are based on this sample of 185,170 students. Each column of Table 1 includes the sample of students who were attending schools with different grade level configurations during their 4th-grade year. Column 1 includes only students who were attending a school ending in 5th grade, column 2 includes only students who were attending a school ending in 6th grade, and column 3 includes students who were attending a school ending in 7th grade or higher.

Panel A includes the descriptive statistics for the student-level variables. The 4th-grade math and reading test scores are standardized to have a mean of zero and standard deviation of one in the population. The means of these test scores are slightly positive in all columns, which indicates that the students who were excluded from the samples scored marginally worse than the students who were included in the samples. In addition, the students who attended a school that ended in 5th grade scored higher math and reading scores than the other students in different grade level configurations.

However, a different pattern emerges for the 7th grade test scores. Students in schools that ended in grade 7 or later did better in both math and reading. The students in schools that ended in grade 6—the same students who were doing better than the rest in grade 4—scored lower compared to the students in column 3. This provides some indication that the analysis will find negative effects associated with attending middle or junior high school. Finally, in terms of demographic characteristics, there are fewer aboriginal students in schools that end in grade 5 and more ESL students in schools that end in grade 7 or higher.

The next panel includes information about school characteristics. The number of students excused from the math and reading tests did not differ between grade level configurations. However, there does exist a difference between the percentage of schools that are rural and the pupil–teacher ratios. For instance, 17 percent of students who attended a school that ended in grade 6 were in a rural area, whereas only 11 and 13.7 percent of students who attended a school that ended in grade 5 and grade 7 or higher, respectively, were in a rural area. Also, the pupil–teacher ratio was higher in schools that ended in grade 7 or higher.

Panel C displays the community characteristics gathered from the census for each kind of grade level configuration. Students who attended a school that ended in grade 6 had lower household income, lower average dwelling values, and higher high school dropout rates than students from the other two grade level configurations. The other large difference between the community characteristics of the different grade level configurations is with respect to percent immigrant and percent visible minority. Schools that ended in grade 6 had much lower percentages of both.

Table 2 explores the summary statistics of the three estimation samples used in this research. The first column includes the full sample of 185,170 students. The second column includes only districts in which 15 percent or more of its students attended a middle or junior high school.[7] The third column includes only cities in which 15 percent or more of the students attended a middle or junior high school.[8] The second and third sample is used to limit the identification to students who had the opportunity to attend a middle or junior high school. Panel A examines the test scores of each of these three samples. The 4th-grade test scores between the three samples are quite similar. This is reassuring as it implies that districts and cities that have a large number of middle and junior high schools are not substantially different in terms of their ability to produce grade 4 test scores. Therefore, the analysis can assume that the students are starting at a similar level in grade 4 in all three samples. However, a large significant difference can be seen in the 7th grade test scores between the three samples. This once again gives some indication that students who attend a middle

[7] These districts are Southeast Kootenay, Rocky Mountain, Kootenay Lake, Kootenay-Columbia, Central Okanagan, Abbotsford, New Westminster, Powell River, Okanagan Similkameen, Bulkley Valley, Prince George, Nicola-Similkameen, Peace River South, Greater Victoria, Sooke, Gulf Islands, Alberni, Fraser-Cascade, and Cowichan Valley.

[8] These cities are Abbotsford, Armstrong, Castlegar, Cranbrook, Fruitvale, Hope, Lake Cowichan, Lumby, New Westminster, Pemberton, Powell River, Prince George, Princeton, Salmon Arm, Smithers, Trail, Victoria, and Whistler.

or junior high school score worse in 7th grade than their counterparts that do not attend a middle or junior high school. Panel B provides more background on the distribution of the different types of grade level configurations. As previously noted, about 32 percent of students attend a middle or junior high school in British Columbia. If the sample is restricted to districts and cities that have more than 15 percent of their students attending a middle or junior high school, this number increases to 63 and 58 percent, respectively. In addition, column 2 shows that there are more students attending junior high school in this sample than in the sample including only cities. Figure 1 provides a visual representation of the districts and cities that contain more than 15 percent of students who attend a middle or junior high school.

