Comparing University Outcomes of IBDP Graduates to their Peers in Toronto and Vancouver, Canada

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Executive Summary

Does a student's high school program influence their eventual outcomes in local universities? In this report, we examine the success of International Baccalaureate Diploma Program (IBDP)[1] graduates across two of Canada's largest high-school-to-university pathways: those between the Toronto District School Board (TDSB) and the University of Toronto (UofT), and public high schools in the Greater Vancouver Regional District (GVRD) and the University of British Columbia (UBC). Data from these urban school districts offer strategic glimpses on the characteristics of IBDP graduates and their performance in two of Canada's top universities. Canada has the world's second largest number of IBDPs, but little research has been conducted on Canadian IBDP students' success relative to their peers in other programs. Moreover, despite recent growth in academic literature on IBDP students and programs, few studies outside of the United States have examined university-level outcomes, and even fewer of these have used multivariable analyses.[2]

We compare university outcomes of IBDP graduates to those of French Immersion (**FI**)[3] graduates and graduates with standard high school diplomas in Toronto (the **Ontario Secondary School Diploma**, hereafter **OSSD**) and Vancouver (the **Dogwood Diploma**, hereafter **DW**).[4] For both UofT and UBC, we focus on several university outcomes: the **Faculties** and/or **fields of study** students' enter and graduate from, their university course grades or **cumulative grade-point averages (CGPA)**, and their graduation rates. In addition, we compare UofT students' winning of **merit awards** by high school program (i.e., OSSD, FI, and IBDP), and for UBC, we examine students' participation in **international study abroad exchange** and **co-operative education programs,** again by high school program (i.e., DW, FI, and IBDP)**.**

Data for the current study had two sources. Toronto data came from linking student administrative records from six consecutive TDSB cohorts of Grade 12 students – those in Grade 12 in 2006-07 to 2011-12 – to all students UofT admitted since September 2006 to September 2021. Most of those TDSB cohorts entered UofT between 2007 and 2013. In total, 18,183 TDSB graduates entered

[1] All acronyms are defined in Appendix 3: Acronyms and Glossary of Terms (page 57).
[2] All boldface text indicates terms that are defined in the Glossary of Terms (Appendix 3), with the exception of boldfacing in tables that serves to highlight key text.
[3] FI students provide a useful comparison to IB Diploma Programme students in most Canadian contexts as both sets of students undergo selection processes to enter and/or remain in popular, intensified, and/or enriched alternative education programs. More typically, FI students enter that program in elementary school, in contrast to IB students in Canadian contexts that more typically begin in secondary school. Furthermore, FI students are typically from families where neither parent speaks French; the families' homes lack French language music, reading materials, and radio and television programming; and the families spend significant portions of summers in a largely, if not completely, English-speaking milieus. Last, at this study's two universities of interest, both sets of students also provide roughly similar sample sizes, which can be computationally useful for statistical comparisons.
[4] One of the challenges in research that compares outcomes of students from different programs experience is the influence of initial selection into a program. Do student outcomes for those graduating from Program A differ from those graduating from Program B because of initial selection into either program or are student outcomes due to differences that the programs themselves generate? We alert readers to this issue at many points and discuss selection effects throughout our analyses.

UofT during the timeline of our study. Of those students, 487 (2.7%) were IBDP graduates, 532 (2.9 %) were FI graduates, and 17,167 (94.4%) were OSSD graduates.

Vancouver data came first from student administrative records on all GVRD-based public high school graduates that UBC admitted between 2012 and 2018. These data distinguish IBDP graduates from those with FI designations, and those with DW diplomas. We randomly sampled the latter from GVRD high school entrants to UBC (both high schools that had authorized IBDPs and those that did not). This linkage yielded 2,014 IBDP graduates and 4,716 non-IBDP graduates. These numbers, both for UofT and UBC, offered sufficient **statistical power** to detect meaningful associations or relations between students' high school programs and their university outcomes.

We report two types of analyses: **bivariate statistics** that compare students from each of the three high school diploma types across all university outcomes of interest and various multivariable analyses that examine each university outcome of interest while controlling for a host of known **confounders**.

In Table 1, we have summarized the key findings for our main research questions (listed in the leftmost column). When comparing IBDP graduates to their peers who attained traditional provincial high school diplomas, IBDP graduates outperform their peers on several key measures. IBDP graduates also appear to have stronger outcomes at UofT and UBC than do their peers who study elsewhere in Canada, although we caution that this is based on a cursory comparison (due to national-level data limitations). Finally, we also find that there is variation among IBDP schools with respect to the success of their graduates in university-level outcomes.

Table 1: Summarizing the research questions and their associated key findings

Research Question	**Findings**	**Interpretation**
1 Does students' high school program influence their eventual university outcomes in Toronto and Vancouver?	✓ Yes, IBDP graduates were more likely to attain higher university grades than were other graduates.	On two specific university-level outcomes, academic grades and likelihood of completion, IBDP graduates were more successful than their peers who graduated from traditional public high school programs. On a third measure, Faculty choice, IBDP graduates also differed from their high school peers by more frequently enrolling in Science.
	✓ Yes, IBDP graduates were less likely to leave university early as compared to other graduates.	
	✓ Yes, IBDP graduates were more likely to enrol in Science Faculties.	
2 How do the outcomes of IBDP graduates at UofT and UBC compare to broader university-wide, provincial and Canada-wide benchmarks?	✓ IBDP graduates at UBC and UofT appear to be exceptional compared to the full population of Canadian undergraduates.	At UofT and UBC, IBDP graduates tend to excel. They do so at rates that appear to be better than for university graduates at other

		institutions for which we have aggregate benchmarks.
3 Do IBDP graduates vary significantly among themselves in their university outcomes?	✓ Yes, both in Toronto and Vancouver, university outcome differences varied among IBDP graduates with respect to the high school they attended.	The individual school at which a student has pursued an IBDP does seem to matter, although modestly, to their university success. On average, though, IBDP graduates tended to do better at university than peers from other high school programs.

Descriptive analyses from Toronto and Vancouver show that IBDP graduates:

1. had slightly higher university admission averages than did traditional provincial diploma (i.e., OSSD or DW) or FI graduates, even accounting for their different entering Faculties;
2. were more likely to enter Science, Technology, Engineering, and Math (**STEM**) fields than were other high school graduates;
3. attained higher university averages than did traditional provincial diploma students (based on various measures of university course averages);
4. were less likely to leave university early than traditional provincial diploma graduates;
5. switched Faculties at rates similar to or lower than traditional provincial diploma graduates; and
6. had rates of graduation similar to or higher than those of traditional diploma graduates.

In Toronto, IBDP graduates were more likely to win merit awards than were other high school graduates. In Vancouver, IBDP graduates were significantly more likely to opt for co-operative education programs than were other graduates, even when accounting for Faculty, but entered international study abroad exchange programs at rates similar to those of other high school graduates after adjusting for year of entry and Faculty.

Multivariable analyses show that:

1. IBDP graduates attained higher academic averages at UofT and UBC than those of traditional provincial diploma or FI graduates, even after adjusting for an array of factors such as university admission average; and
2. among IBDP graduates, high school attended had varying associations with university performance: at UofT, variations were detected among IBDP schools with respect to university outcomes, even after controlling for an array of variables, while in Vancouver there were only small variations in university outcomes among the GVRD high schools that sent graduates to UBC.

In sum, in both Toronto and Vancouver, IBDP graduates had, on average, stronger high school records than did graduates with traditional provincial diplomas. Graduates from FI programs were also highly successful in universities, and in some cases, were as successful as IBDP graduates. Finally, a cursory comparison of our findings to a series of Canada-wide benchmarks suggests that IBDP graduates at UofT and UBC are quite exceptional compared to the full population of Canadian undergraduates.

Recommendations:

Our main policy recommendations can be summarized as follows:

For practice:

1. Recognize widely the success of IBDP graduates in higher education.
2. Strengthen and further promote discussions about promising practices within IBDP communities of practice.
3. Promote more enrolments in IB's Primary Years Program and Middle Years Program.
4. Ensure that IBDP graduates are counselled about the full range of academic options at university, including both STEM and non-STEM fields.

For future research:

1. Develop a systematic program of research on IBDP graduate outcomes.
2. Develop value-added measures of IBDP graduate capabilities.
3. Compare IBDP graduates to graduates from other enriched high school programs.
4. Explore reasons for variations in university outcomes between IBDP schools.

