

Inside and Out: Factors Affecting Secondary School Student Success in British Columbia

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Abstract

The 252 secondary schools in British Columbia have varying resources to educate their students. Recent research has found that the path to creating higher-quality schools is much more complicated than previously thought, with the age-old correlation of money equalling success becoming heavily challenged as of late. With this in mind, this research paper seeks to determine whether schools are subject to the conditions of their surroundings or whether they can sufficiently affect student performance and the learning environment. Over the course of this observational study, we categorized multiple variables as either “internal” or “external” based on a school’s ability to alter such factors and calculated a correlation coefficient with the rankings of a widely-respected national think tank, the Fraser Institute. Our results found that while wealth, an external factor, had a substantial impact on the quality of schooling – one of the most considerable impacts out of the variables considered – many internal factors also significantly impacted a school’s ranking and quality. Even if an external factor such as wealth had one of the most considerable influences measured in the study, it is much more challenging to control, meaning that its usage as a tool for bettering BC schools is limited at best. As such, we concluded that while there are likely multiple ways to improve a school’s educational environment, it is much more feasible for schools to make small or medium-sized changes to their policies/timings to enhance student success.

Keywords: education, schooling, youth, policy

1. Introduction

With education reemerging as a heavily debated topic in today’s political environment, the quality of education that schools deliver has again come under the spotlight. Over the past few years, British Columbia’s education system, particularly its secondary schooling network, has become more fragmented and unequal, with disparities between private and public, rural and urban, and rich and poor becoming more visible and seemingly more impactful on the trajectory of a student’s life well after their graduation (Miller et al. 2019) [1].

With nearly 550,000 school-age children in BC public schools alone [2], the province’s educational institutions have become increasingly tested through issues such as teacher strikes, educational cuts, and the recent COVID-19

pandemic, leading to a shift in the quality of education students experience within their schools [3].

This project aimed to ascertain whether the eight tested variables had a robust correlation with a school’s ranking, demonstrating a probable chance that said particular variable affected student outcomes. With this in mind, we hope to determine which variables have the most decisive impact on school rankings and, by extension, what the ideal condition for those variables would be to maximize the calibre of education provided by secondary institutions. In doing so, we aim to provide a “roadmap” for school and provincial officials to follow to ensure that all BC students receive a quality education, no matter their background, socio-economic status, or location.

Literature Review. The unique setting of BC schools brings the validity of the timeworn postulate of more affluent

students and schools leading to higher achieving students into question for two main reasons.

Firstly, schools in British Columbia are not funded directly by their regions' property taxes. Instead, provincial taxes are collected and redistributed to individual school districts through a predefined formula to ensure that funds are more equitably distributed, accounting for the regional variation among schools. This means that the economic imbalance of attending a school in a more affluent postal code compared to a poorer one is severely reduced since, unlike in the United States and other countries, taxes from more prosperous postal codes are not directly funnelled into local schools (Kenyon et al. 2022) [4][5].

Secondly, new research has shown that schools located in higher-class neighbourhoods do not necessarily outperform schools with a sizeable middle-class student population. A 2022 Norwegian study examined the effect of pressure and competition on students, concluding that middle-class schools performed better than both higher-class schools, where the sometimes toxic learning event hindered student performance, and lower-class schools, where some students might not have been able to access the same level of extracurriculars or educational tools (Markussen & Røed 2022) [6]. Given the limited public data concerning income/wealth by postal code in BC, it was impractical to replicate this study in a British Columbian context. However, proxies such as housing prices in a school's neighbourhood may be used to infer and extrapolate data regarding community affluence to compare the prior study's findings to those of this observational study.

The large proportion of students enrolled in independent educational institutions in BC also allows for substantive research concerning the widely-held belief of extreme divisions in quality between public and private schools. In BC, over 13% of students attend independent schools – the most significant proportion in the country [7]. While the province does not fully fund these schools, these schools still receive a sizeable portion of their operating revenue from the Ministry of Education, receiving up to 50% of their local school district's funding rate, totalling around \$491 million in the last school year (2022-23) [8][9]. Due to these statistics, BC is a formidable research subject, with enough students enrolled in independent schools to minimize the chance of outliers resulting from a small sample size.