V. Results

A. Main Effects

The analysis begins by estimating equation (1) using the data described in Section IV. Table 3 contains these results. Panel A includes the results from the ordinary least squares specification. All specifications include standard errors that are clustered at the district level. Column 1 lists the estimates from a specification that includes no control variables and was run using the full sample of students in British Columbia. The point estimates indicate that students who attended a middle or junior high school in 6th or 7th grade scored 0.158 standard deviations lower than students who did not. The student, school, and census control variables are added in column 2, and the point estimates decrease slightly to -0.125 standard deviations. Because grade level configurations are determined at the district level, it is appropriate to take into account differences between districts that choose different grade level configurations. Therefore, district fixed effects are added in column 3. Including district fixed effects does not substantially affect the estimated coefficient. Column 4 limits the sample to include only school districts that contained 15 percent of more of their students in a middle or junior high school in 7th grade.[9] This estimate is based on only students that were in districts that offered middle or junior high schools to at least 15 percent of the student body. The point estimate for this sample, which includes district fixed effects, is -0.141. Finally, a district may offer middle or junior high school but only in certain cities, and the identification in the previous column may be from differences across individuals from different cities. Therefore, the sample is again limited to include only cities in which more than 15 percent of the students attend a middle or junior high school. In this specification, city fixed effects are included so that the identification comes from students within cities, rather than across cities.[10] Using this sample, I find that attending a middle or junior high school decreases math scores by 0.187 standardized units. Columns 6 through 10 display the coefficients for the reading test. Overall, the point estimates are about half the size of the math estimates. Compared to the estimates of Rockoff and Lockwood (2010) which estimated one-year gains, the estimates in Panel A of Table 3, which are for three-year gains, are slightly lower in magnitude but overall consistent with their findings. Schwartz et al. (forthcoming) used a different specification, but also found estimates larger than the estimates from Panel A.

The first stage of the two-stage least squares specification can be found in Panel B. As can be seen, the instrumental variable is strongly correlated with actual entry into middle or junior high school. The F-statistic ranges from 35 to 407. The coefficients in columns 1 and 2 are similar in magnitude to coefficients found in Rockoff and Lockwood (2010). The first-stage

[9] These specifications include only 19 districts, so having too few clusters may be a problem. Therefore, following Cameron and Miller (2010) and Cohen and Dupas (2010), the tables use critical values from a t_{G-1} distribution where G is 19 (for each cluster). The critical values for 1%, 5%, and 10% significance are 2.878, 2.101, and 1.734, respectively. However, Hansen (2007) has shown that the standard errors listed in the tables, which were computed with the STATA cluster command, are reasonably good at correcting for serial correlations in panels with as low as 10 clusters.

[10] The estimates are similar if district fixed effects are included. Also, the magnitudes of the estimates are similar but are less precise if the samples include districts and cities with more than 25 percent of the students attending a middle or junior high school. This is probably due to the decrease in sample size.

results found are consistent with the finding in Schwartz et al. (forthcoming) that many students are “off path”—i.e., they don’t follow the proscribed path set by the grade level configuration in 4th grade. The magnitude of the coefficient decreases when district or city fixed effects are included, but the instruments remains valid. The coefficient decreases because the average percentage of students being “on path” in some districts is very low. For instance, in District 85—Vancouver Island North—there are 10 schools in the district: six schools that are kindergarten through 7th grade, one school that is kindergarten through 5th grade, one school that is kindergarten through 10th grade, and two schools that are 8th through 12th grade schools. The individuals attending the kindergarten through 5th grade school in 4th grade cannot follow the “correct” path and attend a middle school as there are no middle schools in this district, so all of these students move to a kindergarten through 7th grade school or kindergarten through 10th grade school in grade 6. Therefore, the first-stage coefficient for this district is incredibly low. In addition, some schools change their grade level configurations during this period of time. The students in these schools will be “off-path” in the sense that their 4th grade school grade level configuration will not predict their school movements over time due to the change in grade level configurations. Hence, it is important to remember that the results from the two-stage least squares estimates are local average treatment effects. They apply only to students who follow the “correct” path of schools predicted by their grade 4 grade level configuration.