Introduction: Study Rationale

More Canadian students than ever are graduating from high school and entering post-secondary institutions. Whereas only a small slice of the adolescent population entered universities a half-century ago, today a majority of those in major urban centers does so (Davies & Guppy, 2018). As universities become increasingly important sorters and selectors of youth, more students are concerned with placing themselves in high-status institutions and fields of study, as well as in advantageous professional and/or graduate programs (Ibid).

Similarly, paths into university have multiplied recently. Today's public high schools offer students ever-greater curricular choice, especially in urban areas (Bosetti et al., 2017). Only a few decades ago, virtually all high school students took their province's traditional, 'one-size fits all' curricula in neighborhood public schools. But today's urban students have far more curricular choice (Ibid). Some choice is provided between schools, as when entire schools are devoted to an alternate curriculum, as in specialized magnet schools, charter schools, or public schools that specialize in science, language immersion, or creative arts (Bosetti et al., 2017; Davies & Aurini, 2013). But much more curricular choice is provided by distinct program offerings within generalist public schools, such as FI, Advanced Placement, or IBDPs. The combination of between-school and within-school choice has created a smorgasbord of curricular offerings for urban students. The total of these choices is making the high school-university nexus increasingly complex.

As many families enroll their children in academically intensive programs hoping to boost eventual success in university, our central research question is: Does a student's high school program influence their eventual university outcomes in Toronto and Vancouver? We answer this question by comparing the university outcomes of students from special high school programs to those from traditional provincial high school programs. But any comparisons must be mindful that students who enter different high school programs likely had different social and academic characteristics from the outset. Taking any such differences into account, two kinds of social processes are possible. One is that program choices merely sort students with different pre-existing academic and social advantages into different paths, but the differing paths do not in and of themselves independently boost the odds of later success at university. According to this 'selection and sorting' perspective, special programs are vehicles that select students, and/or allow students to self-select, but do not independently boost any skills, aspirations, or aptitudes beyond those that students had from the outset of those programs and would have subsequently acquired in a traditional provincial high school program. From this perspective, secondary-school programs largely sort students into different routes, but do not independently add value by enhancing chances for success. According to this 'selection and sorting' approach, students who already enjoy social and academic advantages are likelier to pursue academically intensive program and school alternatives, and it is those prior advantages that would generate any added future success in higher education.

Alternatively, it is possible that even taking any pre-existing academic and social advantages into account, special programs can directly facilitate success in students' higher education performance and perhaps eventually even boost labor market and career success. From this

perspective, some high school programs provide more tangible academic preparation than do others, and thus raise students' later odds of success at university. According to this 'value-added' approach, academically intensive secondary-school programs can be far more demanding than traditional provincial high school programs, exposing all their students, regardless of academic and social backgrounds, to more rigorous curricula, and thereby raising scholarly skills and aspirations. From this vantage point, students who attend academically intensive programs acquire the skills, aptitudes, and aspirations that facilitate greater success in higher education.

Examining the IBDP in the Canadian context can be strategic for research on higher education entry pathways. As discussed below, the number of studies of IBDPs conducted in Canada is surprisingly small despite Canada's relatively large number of IBDPs. Internationally, Canada ranks relatively high in terms of its level and equality of educational achievement (using results from the **Program for International Student Assessment** (**PISA**); Zeman & Frenette, 2021) and higher education attainment (Deller et al., 2019). Also, Canada's prestige hierarchy of universities is relatively flat compared to that of countries such as the U.S. and U.K. (Davies & Zarifa, 2012; Zarifa & Davies, 2018).[5] Yet, compared to the U.S., Canada has an interesting mix of high school options. Despite lacking large numbers of charter and magnet schools, Canadian urban jurisdictions have many other kinds of school choice, both public and private (Davies & Aurini, 2011). This combination of features – relatively high average student achievement within an institutional structure that is comparatively unstratified, yet also highly varied – provides an especially interesting context to examine IBDPs.

Our main contrast is between the experiences of IBDP graduates and their high school peers who completed traditional provincial high school programs. However, we also included Toronto and Vancouver students who graduated from a very different intensive high school program – French Immersion. FI programs have unique origins in Canadian federal politics and have evolved into a popular choice of enriched programming at both the elementary and secondary level (outside of Quebec, a mainly French-speaking province, where FI is not offered). FI programs now enrol over one of every ten K-12 English-speaking students. In lower grades (typically K-2 or 3) all instruction is in French, whereas in secondary school, at least 25 percent of instruction must be in French (in order to receive federal funding). What makes FI intensive is that while the traditional provincial curriculum is generally followed, the instruction is in a language different than that of their family home.[6]

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[5] U.S. universities are arrayed on an elaborate prestige hierarchy, with highly selective institutions such as those in the Ivy League schools sitting at its top. But Canadian universities are less hierarchically arrayed. While both UofT and UBC are top-flight schools in Canada, differences between them and other Canadian universities, particularly with respect to admission selectivity, are far less extreme than among comparable U.S. institutions of higher learning (see also Davies & Hammack, 2005; Guppy et al., 2013).

[6] FI students provide a useful comparison to IB Diploma Programme students in most Canadian contexts as both sets of students undergo selection processes to enter and/or remain in popular, intensified, and/or enriched alternative education programs. More typically, FI students enter that program in elementary school, in contrast to IB students in Canadian contexts that more typically begin in secondary school. Furthermore, FI students are typically from families where neither parent speaks French; the families' homes lack French language music, reading materials, and radio and television programming; and the families spend significant portions of summers in a largely, if not completely, English-speaking milieus. Last, at this study's two universities of interest, both sets

FI graduates share with IBDP graduates the pursuit of an academically intensive secondary school curriculum. That is one reason we have for comparing these two groups of graduates. Beyond that, however, both groups of graduates tend to come from higher socioeconomic backgrounds (Barrett DeWiele & Edgerton, 2021). This provides us, then, two key reasons to contrast IBDP graduates with FI graduates. The latter follow a curriculum that is different from IBDP, but one that is also intensive, and they share with IBDP graduates the tendency to come from higher socioeconomic backgrounds. This IBDP v. FI contrast gives us another angle from which to distinguish between the 'sorting and selecting' perspective as compared to the 'value-added' perspective.

Finally, UofT and UBC represent interesting university contexts for these comparative contrasts between graduates of different secondary school program streams. Both institutions are large and high-performing public research universities. They are each highly ranked at the world level. According to the Times Higher Education Supplement and QS, UofT ranked 18 and 25, respectively, in 2020 and was the second highest-ranked public university in North America. UBC ranked 34 and 45, respectively, at the world level. Yet, both are large mass-access universities: in recent years, UofT has annually enrolled approximately 90,000 students across three campuses, while UBC has annually enrolled about 66,000 students across two campuses. As such, these universities have varied rather than highly selective undergraduate populations. The former is the norm in Canadian higher education.

Research Questions

We focus most of our attention on one main research question, and then pose two follow-up questions. Our main research question is: Does students' high school program influence their eventual university outcomes in Toronto and Vancouver? We answer this question by comparing UofT and UBC outcomes among IDBP graduates versus those with other secondary school diplomas. We examine four types of university outcomes: i) fields of study, ii) grades, **grade-point averages (GPA)**, and credit accumulations; iii) tendencies to engage in international study abroad exchange or co-operative education programs and/or earn merit awards, and iv) eventual graduation rates and times to completion. We then pose two follow-up questions: i) How do the outcomes of IBDP graduates at UofT and UBC compare to broader university-wide, provincial, and Canada-wide benchmarks? ii) Do IBDP graduates vary significantly among themselves in their university outcomes? That is, are graduates from certain IBDP high schools more successful than those from other schools, and do university outcomes among IBDP graduates vary significantly by key demographics and/or prior academic records? In addressing the first follow-up question, we have briefly reviewed some relevant Canadian literature on university outcomes and compare our two cases—UofT and UBC—against these benchmarks. In addressing the second follow-up question, we have run a series of **multiple regression models** that include IBDP graduates only and explore variations by individual high schools and key demographic and academic variables.

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of students also provide roughly similar sample sizes, which can be computationally useful for statistical comparisons.