A secondary aim of this paper is to examine the rural/urban divide between BC schools. With only one (maybe two) central metropolitan area(s), the province has a radical imbalance between its rural and urban populations. The Metro Vancouver Regional District contains over 50% of the province's 5 million residents [10], with the Capital Regional District being the home of around 300,000 more citizens. It is widely accepted that rural schools face more challenges than schools in a more urban environment, and

these suspicions were confirmed in the 2017 BC Rural Education Report [11]. The provincially commissioned report concluded that rural schools face most of the problems that urban schools face, in addition to unique problems such as low teacher retention rates and the lack of educational opportunities owing to their remote locations. According to the report, rural schools do not only have to deal with issues that arise from their often-remote location – many challenges urban schools face are further exacerbated in a rural environment [12]. This report demonstrates that while schools can significantly influence their quality of education, a school's environment (in this case, location) still strongly influences educational outcomes. The information from this report provides valuable insight surrounding the issues that rural communities face in education and can be used as evidence that a school's environment is more influential than previously thought.

On the other side of the debate, schools still retain considerable influence over a student's learning environment. Start times are an example of a policy that a school district can unilaterally adjust for various reasons – student performance among them. In 2014, an American study tested the effect of school start time on student test scores. Three of the six schools in the study were selected to push their start times back (between 8:00 and 8:55 am), while the other three schools acted as a control group and retained their pre-existing start time.

The study found a significant boost in metrics such as average student sleeping time, lower alcohol use, and fewer teen car crashes, owing to the additional sleep period afforded to students (Wahlstrom & Owens 2014) [13]. In addition, the study found a marginal increase in students' grades throughout the experiment. Interestingly, most of the schools featured in the study had varied starting times before the study, owing to the geographic diversity of the schools from Wyoming, Minnesota, and Colorado – a very similar fact to the staggered starting times all over British Columbia. This detail is especially relevant in examining the effect of starting times on schools in a province with significant differences in geography, time zones, and educational quality. As a result of previous literature, we can be sure that the start times from various BC schools will provide an invaluable tangible and objective measure of a school's inherent qualities.

2. Hypothesis

Through examining past research and popular belief, it is clear that many factors affect student outcomes. However, it is unclear which specific variables have the most significant effect on performance, an inquiry we seek to provide some commentary on through our calculations. The question we seek to answer is twofold:

1. How much impact do schools have on student performance?
2. If schools do, in fact, have an immense effect on student performance, what factors may be altered to maximize student achievement?

These two questions bear heavy importance in the context of a British Columbian education system facing school closures [14] and educational cuts [15]. This study has the potential to identify the main flaws plaguing underperforming schools and suggest remedies to discover an efficient way to bring schools up to standard without expending valuable resources inefficiently.

To answer the first question, this study shall categorize the factors measured as either “internal,” i.e. controllable by the school or school district, or “external,” i.e. out of the control of the school or its district. On this question, we hypothesize that external factors bear significantly more influence over school student performance than internal factors. We came to this conclusion despite past research demonstrating a relatively equal balance between the two categories through the reasoning that it is in the best interests of the BC Ministry of Education and its schools to provide high-quality education. Thus, if the issues many schools face today could be solved by a school or district alone, they would have resolved them already. This leads us to believe that outside factors are at play, hindering certain schools' ability to deliver a first-rate education to their students.

Given the wide range of variables we seek to test, we have deemed it imprudent to expect any individual variable to have the most significant impact on school quality, primarily due to BC's unique circumstances, which render previous research less reliable in this context. As such, the second half of the study will be conducted with a null hypothesis, i.e., assuming that all tested variables will have the same effect on school quality.

3. Study Design

As one of Canada's most comprehensive and well-respected school ranking systems, the locally-based Fraser Institute's rankings were used for this study. This system ranks private and public schools on a scale of 1-10, measuring standardized testing results, graduation rate, and exam failure rate.