Panel C reports the estimates from the two-stage least squares estimates. Overall, the coefficients for math are slightly larger than the ordinary least squares estimates but continue to be statistically significant. The estimates are not statistically significant in the reading specifications when district or city fixed effects are included. Estimates from Rockoff and Lockwood (2010) found that math achievement falls by roughly 0.17 standard deviations and

English achievement falls by 0.14–0.16 standard deviations when measured in 8th grade. The yearly magnitude estimated by Rockoff and Lockwood (2010) is approximately three times larger than the effects estimated in this paper. In addition, Rockoff and Lockwood (2010) found significant results for the English tests, whereas I find little to no statistically significant results for the reading test scores once district or city fixed effects are included.

B. Middle or Junior High School?

Next, I explore whether moving to a middle school in grade 6 has a different effect than moving to a junior high school in grade 7. Table 4 has the results for the specification that includes two dummy variables, one for moving to a middle school in grade 6 and one for moving to a junior high school in grade 7. The specification is run using ordinary least squares in Panel A and two-stage least squares in Panel B. The estimates for middle school and junior high school are roughly the same for both math and reading in Panel A. This implies that there might be a one-time shock to test scores, but that spending two years in a middle school before the exam in 7th grade is not necessarily worse than spending one year in a junior high school before taking the exam. In Panel B, there exist some non-significant results for the junior high school coefficients for both math and reading. Therefore, there is some evidence of a larger negative effect for attending middle school versus junior high school when tested in 7th grade. This is a slightly surprising result, as the disruption of moving to a junior high school would be fresher than if the student moved the year prior. However, Rockoff and Lockwood (2010) found a similar pattern using New York City data. In addition, Cook et al. (2008) came to a similar conclusion regarding discipline problems using North Carolina data, and hypothesized that younger students may be more sensitive to the negative influences of older students.

C. Heterogeneous Effects

Table 5 explores whether the negative effect of attending middle and junior high school varies by different demographic characteristics. Panel A examines gender by interacting an indicator variable for male with the middle/junior high school indicator variable. Each test and estimation strategy includes results for three different samples/specifications. The first column corresponds to the third column in Table 3 and Table 4. It includes the entire sample along with district fixed effects. Column 2 corresponds to the sample of only districts with 15 percent or greater of students attending a middle or junior high school along with district fixed effects. Column 3 includes cities with 15 percent or greater of students attending a middle or junior high school along with city fixed effects. These three columns are repeated for the reading test and for the math and reading test results using two-stage least squares. Overall, there is very little evidence that males are affected differently than females. The same is true for students in special education (Panel B), aboriginal students (Panel C), and ESL students (Panel D). However, Panel E includes an indicator for whether the student scored in the lowest 50 percent of test takers in 4th grade. This indicator is interacted with the middle/junior high school variable. Here we see a very large negative effect for those on the lower half of the ability distribution. In particular, in reading, the whole effect is driven by these lower achieving students. These findings correspond to those of Rockoff and Lockwood (2010) but have some dissimilarities with those of Schwartz et al. (forthcoming) as they found no differential impacts for females, special education students, or limited English proficiency-eligible students in math. They did, however, find large positive effects for limited English proficiency-eligible students in reading. I find no heterogeneous effects in reading for ESL students. These differences may be due to differences in the programs available to the ESL students in these two locations.

D. Moving or Middle/Junior High School?

A possible interpretation of these findings is that the effects found have only to do with the act of moving schools and nothing to do with attending a particular type of grade level configuration. The literature generally finds negative effects of moving schools on the student's academic achievement (see Engec 2006; Gruman et al. 2008; Ingersoll et al. 1989; Mehana and Reynolds 2004). However, it is difficult to separate whether this negative effect is due to the act of moving or due to the characteristics and circumstances of the students who move. Therefore, is it difficult to disentangle whether the results found above are due to simply moving schools versus moving to a middle or junior high school.