Academic Literature

To ground our study, we searched[7] two broad literatures: studies on i) IBDPs in Canada and ii) that also tracked students from secondary school through to university completion and compared the outcomes of graduates from IBDP to those with a traditional high school diploma. We found evidence of huge growth in the literature on IBDPs and their students during the past few decades, particularly in the past dozen years (Ben Jaafar et al., 2021; Dickson et al., 2018). That literature appears to have grown in tandem with the global rise of IBDPs themselves. Indeed, a group of emerging studies is charting the rise of IBDPs in the context of intensifying globalization (e.g., Maire & Windle, 2022).

However, we also found that two bodies of relevant literature have remained quite small. First, despite Canada having the world's second largest number of IBDPs (Ibid; IBDP website), Ben Jaafar et al. (2021) concluded that the Canadian literature remains disproportionately small compared to that of other countries. Second, those Canadian studies (see also Dickson et al., 2018 regarding Australia) did not focus on student outcomes per se, but instead examined other topics, such as administrators' perceptions of IBDP in Ontario (Fitzgerald, 2015) and the spread of IBDP throughout Canada (Resnik, 2009; 2012; Tarc & Beatty, 2012). Only one Canadian study examined student performance (Poelzer & Feldhusen, 1996), but it examined high school grades, not university outcomes.

Yet, this lack of relevant Canadian studies may be unsurprising, since relatively few rigorous studies on IBDP graduate outcomes are emerging from any country. Dickson et al. (2018) found 39 peer-reviewed articles that examined relations between IBDPs and student learning. These studies tended to find that IBDP graduates have very good academic outcomes on average. However, few of those studies controlled for both students' prior academic records or their demographic backgrounds, which is important since studies find that IBDP students tend to come from middle-class or professional families and have high prior academic skills (Ibid). Indeed, Dickson et al. (2018) found only one peer-reviewed study that controlled for prior academic ability/achievement and student background characteristics such as family income and/or other indicators of **socioeconomic status**. That paper was Saavedra's (2014) study of 15,000 students in Chicago Public Schools, 22% of whom were IBDP students. Saavedra found that IBDP students had 20% higher rates of graduating from high school than non-IBDP peers, aptitude scores that were 0.54 **standard deviations** higher, and 38% higher university participation rates. Saavedra considered those results to be remarkable given the prevalence of low-income students in Chicago Public Schools. Analyzing the same data, Cortes et al. (2013) used a **difference-in-difference** strategy to find that IBDP's were associated with gains in a series of high school outcomes (see also Coca et al. 2012)[8] One Australian study (Cole et al., 2015) found that university students with IBDPs had greater critical thinking skills than their non-IBDP peers.

[7] This search did not involve any systematic techniques since our search was a) pointed towards a very specified research question on IBDP student outcomes with an eye towards Canadian studies, and b) yielded a small number of articles. Our non-systematic search used the terms "International Baccalaureate" and "student outcomes" in Google Scholar. We read abstracts and full articles that appeared to be relevant and also used an ancestral search technique in which we examined any articles referenced in searched articles that also appeared to be relevant.

[8] Dickson et al. (2018) did not capture these latter papers in their review. The Cortes et al. (2013) paper is a book chapter and Coca et al. (2012) is a research report, but not in a peer-reviewed journal.

However, that study did not address selection bias by, for instance, controlling for other factors that might be related to student or school characteristics (e.g., family or neighborhood background) that are likely to be related to how students opted into or were selected for IBDP participation.

Dickson et al. (2018) note that, otherwise, very few well-designed studies compare the influences of IBDP versus those of other high school programs on students' university outcomes. More studies examined participants' perceptions or experiences and self-reports of IBDP relations to teaching and/or learning but did so without employing observational or experimental research designs. Thus, Dickson et al. called for more studies that compare outcomes of IBDP versus those of non-IBDP graduates. They also emphasize the importance of accounting for additional factors such as prior academic ability/performance, international experience, and socioeconomic status. We address both these issues in the current study.

Project Context and Scope

Our study compares university outcomes of IBDP graduates to those of their peers with other high school diplomas in two Canadian cities – Toronto and Vancouver. These student populations are solely urban. However, they are large and very dynamic populations. Toronto is Canada's largest city (population 6,555,205)[9], and the TDSB and UofT are Canada's largest school board and university, respectively. UofT is the single most popular destination for TDSB graduates, and TDSB is UofT's single largest source of students (Brown et al., 2019). Vancouver is Canada's third largest city (population 2,737,698), and UBC and GVRD public high schools are the largest catchment for UBC. The TDSB-UofT and GVRD-UBC high school-university pathways are likely Canada's largest and second largest, respectively. Both Toronto and Vancouver are 'global cities' marked by affluence, high university attendance rates, keen educational competitions, large-scale and selective immigration, dynamic postindustrial economies, very ethnically diverse populations, and expensive housing (Perl et al., 2020). Both UofT and UBC are the flagship institutions in their respective provinces, and are ranked among the world's top public universities, as referenced above. These research sites offer strategic glimpses into the outcomes of IBDP graduates in competitive and high-achieving contexts.

For several reasons, we limited our study to graduates from each city's main public school board (TDSB) or main public schools (GVRD).[10] First, selecting only students who lived and studied in the same urban environment reduces the influence of other variables on both high school and university outcomes, such as urban-rural differences, interprovincial differences in high school grades,

[9] Population estimates in this paragraph are for 2020, using Census Metropolitan definitions that do not perfectly align with our school district / board borders. The population of 15-19-year-olds is 385,105 (Toronto) and 149,452 (Vancouver). From: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710013501

[10] Our chosen school boards are not entirely similar. The current TDSB was formed through a 1998 amalgamation of several boards that each served different jurisdictions, including the original city of Toronto and its former boroughs such as Scarborough, North York, Etobicoke, etc. The Vancouver School Board (**VSB**) would be equivalent to Toronto's former school board from its city centre. In contrast, the VSB and boards from Surrey, Burnaby and Richmond would be best captured by a 'GVRD' reference point, thus more comparable to TDSB schools.

and domestic versus international curricula (Usher, 2021). Second, beyond the greater density of urban areas, and in further contrast to rural areas, cities also share a faster pace of life and associated complexity, have different occupational and industrial profiles, and possess differing cultural milieus (Bell & Owens-Young, 2020). Third, this data-selection strategy allowed us to mirror the data-collection strategy undertaken in both cities and create two complementary case studies.

Though our project spans only two educational jurisdictions, it can offer good internal validity for assessing the effects of IBDPs. Its design has the capacity to control for many measured *and* unmeasured variables. Since all students in its respective samples attended schools in the same urban environments and eventually attended the same university, its comparison groups were thus exposed to roughly the same high school and university environments (see details below). Those similar environments serve as latent control variables. If our samples had instead pooled students across numerous boards, cities, and universities, their schooling environments would have varied widely along multiple dimensions, which could have potentially confounded any of our estimates of the effects of high school programs.

Research Design

Our data track multiple cohorts of university entrants from high school graduation into bachelor's degree studies. These data have extended time windows that capture any TDSB or GVRD graduate who entered UofT or UBC during the years between Fall 2007 and Fall 2013 and the Fall 2012 and Fall 2018, respectively. The data also captures any of those students who earned bachelor's degrees by Spring 2020. These time windows can capture many students who dropped out of university, and perhaps returned or transferred to complete their degrees in later years. In particular, our earlier cohorts had sufficient time to enter university and complete their degrees (typically a minimum of four years, but often somewhat longer). Students admitted from 2015 onwards are useful for examining students' early, and recent, university performance but not their graduation rates. Thus, our inclusion of multiple cohorts allows us to check for possible changes over several consecutive admission cycles.

Method

1. Data Collection, Measures, and Variables

Currently, neither Canadian national nor provincial governments collect detailed, large-scale data that would allow researchers to track IBDP graduates[11] from high school into and through

[11] For clarity, when discussing our research cases, we use the terms graduates, entrants, and students as follows. Graduates refer to students graduating from high school, entrants refer to individuals entering university, and students refer to individuals enrolled at either UofT or UBC.

universities.[12] But smaller-scale projects that link data from particular schools and universities make such a task possible. Our study had two branches that each identified IBDP students. For the UofT case, administrative data were merged between the TDSB and UofT to track IBDP high school graduates in and through UofT. For the Vancouver case, we relied on UBC records to identify both measures from high school (e.g., Grade 12 grades, high school programs) and from university (e.g., admission averages, fields of study, dates of graduation). Each case offered the possibility to merge unique, powerful, and complementary data that created extended time windows to capture student pathways across different high school programs into, and typically through, their university undergraduate programs. However, the case's respective protocols had to differ somewhat because of administrative differences, both at the high school and university levels. In the next two sections, we describe the datasets for each case (Toronto and Vancouver). Appendix 2 provides additional detail.