Despite the Fraser Institute's rankings' reputation as one of the most trusted sources in the country, some criticisms persist about its methodology and bias. The main argument against these rankings is the assertion that they depend too heavily upon the results of standardized tests, which disproportionately favour kids from higher-income backgrounds. While this contention is generally true, the entire education system, in general, tends to favour more affluent students for a variety of reasons, including the existence of a safety net in the case of failure, decreasing

stress, and greater access to extracurriculars and tutoring services. Therefore, these rankings are in line with the status quo. Whether or not this inequality is justified or a positive thing is outside the scope of this paper; however, it is clear that this disparity exists in both the Fraser Institute's rankings and the real world, ironically reinforcing the Institute's rankings as reliable.

In order to select experimental units for this project, a systematic sample of schools was taken, with each 10th school starting from the #1 ranked school in 2019 being selected. This ensured that the sample size would be decently sized yet representative of BC's diverse educational system. Altogether, 25 out of BC's 252 secondary schools were selected to fulfill the 10% rule for independence while simultaneously measuring a large enough amount of schools to limit the effect of random variation on the sample. The lack of a 26th school was due to the lack of data available for school #251 (Chetwynd), which was subsequently cut from calculations not to skew any data.

To measure the relative consistency of schools across a medium length of time, each school's rankings between the 2015-2016 and 2018-2019 school years were compiled and averaged to create a composite 2015-2019 score. Following this, the collected eight variables had correlations calculated with the composite school ranking to discover any simple correlations between a particular variable and school ranking.

The next step in experimentation was to categorize each variable as either “internal” or “external” to observe which category affected student performance more. Following this step, the most impactful “internal” variables would be analyzed to determine the feasibility of a change in policy with the ultimate goal of boosting educational outcomes.

Eight variables were collected in this study. These were selected due to their assumed importance to school performance, publicly-available data, and exclusion from being considered in the Fraser Institute's rankings. The eight variables were as follows:

1. Average housing price
2. Average price per housing foot

These two variables were collected to indirectly measure the approximate wealth of the residents within a school's postal code. While there is a sizeable amount of students who do not reside within the confines of a school's postal code, especially for those living in more rural areas, school catchments help filter most students living in a particular region into their local high school. Variables 1 and 2 were collected using mean costs by postal code from HousingPriceHub.com's database for June 2019, the final month of the school rankings [18]. Housing price per frontage foot was later dropped due to its close correlation with average housing price and the fact that it could only be found for 12/25 schools sampled, leading to its unreliability as an explanatory variable.

3. Population density
4. Population change since 2000
5. The number of educational institutions per 1,000 residents

These seemingly less relevant variables were also included in data collection via cybo.com, a global business directory that collects stats for individual postal codes [19]. The goal of collecting these three variables was to examine some external factors that have intuitively less impact on schooling and have yet to be studied as much previously to examine if there is a relationship between these often-neglected statistics and school rating. On the website, we collected population density/ km², population change in % since 2000, and the number of educational institutions per 1,000 residents; the number of educational institutions includes elementary, secondary, and post-secondary schools in its industry definition.

Population density was used to examine the urban/rural divide between BC schools by comparing the rankings of schools in more densely populated areas to those in more rural regions. Population change was collected to identify any significant correlation between shifts in population and educational quality, seeking to pinpoint any possible education-related impacts of a large influx or reduction in a region/school's population. The number of educational institutions per 1,000 residents in a school's postal code was collected to ascertain whether the number of educational institutions, which impacted student choice in schools, affected school quality.

6. Average teacher salary

The average teacher salary at each school was acquired from the public 2019 pay grade in a school's district for a category five teacher with five years' seniority, roughly the average of most teachers in the province [20]. In the case of certain independent schools, glassdoor.com was used to determine the average salary for instructors [21].