Ideally, one could find an exogenous reason for students to move schools and then compare the effects of moving schools for those students with the effect of moving to a middle or junior high school. Unfortunately, finding an exogenous reason is difficult in these particular data. However, in Table 6, I explore the test score effects of moving for two different samples of movers. In Panel A, an indicator variable is used that equals one for all students who moved schools during this sample whose move was not related to attending a middle or junior high school. The point estimates indicate a negative relationship between changing schools and test score gains from grade 4 to grade 7. The magnitude is between one-third and one-half as large as the negative effects found for middle/junior high school attendance. However, this sample of students may be negatively academically selected to start with (Pribesh and Downey 1999). It may be that these students are likely to do worse than other students in terms of academic gains due to other unobservable characteristics. However, it is interesting that the correlation is much smaller than the point estimates found for middle/junior high school attendance.

Starting in 2000, many schools were closed in British Columbia due to decreasing student enrolments. In this sample, 56 schools closed between 2000 and 2005. In Panel B, I use the students that were forced to move schools due to school closure to estimate the effect of mobility on test score gains. The school closures were not exogenous events, as the schools were selected to be closed due to decreasing enrolments, and this may have been correlated with other unobserved factors. However, this is still informative as it may remove some of the selection into the movers' sample found in Panel A. Interestingly, moving schools due to school closures did not have any statistically significant effect on students' test score gains in math or reading.

Neither Panel A nor Panel B shows conclusive evidence of whether the effects found in this research are due to moving schools versus moving to a middle or junior high school. However, they do show suggestive evidence that the move to middle or junior high school may be significantly worse on student achievement gains than just changing schools during the elementary years.

VI. Conclusion

Overall, I find large, statistically significant negative effects of attending a middle or junior high school. The magnitudes are similar to other education interventions such as improving a teacher by one standard deviation (Aaronson, Barrow, and Sander 2007), the black–white test score gap (Fryer and Levitt 2006), or reducing class sizes (Harris 2009). The large effect size and the potential easy policy reform make changing grade level configurations an important and viable education reform. The adoption of a kindergarten through 8th grade configuration is becoming more popular with a variety of U.S. school districts that are moving in that direction, such as New York City, Cleveland, Cincinnati, Philadelphia, and Boston (Schwartz et al. forthcoming). This research shows that this reorganization may be quite beneficial and that British Columbia school districts may want to rethink their grade level configuration options.

Despite the consistent and large effects found in this research, it is still unclear exactly what is causing the negative effect of middle and junior high school attendance. Is it the grade distribution of the students in the school? Are middle/junior high schools less efficient? Do the peer effects matter? These are all questions that cannot be answered with these data but that are important for future research.

VII. References

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Table 1
Descriptive statistics of student, school, and community characteristics

	Ending grade of school, Grade 4		
	Grade 5	Grade 6	Grade 7 or later
	Mean (Std. Dev.)	Mean (Std. Dev.)	Mean (Std. Dev.)
Panel A: Student characteristics			
Grade 4 math test scores	0.183	0.031	0.053
	(0.905)	(0.896)	(0.931)
Grade 4 reading test scores	0.146	0.071	0.063
	(0.861)	(0.876)	(0.904)
Grade 7 math test scores	-0.017	-0.132	0.047
	(0.907)	(0.880)	(0.951)
Grade 7 reading test scores	0.073	-0.003	0.071
	(0.884)	(0.904)	(0.913)
Male	0.509	0.498	0.504
	(0.500)	(0.500)	(0.500)
Aboriginal	0.079	0.139	0.103
	(0.270)	(0.346)	(0.304)
ESL	0.168	0.060	0.245
	(0.374)	(0.237)	(0.430)
In special education	0.065	0.061	0.058
	(0.247)	(0.240)	(0.234)
Panel B: School characteristics			
Number excused from math test	0.030	0.031	0.038
	(0.041)	(0.043)	(0.049)
Number excused from reading test	0.030	0.031	0.039
	(0.041)	(0.044)	(0.050)
Rural	0.110	0.171	0.137
	(0.312)	(0.376)	(0.344)
Pupil/teacher ratio	14.310	14.118	15.591
	(3.080)	(3.443)	(2.602)
Panel C: Community characteristics			
Average household income	56553	49547	57242
	(18072)	(15984)	(22725)
Average dwelling value	232170	185686	248776
	(97016)	(99618)	(133107)
% no high school degree	0.228	0.271	0.258
	(0.095)	(0.096)	(0.108)
% high school degree	0.268	0.266	0.265
	(0.061)	(0.063)	(0.057)
% university degree	0.196	0.144	0.197
	(0.102)	(0.076)	(0.116)
% unemployed	0.063	0.078	0.072
	(0.047)	(0.060)	(0.057)
% immigrant	0.239	0.131	0.263
	(0.134)	(0.059)	(0.174)
% visible minority	0.169	0.044	0.231
	(0.181)	(0.053)	(0.249)
% of population over 65 yrs old	0.132	0.138	0.120
	(0.102)	(0.098)	(0.088)
Number of Observations	24,257	25,241	135,672