1a. The Toronto Case

The Toronto case extends a 2018 pilot project in which Dr. Davies tracked the full population of former TDSB students who entered UofT between 2004 and 2018, capturing more than 32,000 students (see Brown et al., 2019; Davies, 2020; Davies et al., 2020). That pilot project utilized multiple cohorts and extended time windows to capture data from any students who entered and flowed through TDSB and UofT. Many students had varying timings: some dropped out or **stopped out** of high school, and then entered UofT later, some transferring from another institution (Davies, 2020). Those data had rich measures of students' high school records, school attended, demographics, university **field of study**, GPA, and whether they graduated within the study timeframe. But we had to request new data from TDSB and UofT for the current study since those pilot data did not contain indicators of whether students were in IBDPs (the prior data had been stripped of all school or student identifiers).

We created the new TDSB-UofT dataset in 2021 by merging a new TDSB dataset containing information about students' secondary school experiences to UofT admission records. We used two procedures to ensure accurate merges. Initially, we used Ontario Education Numbers (**OEN**, the province's main student identifier) to match students. Then, we supplemented that matching via alphanumeric identifiers to improve match rates among earlier cohorts (2006 through 2008) for which the OEN had not yet been fully introduced among Ontario post-secondary institutions. The TDSB portion of the merged data consisted of all students enrolled in their *final* year Grade 12 over six consecutive school years: 2006-7, 2007-8, 2008-9, 2009-10, 2010-11, and 2011-12. For example, any student that was in Grade 12 during 2009-10, then returned in 2010-11, but was not present in 2011-12 was placed into the 2010-11 cohort. This coverage of multiple cohorts over multiple years offers a key advantage: it captures students who do not necessarily take linear paths through high school and into university. Approximately 20% of TDSB Grade 12 students return for an additional school year, a phenomenon known colloquially as the 'victory lap', and as a result, students in their final year of Grade 12 can range from 16 to 20 years of age (Brown et al., 2019). These data do exclude students who dropped out before completing Grade 12, but those numbers are likely to be quite small, since

[12] This is slowly changing with the introduction of personal identification numbers for all students in provincial education systems.

those who leave high school prior to Grade 12 now comprise only 3-4% of TDSB students (Ibid), and such proportions are likely to be even smaller among IBDP students. Thus, TDSB students in their final year of Grade 12 represent a large and immediate intake population for Toronto post-secondary institutions such as the UofT.

The UofT portion of the merged data consists of all TDSB students who we matched to UofT admission records. UofT records all students who apply, receive offers, accept and confirm their attendance. The full merged file consists of 56,484 former TDSB students that each had one kind of match at UofT: 18,183 (32.2%) who entered UofT as undergraduates; 33,669 (59.6%) who applied to UofT but did not attend; 2,707 (4.8%) who entered UofT in noncredit or transitional programs, and 1,925 (3.4%) who entered UofT only as graduate students. This report focuses only on the first group of matches – TDSB students who entered UofT as undergraduates to pursue bachelor's degrees. See Appendix 2 for further details regarding the Toronto secondary schools captured in this study. We also used UofT administrative records to access student university outcomes.

1b. The Vancouver Case

We accessed Vancouver data directly from UBC, recording for each student across multiple cohorts whether they took IBDP courses in high school, along with some of their demographic characteristics, their high school and university grades, their fields of study at UBC, and their UBC graduation status. We created those data by merging two administrative files that, when combined, contained student details about both their characteristics upon admission to UBC and their ensuing achievements throughout their university careers. The *admission files* included students' high school attended, high school grades (designated by course), basic demographics and a flag delineating their type of high school program (e.g., IBDP). A UBC *student information file* recorded their progress through UBC, including courses taken, grades achieved, field of study choices, and graduation status.

We relied upon UBC application data to identify high school graduates from each of three distinct pathways used among GVRD schools:

1. Those who completed British Columbia's traditional public high school curriculum, known as a "Dogwood Diploma" (i.e., DW);
2. Those who completed a specialized French Immersion Certificate (i.e., FI) called a *Diplôme de fin d'études secondaires en Colombie-Britannique,* along with their DW; and
3. Those whose credentials indicated they had obtained an IBDP diploma.

We then created two approximately equal-sized comparison groups from the pool of DW students. We randomly sampled one group from the same high schools that IBDP graduates attended; the other group, again randomly sampled, came from high schools without an IBDP. The Vancouver analyses reported below do not differentiate between these groups since we found similar results when replicating analyses using only IBDP and DW students from the same high schools. This procedure has added confidence that our results are not due to effects attributable to the high schools, as distinct from the high school programs, that students attended. See Appendix 2 for added details about the UBC data, along with information about UBC admission.

2. Comparisons across UofT and UBC

Overall, the Toronto and Vancouver datasets can be used to generate an interesting depiction of the university outcomes of IDBP graduates in two large Canadian cities. However, for transparency, several caveats need to be recognized. Our chosen school boards are not entirely similar (please see footnote 6). Moreover, Toronto and Vancouver cohorts are not exact replicates. The Toronto dataset contains an older range of students: 97% of those students entered UofT between 2007-2013. In contrast, the Vancouver cohorts entered UBC between 2012 and 2018. Toronto's eldest two cohorts overlap with Vancouver's youngest two cohorts, but otherwise the Toronto cohorts began university earlier. Further, the Toronto undergraduates come from full populations of cohorts of former TDSB Grade 12 students, and thus offer a very large number of non-IBDP and non-FI students - 17,167 such students, for a total UofT *n* = 18,183 students. The Vancouver DW data come from samples of students from local high schools, about half from schools that offer IBDP's and another portion from schools that do not (*n* = 6,066 in total).[13] However, the Vancouver sample contained more IBDP graduates (*n* = 1,731) than did the Toronto cohorts (*n* = 487). Finally, and not surprisingly given different provincial governments, and school boards, some measures across the two regional datasets are not identical, as we note below.

Both datasets share many variables in common, allowing for good comparative analyses. The key variables used in the subsequent analyses are displayed in Table 2 (next page), where we first indicate a variable's name, then provide a brief description of it, and then indicate the university dataset in which the variable occurs.

For the most part, the variables displayed in Table 2 are self-explanatory. However, a few extended comments are in order so readers will appreciate some of the nuances in the datasets. First, high school grades in both Ontario and British Columbia are reported on a percentage scale (0-100). Although IBDP grades use a different scale (1-7 for most courses), both UofT and UBC translate these IB grades into equivalent percentage grades for admission purposes. This approach allowed us to use a common scale, appropriate to each university, to measure the academic grades of IBDP graduates and graduates from the OSSD, DW, and FI programs. Second, UofT records student university-level course grades using a four-point GPA (0-4), whereas UBC records course grades using a percentage scale (0-100). Third, some variables that we define as common have nuanced differences. Field of study would be an example. At UofT, The Rotman School of Management offers an undergraduate commerce degree, while the UBC commerce degree is offered via the Sauder School of Business. Despite these different names, management at UofT and business at UBC, both universities offer similar degrees. A more complicated example would be music. At UofT, music is a separate Faculty, while at UBC music is part of the Faculty of Arts. For these two examples, and in several others, we have defined fields of study in a way that ensures they are similar, for our purposes, in comparing UofT and UBC (e.g., music is always part of Arts in our working definitions). Finally, at UofT, we have measures of who earned merit awards, but these measures were not available at UBC. Conversely, at UBC we had measures of

[13] This approach allowed us to control for potential school effects by comparing IBDP students with DW students who attended high schools that offered the IBDP versus those who attended high schools without IBDPs.

participation in international study abroad exchanges and co-operative education programs but these measures were not available for UofT.