7. Average grade size

While it would be highly challenging to calculate median class sizes given the variation in subjects and individual periods, the BC Ministry of Education keeps records of the exact number of students in each grade at each public and private secondary educational institution. While some schools selected did not teach the typical age range of grades 8-12, this issue was solved by determining the average grade size for grades within the normal range of grades 8-12 to establish uniformity [22].

8. School start time

Past research has shown that school start time affects student achievement. To test the validity of this hypothesis in a British Columbian context, each school's start time was collected through their website/online class schedule.

Out of these variables, variables 1-5 were classified as external, while variables 6-8 were considered "internal" factors. Even though some of these variables could be considered both internal and external, the deciding tiebreaker to categorize the variables into the two specific camps examined if a school, school district, or the Ministry of Education could control the variable comprehensively in a relatively short period. For example, while variable five – educational institutions per 1,000 residents – is controllable by the province, it would take years, maybe even decades, to effectively alter the number of educational institutions in a given area. At the same time, changing a school start time or increasing teacher pay would be much easier, so that particular variable would be classified as "internal".

4. Results

It should be noted that there were three data cells for which no data could be found, those being the start time for Glenlyon Norfolk (21) and St. Margaret's (121) and the average teacher salary for Pacific Christian (221). However, these omissions did not affect the collection and correlation of the data in a significant manner.

Certain variables demonstrated strong or moderate positive or negative trends, while others reflected an almost constant value across rankings.

Only four out of seven tested variables showed a statistically significant r^2 value above the level of 0.05: average teacher salary, average grade size, start time, and average home price. Of these four variables, three were internal, while one (average home price) was external. Interestingly, all three tested internal factors demonstrated a coefficient of determination above the cutoff line. At the same time, only one out of four external variables made the cut, indicating that schools certainly have a degree of agency over educational quality.

One more intriguing result was that contrary to previous research, later school start times appeared to have an adverse effect on student performance, with a general decline in ranking accompanying later start times – but more on that in a bit.

The accumulated statistics and graphs are included on the following pages.