Notes: Test scores represent the z-score by year, grade, and skill among the population of schools prior to sample exclusions.

Table 2
Descriptive statistics of test scores and grade configurations for estimation samples

	All districts/cities in British Columbia	Only districts with > 15% of students in middle schools	Only cities with > 15% of students in middle schools
	Mean (Std. Dev.)	Mean (Std. Dev.)	Mean (Std. Dev.)
Panel A: Test Scores			
Grade 4 math test scores	0.067	0.034	0.066
	(0.924)	(0.908)	(0.914)
Grade 4 reading test scores	0.075	0.069	0.090
	(0.896)	(0.891)	(0.887)
Grade 7 math test scores	0.014	-0.078	-0.038
	(0.938)	(0.916)	(0.930)
Grade 7 reading test scores	0.061	0.021	0.042
	(0.908)	(0.919)	(0.924)
Panel B: Grade Configurations			
Middle/junior high school	0.317	0.630	0.582
	(0.465)	(0.483)	(0.493)
Middle school in 6th grade	0.162	0.255	0.356
	(0.369)	(0.436)	(0.479)
Junior high school in 7th grade	0.157	0.382	0.232
	(0.364)	(0.486)	(0.422)
Number of Observations	185,170	47,264	29,935

Notes: Test scores represent the z-score by year, grade, and skill among the population of schools prior to sample exclusions.

Table 3

Ordinary least squares estimates of the effect of middle and junior high school on academic gains

	Math					Reading				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: OLS										
Middle/junior high school	**-0.158**	**-0.125**	**-0.130**	**-0.141**	**-0.187**	**-0.056**	**-0.065**	***-0.055***	**-0.079**	**-0.108**
	(0.033)	(0.027)	(0.030)	(0.031)	(0.029)	(0.018)	(0.016)	(0.028)	(0.023)	(0.026)
Panel B: First stage										
Grade 4	**0.776**	**0.697**	**0.294**	**0.359**	**0.341**	**0.781**	**0.697**	**0.294**	**0.359**	**0.341**
	(0.003)	(0.004)	(0.005)	(0.011)	(0.013)	(0.003)	(0.004)	(0.005)	(0.011)	(0.013)
Panel C: 2SLS										
Middle/junior high school	**-0.192**	**-0.147**	**-0.138**	***-0.116***	**-0.215**	**-0.077**	**-0.082**	-0.062	-0.051	-0.085
	(0.036)	(0.029)	(0.049)	(0.059)	(0.057)	(0.022)	(0.019)	(0.039)	(0.049)	(0.062)
Number of obs	185170	185170	185170	47264	29935	185170	185170	185170	47264	29935
Control variables:										
Student/school/census	no	yes	yes	yes	yes	no	yes	yes	yes	yes
District fixed effects	no	no	yes	yes	no	no	no	yes	yes	no
City fixed effects	no	no	no	no	yes	no	no	no	no	yes
Sample:										
Full sample	yes	yes	yes	no	no	yes	yes	yes	no	no
Only districts > 15%	no	no	no	yes	no	no	no	no	yes	no
Only cities > 15%	no	no	no	no	yes	no	no	no	no	yes

Standard errors corrected for clustering at the district level are in parentheses. Critical values for columns 4, 5, 9 & 10 are from a t-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. **Bold italic coefficients are statistically significant at the 10% level.** See Section IV for a description of the demographic and census variables included in the regressions. The F-statistic for the first stage regressions range from 35 to 407.