Table 2: Summarizing the key variables used in the current study, by institution

Variable name	Description	UofT	UBC
High school type	High school program: OSSD or DW, FI, IBDP	✓	✓
Admission average	High school grades (i.e., average) used for UofT or UBC admission	✓	✓
Grade 12 grades	Grades for high school courses in Grade 12 (or IBDP equivalent)	✓	✓
Gender	Male or female	✓	✓
Initial univ. year	Year student entered UofT or UBC	✓	✓
Initial Faculty	Faculty student first entered at UofT or UBC	✓	✓
Total univ. credits	Total number of credits a student successfully completed	✓	✓
Graduated flag	Did students obtain a university degree?	✓	✓
Year graduated	Year in which student graduated	✓	✓
Entry field of study	Field of study / Faculty initially enrolled in at university	✓	✓
Grad. field of study	Field of study / Faculty graduated from at university	✓	✓
Univ. cumulative av.	Academic average for all credits of coursework completed	✓	✓
Merit award	Did the student win a merit award while at UofT?	✓	
Student-loan status	Status of student-loan eligibility on entry to UBC		✓
Special H.S. program	Did high school student attended have special programs (IBDP, FI)?		✓
Exchange flag	Did student study abroad for at least one term?		✓
Co-operative flag	Did student enroll in a co-operative education program?		✓

Notes: univ. = university; av. = average; H.S. = high school

3. Samples

Overall, pooling Toronto and Vancouver datasets, our analyses include more than 2,200 IBDP graduates and more than 22,000 comparison students. In Tables 3a and 3b, we show these numbers for each case.

In Table 3a (next page), we report the numbers of students included in our Toronto analyses, by high school program and year of university entrance. The Toronto data collection protocol captured 487 IBDP graduates, 532 FI graduates, and 17,167 graduates with Ontario's traditional OSSD. Almost all IBDP and FI students were admitted to UofT between 2006 and 2012, with larger numbers of IBDP students captured between 2009-2012.

Table 3a: IBDP graduates entering UofT increase over time

	High School Program			
Year of entry UofT	OSSD	FI	IBDP	Total
Before 2007	68	0	2	70
2007	2,830	91	86	3,021
2008	2,611	85	76	2,789
2009	2,793	100	93	2,999
2010	2,558	91	91	2,748
2011	2,621	70	98	2,803
2012	2,636	66	128	2,847
2013	580	14	7	596
2014-20	469	15	4	487
Total	17,167	532	487	18,183

In Table 3b, we detail numbers of students included in our Vancouver analyses by high school program and year of UBC entrance. We included all IBDP and FI high school graduates admitted to UBC between 2012 and 2018 from GVRD public high schools. DW graduates came from random samples of those students admitted to UBC from GVRD schools, approximately equally distributed between schools with and without IBDP programs.[14] Over the time period 2012 to 2018, FI admission increased, while IBDP admission fluctuated, starting at 196 IBDP students in 2012, increasing to 284 in 2015, then falling to 258 in 2018. Given the overall 20% increase in UBC enrolment over these years, the proportion of IBDP students entering UBC declined between 2015 and 2018, while the proportion of FI graduates rose slightly faster, at about 30%, compared to the overall enrolment.

Table 3b: IBDP graduates entering UBC increase 2012 to 2015 but decline slightly to 2018

	High School Program			
Year of entry UBC	DW	FI	IBDP	Total
2012	472	137	196	805
2013	429	128	221	778
2014	396	137	277	810
2015	427	154	284	865
2016	481	170	255	906
2017	444	210	240	894
2018	549	201	258	1,008
Total	3,198	1,137	1,731	6,066

[14] UBC agreed only to release anonymized data to provide sufficient statistical power for the current analysis. For this reason, we employed a different sampling procedure for UBC as compared to UofT.

UofT's admission flag for IBDP students created a complication in the Toronto data. A total of 589 TDSB graduates were flagged as having applied to UofT as IBDP students. However, some of those students were not listed has having attended one of the seven TDSB schools that offered IBDPs as their previous institution. Instead, only 487 of those 589 students (82.7%) had one of those seven schools listed as their previous institution. Accordingly, 102 students with IDBP flags in their UofT admission records had other schools listed as their previous institution. Our analyses (available upon request) show that those 102 students took an array of paths before entering UofT. As a group, they had 55 distinct schools or programs listed as their previous institution. Most of those institutions were other TDSB high schools, though some of those were designated online, adult, summer credit, or alternative programs. Further, only 73% of those 102 students graduated from TDSB in 4 years, compared to over 96% of IBDP flagged students from IBDP designated schools (difference of proportions $p < .001$). Moreover, whereas only 3.7% of IBDP students who attended IBDP schools repeated Grade 12, that rate was 20.6% among the 102 IBDP-flagged students without an IBDP school listed as their previous institution. Similarly, the corresponding percentages of students who entered UofT directly after graduating high school were 79% and 95% ($p < .001$). Finally, the UofT outcomes of those 102 students were significantly worse than those of the 487 IBDP graduates from designated IBDP schools. The former had lower overall graduation rates from UofT (73.5% versus 84.5%) and lower rates of graduating within 4, 6, or 8 years. They had almost double the rate of early leaving from UofT (23.5% versus 12.9%), lower rates of entering STEM programs (52% versus 64%), lower initial and final CGPAs, and amassed fewer credits at UofT (p's for all differences < .01).

After inspecting these results, we decided to designate 487 students as 'IBDP graduates' if their UofT admission record had both an IBDP flag and an IBDP school listed as their previous institution. We designated 102 students to be OSSD graduates if they had IBDP flags but non-IBDP schools listed as their previous institution. We surmised that those 102 students likely applied initially to UofT from IBDPs, and UofT admission thereby flagged them as having IBDP status, but then those 102 students left those IBDPs before completing them, most transferring to another school before later graduating from TDSB.

4. Creating Comparison Groups

Both Toronto and Vancouver branches of the project compared IBDP graduates to high school graduates who followed the standard provincial curriculum in the same school board (or equivalent). One major challenge was to create comparison groups for identified IBDP graduates. One logic of comparison is to simply compare IBDP students to all others. This 'descriptive' logic aims to broadly compare groups of students without attempting to attribute any particularly cause to any detected differences. This logic of comparison is useful when other students are representative of broader student bodies, and when there is no attribution made to any program's potential causal effects.

A second logic of comparison is based on an 'apples to apples' reasoning used to make inferences about a program's potential causal, or at least quasi-causal, effects. Such an approach aims to compare IBDP graduates to other students who are deemed similar along various dimensions. The reasoning here is that IBDP students are likely to be considerably selective, possibly both via self-

selection and institutional selection (e.g., school acceptance of students into IBDPs). Students are not randomly assigned to IBDPs; they, therefore, likely differ in key ways from other students. Using this reasoning, both Toronto and Vancouver branches of the current study compared IBDP graduates to graduates from FI programs since both sets of students had to undergo selection processes to enter and/or remain in intensified and enriched alternative high school programs.

Our research design also helps to reduce the impact of some confounders and selection bias using multivariable models. First, since we know the temporal ordering of most of our variables, this can help sort out what is causing what (i.e., high school grades can impact university academic grades, but not the reverse). Second, our rich datasets include several indicators that control for many of students' academic and demographic differences (e.g., testing whether high school grade differences between groups might account for university outcomes). To make our results robust, our comparisons also span a series of cohorts. This multi-prong strategy should reduce the impact of **observed and unobserved** differences across our comparison groups on our results. Nevertheless, we emphasize that our research design can only generate quasi-causal results, and do not claim to have fully removed all impacts of all confounders.

A third logic of comparison retains the latter 'apples to apples' logic, but attempts to compare IBDP graduates to a general pool of other graduates (i.e., not just FI graduates), while limiting that pool in ways that make it more similar to the pool of IBDP graduates. One procedure for doing so is to limit comparisons to students attending the same high schools. This procedure can reduce the influence of some confounders since all students are from the same schools (no high school in these datasets has only IBDP students) while retaining other control variables. The reasoning here is that such students encounter similar academic conditions (i.e., school climates and cultures, as well as teachers) and are more likely to live in the same, or similar, neighborhoods. However, this procedure has some practical limits. Many IBDP students, and some non-IBDP students, commute to their high schools from outside their regular catchment areas, and thus do not necessarily live in the same neighborhoods as their schoolmates. Further, since many IBDP instructors often teach a separate curriculum, students in the same schools can nevertheless encounter different classrooms, teachers, and peers.