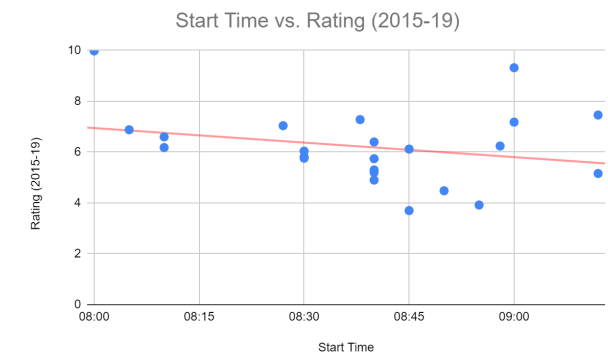
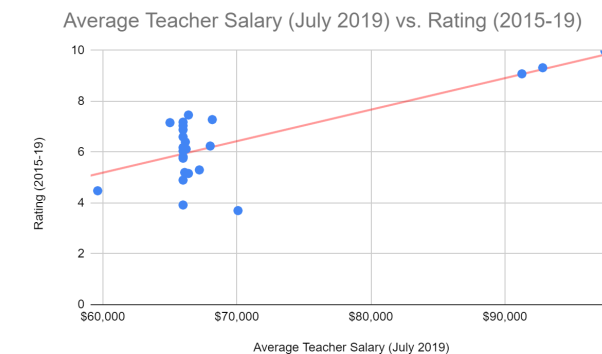
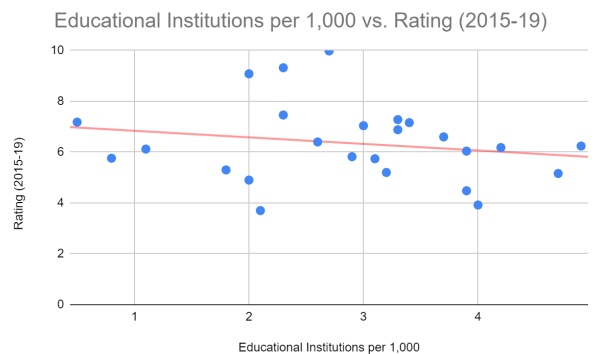
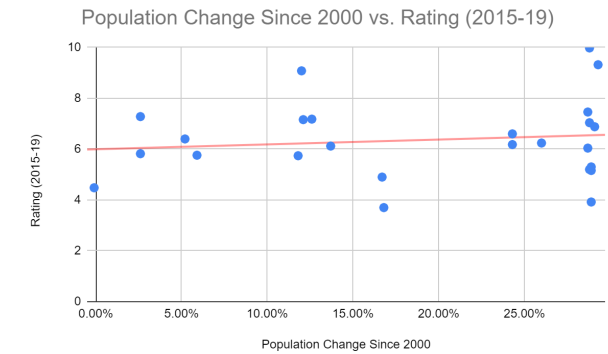
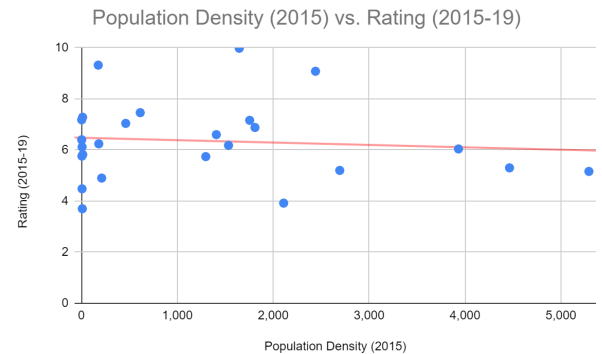
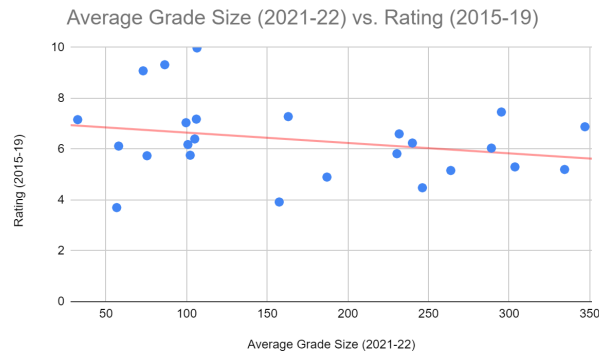
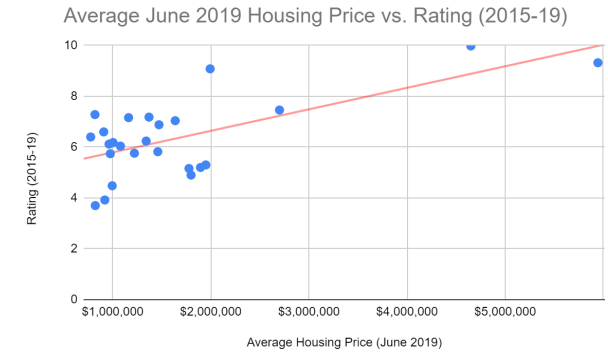
All Tested BC Schools

Ranking (2019)	Name	Rating (2015-19)	City (SD)	Average Housing Price	Population Density Per km ² (2015)	Population Change Since 2000	Education per 1,000	Average Teacher Salary	Average Number of Students Per Grade (2021-2022)	Start Time
1	Crofton House	9.98	Vancouver (P)	\$4,649,732	1,646	28.80%	2.7	\$97,458	106.4	08:00
11	Mulgrave	9.32	West Vancouver (P)	\$5,944,606	175.8	29.30%	2.3	\$92,818	86.4	09:00
21	Glenlyon Norfolk	9.08	Victoria (P)	\$1,993,135	2,441	12.00%	2	\$91,266	73	
31	J Lloyd Crowe	7.28	Trail (20)	\$819,400	12.7	2.60%	3.3	\$68,171	163	08:38
41	Elphinstone	7.18	Gibsons (46)	\$1,370,144	3.06	12.60%	0.5	\$65,992	106	09:00
51	Handsworth	7.46	North Vancouver (44)	\$2,699,781	613.6	28.70%	2.3	\$66,393	295.2	09:12
61	Howe Sound	6.24	Squamish (48)	\$1,341,430	181.3	26.00%	4.9	\$68,018	240	08:58
71	Langley Fine Arts	7.04	Langley (35)	\$1,637,169	462.2	28.80%	3	\$65,992	99.6	08:27
81	Yale	6.6	Abbotsford (34)	\$908,909	1407	24.30%	3.7	\$65,992	231.8	08:10
91	Lord Tweedsmuir	6.88	Surrey (36)	\$1,471,991	1810	29.10%	3.3	\$65,992	347	08:05
101	Carson Graham	5.16	North Vancouver (44)	\$1,777,348	5292	28.90%	4.7	\$66,393	263.8	09:12