Table 4

OLS and instrumental variables student level estimates of school structure changes

	Math					Reading				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: OLS										
Middle school grade 6	**-0.130**	**-0.125**	**-0.146**	**-0.148**	**-0.179**	-0.028	**-0.053**	**-0.057**	**-0.078**	**-0.090**
	(0.034)	(0.035)	(0.029)	(0.033)	(0.027)	(0.017)	(0.020)	(0.026)	(0.026)	(0.032)
Junior high school grade 7	**-0.185**	**-0.123**	**-0.113**	**-0.123**	**-0.185**	**-0.086**	**-0.079**	-0.055	**-0.073**	**-0.128**
	(0.033)	(0.027)	(0.039)	(0.040)	(0.042)	(0.022)	(0.021)	(0.036)	(0.031)	(0.027)
Panel B: 2SLS										
Middle school grade 6	**-0.166**	**-0.162**	**-0.178**	**-0.166**	**-0.208**	**-0.051**	**-0.079**	**-0.086**	***-0.079***	-0.064
	(0.036)	(0.032)	(0.050)	(0.063)	(0.057)	(0.022)	(0.021)	(0.031)	(0.039)	(0.055)
Junior high school grade 7	**-0.217**	**-0.125**	-0.038	-0.023	**-0.178**	**-0.101**	**-0.080**	0.009	0.006	-0.106
	(0.040)	(0.034)	(0.054)	(0.063)	(0.078)	(0.024)	(0.027)	(0.064)	(0.069)	(0.110)
Number of obs	185170	185170	185170	47264	29935	185170	185170	185170	47264	29935
Control variables:										
Student/school/census	no	yes	yes	yes	yes	no	yes	yes	yes	yes
District fixed effects	no	no	yes	yes	no	no	no	yes	yes	no
City fixed effects	no	no	no	no	yes	no	no	no	no	yes
Sample:										
Full sample	yes	yes	yes	no	no	yes	yes	yes	no	no
Only districts > 15%	no	no	no	yes	no	no	no	no	yes	no
Only cities > 15%	no	no	no	no	yes	no	no	no	no	yes

Standard errors corrected for clustering at the district level are in parentheses. Critical values for columns 4, 5, 9 & 10 are from a t-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions.

Table 5

OLS student level estimates of school structure changes by demographic characteristics