Each of these three logics of comparison have their strengths and limits. The descriptive logic provides readers with the bare facts of student populations but can be misleading if readers were to inappropriately believe that selection effects were fully considered. The multivariable logic can account for some differences in selection, particularly when it includes measures of student performance prior to their entry into IBDPs. The 'apples to apples' logic can be seen to compare students who are more similar to one another, but for our particular populations, it too has some limits. First, examining only those students who attended IBDP schools greatly limits our numbers. In the Toronto data, it shrinks the pool of students from more than 18,000 to fewer than 2,000. Second, it is questionable whether all students within the same IBDP school live in similar neighborhoods and encounter similar school climates. We know that some IBDP students, and some non-IBDP students, commute to their schools, and we also know that students take many different classes with different teachers (and these factors vary among IBDP schools, also).

Due to these varying limits, both branches of this project used all three logics of comparison. We begin here with Toronto simply because it has the larger population and is, therefore, probably more familiar to readers. All three logics had the benefit of drawing students from the entire TDSB cohort and could identify FI students, as well as students who attended IBDP schools (whether or not they participated in the IBDP). In Vancouver, the analyses followed the lead of the UofT case, with similar comparisons using IBDP, FI, and DW graduates.

5. Analytic Strategy

Both Toronto- and Vancouver-based analyses adopted a strategy of examining associations between graduating from IBDPs and four university outcomes - field of study, university grades or GPAs, graduation status, and other achievements (e.g., winning awards, going on international study abroad exchanges). We completed the statistical analyses using Version 27 of the Statistical Package for the Social Sciences (commonly known as SPSS). We conducted two main types of analyses:

1. **Descriptive Bivariate Statistics**: To provide a series of baseline comparisons, we ran a series of **t-tests** to compare students' demographic characteristics, high school academics, and university outcomes across three types of high school diplomas (IBDP, FI, and OSSD or DW).

2. **Multiple Regression Analyses**: We used **ordinary least squares (OLS) regression** with **dummy variables**, along with **logistic regression models**, to examine if IBDP graduation status has significant and positive effects on university outcomes when controlling for a host of prior demographic and academic measures. Models for student CGPA used OLS regression since CGPA is a **continuous quantitative variable**. In multiple regression models for the Toronto data, we controlled for students' high school grades, high school attended, and student demographics (gender, immigration status, neighborhood income). We used similar but not identical controls with the UBC multivariable analyses, although in this case we scaled the **dependent variable** as a percentage grade (which, too, is a continuous quantitative variable suitable for use in OLS regressions).

6. **Statistical Power**

Our sample sizes either met or surpassed our goals. We initially aimed for sufficient statistical power to obtain **effect sizes** of 0.20- 0.25 with 95% **confidence** (see Kraft, 2020). We chose those effect sizes because they jibed with Davies recent Ontario and Toronto research (e.g., Davies, 2013; Davies et al., 2015; Davies & McKerrow, 2022; Aurini & Davies, 2021; Davies et al., 2016; Davies et al., 2020), and with U.S. reviews of educational interventions (e.g., Hill et al., 2008; Cooper et al., 2000). To reach those levels of statistical power, we estimated that we would need sample sizes of 300-500 IBDP students and 300-500 comparison students in each city, totaling 600-1,000 IBDP and comparison students, respectively. We anticipated that we could draw from pools of 1,075 in TDSB[15] and 1,425

[15] We originally derived our TDSB estimate by summing estimated numbers of IBDP students across those TDSB secondary schools that offered the IBDP.

IBDP graduates in the GVRD, totaling 2,500, but estimated that only 30%-50% of TDSB and GVRD students were likely to attend either UofT or UBC, and so hoped to capture a minimum of 1,000 IBDP students, or 500 per city.

As shown in Tables 3a and 3b, we met or surpassed those goals. The Toronto data captured 487 IBDP graduates while registering more than 17,000 comparison graduates, including more than 500 FI graduates. Our Vancouver data captured 1,731 IBDP graduates, 1,137 FI graduates, and 3,198 DW graduates. Those numbers more than doubled our goals for statistical power.

Findings

a) Toronto Analyses

We begin, in Table 4, by comparing UofT admission averages by high school program (using an average of all students' high school courses). IBDP graduates have averages that are markedly higher than those for OSSD graduates and for FI graduates (each by about 5%).[16]

Table 4: IBDP graduates have higher admission averages than do their peers (UofT)

	High School Program		
	OSSD	FI	IBDP
University admission average: All courses	$\bar{x}$ = 79.0 Std. Dev. = 8.7 *n* = 17,167	$\bar{x}$ = 79.2 Std. Dev. = 8.3 *n* = 529	$\bar{x}$ = 84.0 Std. Dev. = 5.4 *n* = 487

Notes: $\bar{x}$ is a symbol for the arithmetic average; Std. Dev. = Standard Deviation; *n* = the cell counts (number of students) on which the arithmetic average is based. Admission average is a percentage grade (see pages 17-18).

We need to be cautious, however, because as we can see from Table 5 (next page), graduates from different high school programs tend to enter different fields of study at UofT. IBDP graduates were much more likely to enter Science (50.1%) and much less likely to enter Arts (29.8%) than were their high school peers. Indeed, as the patterns of Table 5 reveal, graduates from the two specialized high school programs – FI and IBDP – enter very different paths at UofT, with the former overwhelmingly entering Arts (62%) and the latter disproportionately entering Science or Engineering (almost 62% in total). This finding is noteworthy because IBDPs are sometimes thought to emphasize the Humanities and Social Sciences (perhaps because of the 'Theory of Knowledge' course, even though that course is meant to be transdisciplinary). Moreover, this finding differs from a recent study that found the opposite trends among IBDP graduates in the U.K. (Duxbury et al., 2021).[17] We discuss implications of this finding in our recommendations in a later section.

[16] Without controls these average grades are simply descriptive.
[17] Duxbury et al., (2021) included both private school and international students, two student groups not included in our study.

Table 5: IBDP graduates are more likely than their peers to enter STEM fields (UofT)

University Admission		**High School Program**		
		OSSD	FI	IBDP
Degree program on entry (%)	Arts	48.0	62.0	29.8
	Commerce	11.7	4.3	8.4
	Engineering	8.2	8.1	11.7
	Science	32.1	25.5	50.1
	Total %	100.0%	100.0%	100.0%

Caution is further necessary because admission averages (i.e., based on high school grades) differ by Faculty, as we see in Table 6, where we compare the admission averages for entry into each Faculty. IBDP graduates have higher entering averages than do OSSD graduates in all individual fields identified in the table, and overall, with gaps ranging from 2.5% to almost 6%. Similarly, IBDP graduates have higher admission averages than FI graduates in three of the four Faculties, though some of those differences were smaller, and FI graduates have higher admission averages in Business.

Table 6: IBDP graduates have higher admission averages by Faculty (UofT)

University Admission	**High School Program**			
Degree program on entry	OSSD	FI	IBDP	Total
Arts	75.3	76.5	81.2	75.6
Business	81.7	85.5	84.0	81.9
Engineering	86.0	85.4	87.5	86.0
Science	82.2	82.2	84.9	82.4
Total	79.0	79.2	84.0	79.2

The key messages following from Tables 4, 5, and 6 are:

- ✓ IBDP graduates have higher admission averages than FI and OSSD graduates overall.
- ✓ IBDP graduates are much more likely to enter Science fields and less likely to enter Arts than are other high school graduates.

In Table 7 (next page), we compare graduates from high school programs on two key UofT outcomes: their first and final CGPAs. In the top row, we compare students' first CGPAs (an average calculated after completion of a typical first full year of coursework), while in the bottom row, we show their final CGPA (an average computed over all courses taken by the end of a student's final term).[18] Across all comparisons, IBDP graduates have higher averages than OSSD and FI graduates, though the gaps are

[18] UofT calculates GPA on a 4-point scale, using grades from individual courses that are reported on a percentage scale (0-100%) with the following ranges: 'A' (80-100%, 'B' (67-79%), 'C' (60-66), 'D' (50-59), and an 'F' is below 50%.

smaller for the latter comparisons. Importantly, the gaps in CGPAs grow larger between the two time points, first and final: the gap between IBDPs and OSSDs grows from 0.26 to 0.32, and the gap between IBDPs and FI graduates grows from 0.05 to 0.12.