111	Selkirk	6.4	Kimberley (6)	\$775,845	3.57	5.20%	2.6	\$66,162	105	08:40
121	St. Margaret's	7.16	Victoria (P)	\$1,162,100	1755	12.10%	3.4	\$65,015	32.4	
131	Alberni District	5.82	Port Alberni (70)	\$1,459,825	14.2	2.60%	2.9	\$65,998	230.4	08:30
141	Lake City	4.48	Williams Lake (27)	\$995,000	7.09	-0.10%	3.9	\$59,623	246.2	08:50
151	Southern Okanogan	5.76	Oliver (53)	\$1,221,418	5.43	5.90%	0.8	\$65,992	102.2	08:30
161	Abbotsford Traditional	6.18	Abbotsford (34)	\$1,003,696	1534	24.30%	4.2	\$65,992	100.75	08:10
171	Tamanawis	6.04	Surrey (36)	\$1,079,274	3932	28.70%	3.9	\$65,992	289	08:30
181	Burnaby North	5.2	Burnaby (41)	\$1,894,835	2694	28.80%	3.2	\$66,113	334.4	08:40
191	Ballenas	4.9	Qualicum (69)	\$1,798,684	211.5	16.70%	2	\$65,992	187	08:40
201	Cedar	3.7	Nanaimo (68)	\$822,581	9.78	16.80%	2.1	\$70,089	56.6	08:45
211	Killarney	5.3	Vancouver (39)	\$1,948,957	4464	28.90%	1.8	\$67,207	303.6	08:40
221	Pacific Christian	5.74	Victoria (P)	\$975,749	1297	11.80%	3.1		75.4	08:40
231	Chemainus	6.12	Chemainus (79)	\$963,117	7.44	13.70%	1.1	\$66,222	57.8	08:45
241	Westview	3.92	Maple Ridge (42)	\$919,839	2109	28.90%	4	\$65,992	157.4	08:55

Correlation (r) for Each Variable According to Classification

Internal	External
0.75364 - Avg. Teacher Salary	0.66017 - Avg. Home Price
-0.25830 - Avg. Grade Size	-0.19031 - Educational Institutions/1,000 Residents
-0.25334 - Start Time	0.12796 - Population Change
	-0.09197 - Population Density



5. Discussion

When examining the results, we must revisit the initial questions we sought to answer at the start of this project:

1. How much impact do schools have on student performance?
2. If schools do, in fact, have an immense effect on student performance, what factors may be altered to maximize student achievement?

On the first question, we conclude that schools retain considerable leverage over school quality – but not entirely – as demonstrated by all three internal variables' correlations being statistically significant compared to the ¼ success rate of the external variables. The specific amount of impact that school policies have on student achievement is outside the scope of this project. Still, we are reasonably confident that schools possess some agency over student success, which can be influenced through policy and practical shifts, such as altering when class time begins in the morning or the level of teacher pay.