	OLS						2SLS					
	Math			Reading			Math			Reading		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Male												
Middle/junior high school	**-0.130**	**-0.149**	**-0.198**	***-0.050***	**-0.083**	**-0.107**	**-0.143**	**-0.143**	**-0.266**	-0.058	-0.062	-0.098
	(0.031)	(0.033)	(0.029)	(0.028)	(0.024)	(0.028)	(0.049)	(0.060)	(0.060)	(0.039)	(0.046)	(0.057)
Middle/junior school * male	-0.002	0.016	0.023	-0.011	0.008	-0.002	0.010	***0.055***	0.100	-0.007	0.023	0.025
	(0.009)	(0.014)	(0.016)	(0.010)	(0.012)	(0.013)	(0.012)	(0.027)	(0.058)	(0.013)	(0.029)	(0.057)
Panel B: Special education												
Middle/junior high school	**-0.131**	**-0.143**	**-0.189**	**-0.055**	**-0.082**	**-0.113**	**-0.141**	***-0.121***	**-0.219**	-0.063	-0.057	-0.096
	(0.030)	(0.031)	(0.029)	(0.028)	(0.024)	(0.027)	(0.049)	(0.060)	(0.059)	(0.039)	(0.048)	(0.061)
Middle/junior school * special education	0.018	0.043	0.042	-0.004	0.054	0.085	0.044	0.094	0.086	0.015	0.122	**0.220**
	(0.020)	(0.028)	(0.028)	(0.023)	(0.045)	(0.050)	(0.027)	(0.070)	(0.094)	(0.030)	(0.080)	(0.096)
Panel C: Aborginal												
Middle/junior high school	**-0.131**	**-0.141**	**-0.190**	***-0.053***	**-0.077**	**-0.115**	**-0.138**	***-0.113***	**-0.210**	-0.056	-0.036	-0.084
	(0.030)	(0.032)	(0.030)	(0.028)	(0.023)	(0.025)	(0.049)	(0.061)	(0.061)	(0.038)	(0.047)	(0.066)
Middle/junior school * aboriginal	0.004	-0.001	0.028	-0.015	-0.011	0.061	-0.005	-0.023	-0.041	-0.046	-0.113	-0.013
	(0.025)	(0.040)	(0.041)	(0.028)	(0.040)	(0.038)	(0.032)	(0.063)	(0.081)	(0.037)	(0.080)	(0.092)
Panel D: ESL												
Middle/junior high school	**-0.131**	**-0.137**	**-0.188**	**-0.055**	**-0.072**	**-0.104**	**-0.139**	***-0.096***	**-0.187**	-0.062	-0.036	-0.060
	(0.031)	(0.030)	(0.030)	(0.028)	(0.024)	(0.027)	(0.050)	(0.053)	(0.047)	(0.039)	(0.044)	(0.060)
Middle/junior school * ESL	0.008	-0.038	0.011	0.001	-0.066	-0.032	0.010	-0.207	-0.193	0.005	-0.156	-0.175
	(0.068)	(0.058)	(0.067)	(0.059)	(0.041)	(0.045)	(0.076)	(0.123)	(0.156)	(0.065)	(0.134)	(0.166)
Panel E: Low 4th grade scores												
Middle/junior high school	**-0.101**	**-0.091**	**-0.149**	***0.050***	0.038	-0.013	***-0.101***	-0.046	**-0.154**	0.053	0.085	0.032
	(0.031)	(0.033)	(0.030)	(0.029)	(0.029)	(0.028)	(0.053)	(0.066)	(0.067)	(0.040)	(0.052)	(0.071)
Middle/junior school * low score	**-0.057**	**-0.100**	**-0.076**	**-0.184**	**-0.205**	**-0.171**	**-0.078**	**-0.140**	**-0.127**	**-0.216**	**-0.240**	**-0.230**
	(0.013)	(0.015)	(0.016)	(0.009)	(0.012)	(0.012)	(0.017)	(0.027)	(0.043)	(0.016)	(0.019)	(0.044)
Number of obs	185170	47264	29935	185170	47264	29935	185170	47264	29935	185170	47264	29935
Control variables:												
Student/school/census variables	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
District fixed effects	yes	yes	no	yes	yes	no	yes	yes	no	yes	yes	no
City fixed effects	no	no	yes	no	no	yes	no	no	yes	no	no	yes
Sample:												
Full sample	yes	no	no	yes	no	no	yes	no	no	yes	no	no
Only districts > 15%	no	yes	no	no	yes	no	no	yes	no	no	yes	no
Only cities > 15%	no	no	yes	no	no	yes	no	no	yes	no	no	yes

Standard errors corrected for clustering at the district level are in parentheses. Critical values for all columns except columns 1, 4, 7, & 10 are from a t-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions.

Table 6
Effect of moving schools on test score gains from grade 4 to grade 7

	Math			Reading		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Movers						
Changed schools	**-0.057**	**-0.038**	**-0.050**	**-0.047**	**-0.044**	**-0.051**
	(0.008)	(0.010)	(0.014)	(0.008)	(0.012)	(0.017)
Panel B: Movers due to school closing						
Changed schools	0.031	0.026	0.038	0.029	0.015	0.043
	(0.019)	(0.022)	(0.031)	(0.017)	(0.025)	(0.035)
Number of obs	185170	47264	29935	185170	47264	29935
Control variables:						
Student/school/census variables	yes	yes	yes	yes	yes	yes
District fixed effects	yes	yes	no	yes	yes	no
City fixed effects	no	no	yes	no	no	yes
Sample:						
Full sample	yes	no	no	yes	no	no
Only districts > 15%	no	yes	no	no	yes	no
Only cities > 15%	no	no	yes	no	no	yes

Standard errors corrected for clustering at the district level are in parentheses. Critical values for columns 2, 3, 5 & 6 are from a t-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions.