Table 7: IBDP graduates have higher CGPAs after 1st Year and at University Graduation (UofT)

	High School Program		
UofT Outcomes	OSSD	FI	IBDP
End Year 1: CGPA	$\bar{x}$ = 2.50 Std. Dev. = 1.01 *n* = 17,167	$\bar{x}$ = 2.71 Std. Dev. = 0.94 *n* = 532	$\bar{x}$ = 2.76 Std. Dev. = 0.96 *n* = 487
At graduation: CGPA	$\bar{x}$ =2.61 Std. Dev. = 0.85 *n* = 17,167	$\bar{x}$ =2.81 Std. Dev. = 0.78 *n* = 532	$\bar{x}$ =2.93 Std. Dev. = 0.80 *n* = 487

Notes: First-year CGPA typically reflects the end of first year while last CPGA is normally based on final graduation average; $\bar{x}$ is a symbol for the arithmetic average; Std. Dev. = Standard Deviation; *n* = the cell counts on which the arithmetic average is based. CGPAs are calculated using a 0-4 scale.

From Table 7, we conclude:

- ✓ Using two different measures of course averages at UofT, IBDP graduates consistently achieved higher averages than those of OSSD or FI graduates.

In Table 8 (next page) we show results for several other outcomes among UofT students, namely measures of dropping out (failing to graduate by 2020), switching Faculties after entry, and graduation rates within four and six years of entering UofT. IBDP graduates have the lowest rates of dropping out, with less than 13% of IBDP graduates overall failing to graduate from UofT by 2020. Looking across entry cohorts, this pattern mostly holds. In all cohorts, fewer IBDP graduates than OSSD graduates left early, while fewer IBDP graduates left earlier than FI graduates in four of the six cohorts. Although leaving early does not necessarily indicate dropping out of university – students might later re-enter UofT or switch to another university – some unknown proportion of those students are likely to be permanent dropouts.

Graduation rates within four and six years from entry into UofT also suggest that IBDP graduates complete their university degrees in a timelier manner than OSSD graduates and have better university graduation rates than FI graduates (except among 2012 cohort entrants). In Table 8, we also compare the percentages of UofT entrants who switch Faculties before graduation. Less than 10% of IBDP graduates switch Faculties, while more than 12% of OSSD and FI graduates do.

Table 8: IBDP graduates have strong university outcomes: Less dropping out and switching Faculties, and better rates of graduation (UofT)

		High School Program		
University Outcomes		OSSD	FI	IBDP
Completion measures				
% Leaving early¥	All students	19.6	14.2	12.9
	2007 entrants	20.2	14.3	8.6
	2008 entrants	20.7	16.5	16.9
	2009 entrants	18.8	15.0	12.9
	2010 entrants	18.5	12.4	12.0
	2011 entrants	18.7	18.6	12.2
	2012 entrants	18.6	10.6	13.7
% Graduated within 4 years				
	2008 entrants	62.8	55.6	74.4
	2009 entrants	64.5	75.0	76.2
	2010 entrants	64.4	65.3	78.3
	2011 entrants	62.3	64.3	78.2
	2012 entrants	61.6	74.4	71.2
% Graduated within 6 years				
	2008 entrants	76.5	79.5	82.0
	2009 entrants	78.0	84.5	85.3
	2010 entrants	77.5	79.5	86.3
	2011 entrants	76.4	78.3	85.2
	2012 entrants	75.0	84.3	81.6
% Graduated by 2020	2012 entrants	76.1	84.8	82.1
% Switching Faculties	All Students	12.5	12.7	9.3

Notes: ¥Leaving early is defined as not having completed a full year of coursework at the UofT.

The following key messages follow from Table 8:

- ✓ IBDP graduates are less likely to leave UofT early than are graduates from either OSSD or FI.
- ✓ IBDP graduates are more likely to complete their UofT degrees in a timelier manner than are graduates from OSSD or FI programs.
- ✓ IBDP graduates are less likely to switch Faculties while at UofT than are their non-IBDP peers.

Another key outcome is students' academic average at UofT (i.e., their CGPA). In Tables 9 and 10, we display the results from a series of OLS regressions. In Table 9 (next page), the dependent variable is students' CGPA from all of their completed courses. From Model 1, we see whether those university averages differ by high school program, using OSSD graduates as the **reference category**. The coefficient of 0.32 for IBDP graduates suggests that those students obtain CGPAs that are more than 0.30 points higher than those of OSSD graduates and that they would attain averages of 0.12 points higher than those of FI graduates.[19] That IBDP v. OSSD difference is substantial: it represents an effect size of .38 for the IBDP, using the CGPA standard deviation of 0.85. This effect size can be considered to be large according to emerging criteria.[20] But since other factors also influence CGPAs beyond high school program, we added other predictors to our models.

For Model 2 in Table 9, we added three additional variables: gender, year of entry, and total credits earned. We added gender because women generally attain higher university grades at UofT than do men, and 64% of the IBDP entrants at UofT were female, compared to 58% of FI entrants and 56% of OSSD entrants. We included year of entry to control for any possible grade inflation at UofT over the time frame of the study. We also controlled for number of credits attained (equivalent to number of courses completed), since students who complete few credits often have poor grades, and since students often attain higher grades in senior courses. The results from Model 2 tell us that, when controlling for those factors, IBDP graduates continue to fare better than OSSD and FI graduates, although those gaps shrank to 0.23 and 0.11, respectively, and the effect size shrank to 0.28, which can be considered to be medium to large in magnitude (Kraft, 2020).

In Model 3, we added further complexity by including another possible predictor of CGPA – a students entering Faculty. In this model, gaps between IBDP and OSSD graduates again declined, to 0.20, likely because averages differ across Faculties, and IBDP and OSSD graduates differ in the Faculties they enter. Finally, in Model 4, we added high school average. Recall that IBDP graduates had higher admission averages than did other graduates; that difference could moderate the influence of IBDPs on the CGPAs at UofT.[21] In Model 4, we have shown that the gap between IBDP and OSSD graduates indeed shrinks to 0.07 but remains statistically significant with an effect size of 0.09. In concert, these models boost our confidence that a significant gap between IBDP and OSSD graduates persists across a series of model specifications.

[19] This statistic of 0.12 is derived from subtracting the FI coefficient from the IBDP coefficient.
[20] As Kraft (2020) notes, Cohen's benchmarks for rating effect sizes were based on social psychology experiments from over a half century ago. In light of the mountain of educational research that has since emerged, Kraft proposes the following benchmarks for causal estimates of educational interventions that utilize standardized achievement outcomes: less than 0.05 is "small", 0.05 to less than 0.20 is "medium", and 0.20 or greater is "large." Please note that our estimates here are correlational, not causal, and thus are likely inflated.
[21] Including students' high school averages into Model 4 makes sense if one believes that students from programs such as IBDPs obtained higher grades in university precisely because of their higher admission grades. Conversely, an argument for omitting high school averages from Model 4 is that doing so serves to cancel out the influence of the very skills and abilities that IBDPs themselves fostered (i.e., enhanced academic skills and engagement). We discuss this issue further in our concluding commentary.

Table 9: IBDP graduates have higher CGPAs over all their courses, even after controlling for additional variables (UofT)

Independent Variables	Model 1	Model 2	Model 3	Model 4
OSSD graduates	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
IBDP graduates	.321***	.233***	.199***	.072*
FI graduates	.197***	.116***	.142***	.103***
Gender (female)		.025*	.054***	-.071***
Total credits earned		.079***	.077***	.060***
Year of entry into UofT		Included	Included	Included
Faculty on entry			Included	Included
UofT admission average				.045***
R-Squared	.005	.359	.369	.505
Sample size	18,183	18,177	18,177	14,428

Notes: Unstandardized regression coefficients. 'Year of entry' is measured as a series of dummy variables; 'Faculty on Entry' includes measures to account for the different Faculties students first entered; Statistical significance – * $p < .05$; ** $p < .01$; *** $p < .001$.

Next, we conducted a further robustness check by examining students' early grades at UofT, modeling their averages from their first full-time year of coursework. This outcome provides a tougher test of any IBDP advantage because Table 9 includes any student who ever took any class at UofT. We provide a more stringent test in Table 10 by eliminating any student who dropped out prior to completing their first year of coursework, which effectively excludes students who were ill-prepared for academic work at UofT. This instance tends to occur far more among OSSD graduates than among IBDP and FI graduates. Removing early dropouts served to raise university GPAs among former OSSD graduates more than it does among IBDP or FI graduates.