This issue gets more complicated when answering the second question since various factors may be working in tandem to create a specific school setting, and altering one of the values may throw the balance of said system off. However, we tried our best to isolate and identify variables that may bear great weight on student performance. It is important to note that while this study provides a comprehensive examination of several essential variables influencing school quality, it is still only an observational study, meaning that no correlation-causation links can be established. Thus, all assertions moving forward are strictly theorized based on logic and past research and must be researched more fully in the future to establish a causal relationship.

Beginning with the only statistically significant external factor, the proxy for neighbourhood wealth demonstrated a moderate-to-strong positive correlation with school rating. This trend was not as strong around the median housing price due to the large cluster of schools in that area; however, it becomes more apparent when factoring in schools located in more expensive areas (beginning at around \$2 million), where schools demonstrate higher composite ratings compared to the rest. We theorize that this trend can be mainly attributed to the prevalence of more affluent families sending their children to study at private institutions that receive more funding than institutions primarily funded by the government and carry greater prestige around educational quality and student outcomes. This creates a positive feedback loop, with the more affluent families that can afford better resources and extracurriculars sending their kids to more exclusive schools, where they then gain a reputation as one of BC's elite schools and increase their

school ranking and quality, prompting even more upper-class families to enroll their children in these programs (Frenette & Chan 2015) [23] [24]. While this trend has been observed worldwide, most governments cannot influence such private institutions to halt the cycle of wealthier students enlarging disparities between public and private schools. However, as previously mentioned, BC is in a unique position where the province subsidizes independent schools at a fixed rate. Therefore, policymakers and bureaucrats may be able to influence this disparity by altering the amount or existence of independent school subsidies.

The internal factor with the highest correlation was average teacher salary, demonstrating the strongest correlation between a variable and school ranking throughout the study. Teacher compensation is a sticky subject, with educators across the province recently going on strike in 2014 and narrowly avoiding another one in 2022 in pay disputes. As demonstrated by the graph, there is a robust correlation between teacher pay and student success. However, the causal relationship between the two is disputed, with some maintaining that wealthier schools pay their teachers more. In contrast, others assert that higher-paid teachers are more motivated and experience higher job retention rates, adding more experience to the classroom. Whatever the case, private schools once again seemed to pay their instructors noticeably more, correlating to a higher school ranking. Interestingly, many public schools paid their teachers the same amount per contract, meaning that the correlation between student success and teacher pay is much weaker in the approx. \$66,000 range. This is likely due to other factors affecting school quality when teacher pay is constant. While other research has concluded a causal relationship between higher teacher pay and student success, we recommend further investigating this phenomenon in a Canadian context.

Average grade size was another internal variable that was statistically significant, albeit much less so than teacher pay. There was a loose, slightly downward trend in the data, with schools with smaller grades ranking somewhat higher than schools with larger grades. While grade size does not indicate class size, a smaller, tight-knit community can contribute to a more positive learning environment through closer bonds and tighter connections between teachers and students.

The final statistically significant variable, start time, demonstrated a trend contrary to previous research, with schools starting earlier in the morning performing slightly better in school rankings. This study is not a definitive causal experiment, and since the correlation between the two variables is moderate at best, we cannot conclude whether start time directly affects student performance.

Still, through observation and simple calculations, some evidence suggests that BC schools that start class earlier in the day perform better than their peers who start 30-60 minutes later. Regardless of whether an earlier start time helps or hinders student performance, the results from this study and past research strongly imply that start time bears some effect on educational quality.

6. Conclusion

This project reinforced the theory that many factors affect a student's education, especially regarding schools and their specific conditions. While this study cannot determine a definitive answer to the question of "What should we change to improve schools?" it lends more insight into the unique world of BC schooling and offers a framework for future research to utilize to answer this age-old question.

Based on the observational correlations between variables, we conclude that both internal and external factors impact schools, which can be roughly equal depending on the factors. However, schools should focus on altering internal factors due to the difficulty of influencing external factors such as wealth in a significant manner. Results suggest that schools and school districts have a myriad of tools at their disposal to impact student learning, giving them considerable influence over the future trajectories of their students. Further research should be devoted to this topic, as we are only scratching the surface of a fascinating yet complex issue.

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