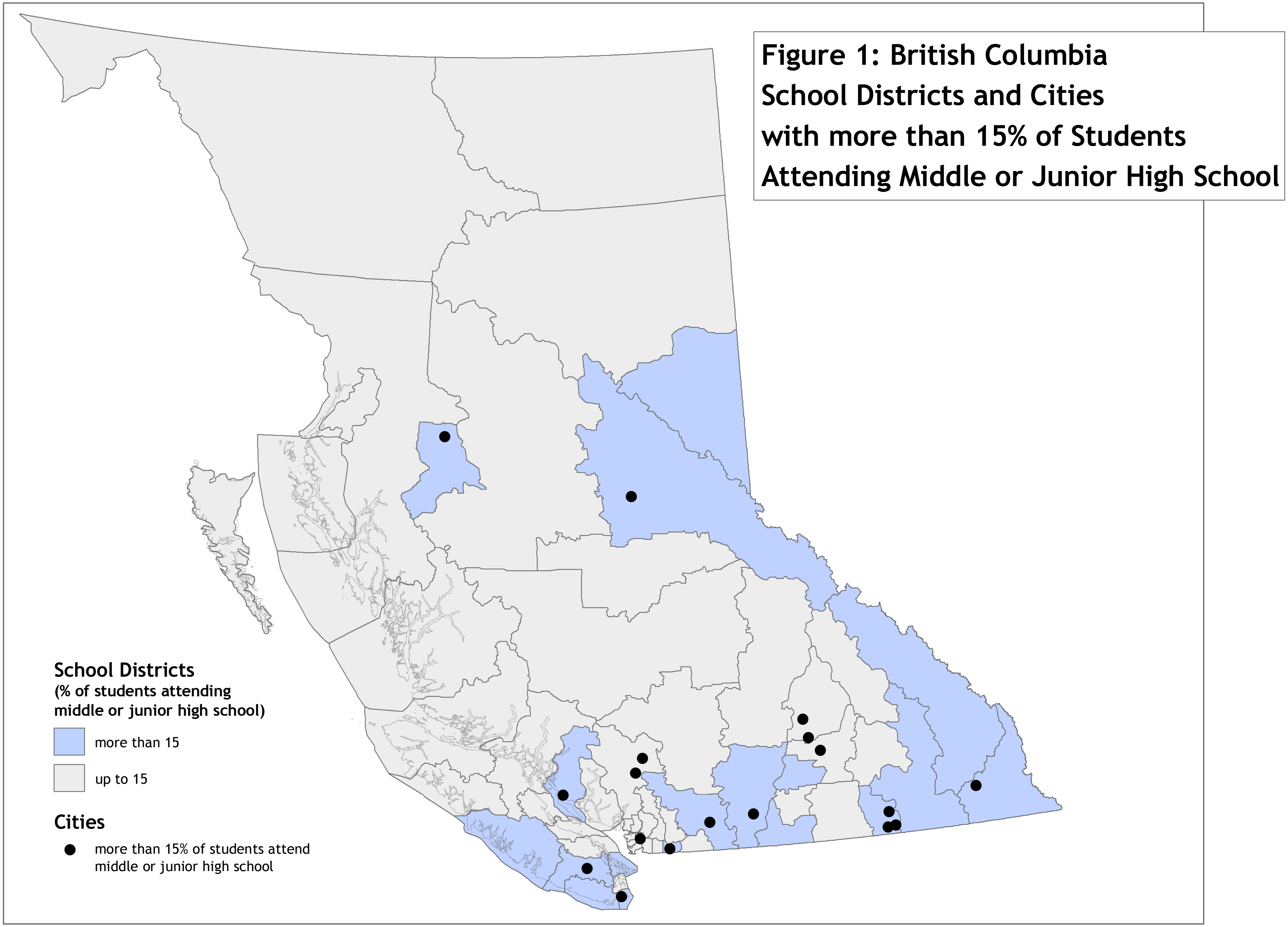
Figure 1: British Columbia
School Districts and Cities
with more than 15% of Students
Attending Middle or Junior High School
School Districts
(% of students attending
middle or junior high school)
more than 15
up to 15
Cities
more than 15% of students attend
middle or junior high school