Table 10: IBDP graduates achieve higher CGPAs than their peers, after their first full year, with controls for other potentially influential factors (UofT)

Independent Variables	Model 1	Model 2	Model 3	Model 4
IBDP graduates	.264***	.253***	.199*	.021
FI graduates	.210***	.212***	.259***	.185***
Gender (female)		-.064**	-.011	-.216***
Year of entry to UofT		Included	Included	Included
Faculty on entry			Included	Included
UofT admission average				.063***
R-Squared	.003	.010	.035	.262
Sample size	18,183	18,183	18,183	14,432

Notes: Unstandardized regression coefficients. 'Year of entry' is measured as a series of dummy variables; 'Faculty on Entry' includes dummy variables for arts, engineering and science, leaving out business as the reference category. Statistical significance – * $p < .05$; ** $p < .01$; *** $p < .001$.

The results in Table 10 mainly echo those from the previous table: IBDP graduates' CGPAs for their first-year coursework were 0.26 points higher than those attained by OSSD graduates without controls (i.e., Model 1). That gap shrank to 0.20 points after we entered controls in Model 3, which can be considered to be a moderate effect size (Kraft, 2019). However, the addition of high school average in Model 4 shrank the IBDP advantage to non-significance, while FI graduates retained their advantages over OSSD graduates across all models. Thus, whether IBDP graduates have significantly higher GPAs than OSSD graduates hinges on whether one includes high school grades in the regression model, and to some extent, exactly which university grades are chosen as the dependent variable. Notice, too, that including UofT admission average greatly improves the model's fit with the data (50% of the variance is explained in Model 4).

Taken together, we conclude from Tables 9 and 10 that IBDP graduates attain higher CGPAs at UofT than do their OSSD peers. Further, since those gaps are larger among students final CGPAs than they are for their initial CGPAs, these results suggest that the IBDP advantage grows over time while attending UofT. The IBDP coefficients are larger in models for final CGPA than they are for initial CGPA and remain significant after controlling for all factors in models for final CGPA (Table 9).

The leading messages from the data captured in Tables 9 and 10 are:

- ✓ IBDP graduates attain higher initial and final CGPAs at UofT than do their OSSD peers.
- ✓ The IBDP advantage in final CGPA over OSSD graduates persists even after adjusting for an array of factors, including university admission average.
- ✓ IBDP and FI graduates appear to be better prepared than OSSD graduates to attain high grades over their careers at UofT, including as they persist into advanced coursework.

The UofT data also allows us to see whether there are systematic differences in the types of students who earn merit awards at the university. In Table 11, we can see that students from IBDPs are the likeliest to earn merit awards at UofT (over 43% winning awards), closely followed by those from FI programs (39%). Students with traditional OSSD's trail significantly at 29% (the **Chi square** is statistically significant; in tests not shown, the difference between IBDP and FI rates of winning awards was not statistically significant). Further, in **logit regression models** not shown, the difference between IBDP graduates and OSSD graduates remained significant when controlling for student gender, year of UofT entry and field of study ($p < .001$), and remained positive but no longer statistically significant after controlling for high school average. Thus, these results suggest that IBDP graduates are the likeliest group of high school graduates to win merit awards at UofT, even after controlling for many important factors, but were not more likely to do so after controlling for high school grades.

Table 11: IBDP graduates earn merit awards at rates higher than their OSSD peers (in %, UofT)

	High School Program		
Merit Award Winner	OSSD	FI	IBDP
Yes	29.0	39.3	43.1
No	71.0	60.7	56.9
Totals	100% (*n* = 17,167)	100% (*n* = 529)	100% (*n* = 487)

Chi square = 69.5, significant ($p < .001$)

The key highlight from Table 11 is:

- ✓ IBDP graduates are more likely to earn merit awards at UofT, but that advantage appears largely to be related to having superior high school grades.

We also examined variation *among* IBDP graduates in their academic trajectories at UofT, using their final CGPA as the outcome of interest. In Table 12 (next page) we show differences in that outcome among the 487 IBDP graduates that matriculated from one of the seven TDSB high schools that offered IBDPs. Model 1 displays dummy variables for each school using a masked numerical label that TDSB provided. In Model 1, we found that graduates from three of those schools had final CGPAs that were significantly lower than the reference category (TDSB Reference School #36; randomly chosen). In Model 2, when we controlled for gender, year of entry, and faculty of entry—all three variables having associations with final CGPA—those three coefficients remained largely similar in magnitude. In Model 3, we added another control: students' high school average. That control is strongly related to the outcome and its inclusion serves to alter many other coefficients in the model. In that instance, two schools still had significantly negative coefficients. Finally, in Model 4 we added a measure of the number of credits earned at UofT (which itself is statistically significant) and also serves to alter many coefficients in the model. Nevertheless, despite including an array of controls in Model 4, students graduating from two IBDP schools still have significantly lower average final CGPAs than the reference school (#36).

This pattern of results suggests that the TDSB high school that an individual attended has at least modest relations with their university performance. While the dummy variables for schools alone explain only a small amount of variance (7.8%), IBDP graduates from two schools had significantly weaker performances than did peers from other IBDP schools, even after controlling for several important academic indicators. The results from Table 12 can be interpreted as suggesting that TDSB high schools that offer the IBDP vary somewhat in their capacity to prepare their graduates for success at UofT. These detected differences between IBDP schools could vanish if other important measures that vary between schools were entered into the models, such as student socioeconomic status or home language. However, Model 4 is quite powerful by social science standards, predicting over half the variance in the outcome measure, and thus obviously contains many key predictors of students'

final CGPA. In lieu of finding other such predictors, our results appear to detect important variations across high schools in their capacity to prepare their IBDP graduates to earn high grades in university.

Table 12: For IBDP graduates, final CGPAs (all courses) vary by IBDP high school, with controls for other potentially influential factors (UofT)

Independent variables	Model 1	Model 2	Model 3	Model 4
IBDP high school #36	Ref. cat.	Ref. cat.	Ref. cat.	Ref. cat.
IBDP high school #46	.119	.096	.055	.048
IBDP high school #52	-.182	.035	.099	.223
IBDP high school #54	-.673***	-.675***	.162	.233
IBDP high school #62	-.101	-.173	-.394***	-.315**
IBDP high school #67	-.229*	-.249*	-.184*	-.148
IBDP high school #103	-.625***	-.601***	-.560***	-.502***
Gender		.002	-.080	-.083
Year of entry to UofT		Included	Included	Included
Faculty on entry		Included	Included	Included
UofT admission average			.099***	.090***
Total credits earned				.046***
R-Squared	.078	.089	.444	.534
Sample size	487	485	424	424

Notes: Unstandardized regression coefficients. 'Year of entry' and 'Faculty on Entry' are both entered as a series of dummy variables and were included to account for possible CGPA differences across different Faculties and entry cohorts. * $p < .05$; ** $p < .01$; ***, $p < .001$. Schools that housed the TDSB's seven main IBDPs are entered as separate dummy variables, with one school serving as the reference category. School numbers are codes provided by TDSB for research purposes only and are not otherwise identifiable. Only graduates of IBDPs are included in the models.

A key message we take from Table 12 is:

- ✓ IBDP graduates from TDSB high schools that offer the IBDP vary somewhat in the final CGPAs at UofT, even controlling for their gender, prior grades, credits earned, Faculties upon entry, and year of entry.

b) Vancouver Analyses

The analyses presented below for UBC follow the spirit and logic of the UofT analyses. However, we caution again that the two universities use different definitions and measures of some key variables, such as student grades. The cases serve as separate, but complementary, research sites. We also highlight any substantial differences between the Toronto and Vancouver analyses.

In Table 13, we offer a first glimpse of how UBC admission averages differ by high school program. Based on averages from 'all courses used for admission', we show that IBDP graduates have higher admission averages than those for DW graduates (by 2.3%) and slightly higher than those for FI graduates (by 0.8%). A similar pattern emerges when using a slightly different indicator, English Grade 12 marks. Grades from this English 12 course are used, as one course component, in determining every student's admission average. IBDP graduates have averages in this high school course that are 3.4% higher than those of DW graduates, while FI English 12 averages are similar to those of IBDP graduates. These results suggest that, without any adjustments, IBDP graduates would be expected to attain higher university grades given their superior grades in high school. For this reason, we examined university outcomes in light of these differences in admission averages, as we did in the UofT analyses.

Table 13: IBDP graduates have the highest admission averages (UBC)

		High School Program		
University Admission		DW	FI	IBDP
Admission grades on entrance	All courses	$\bar{x}$ = 89.5 Std. Dev. = 5.13 *n* = 3,189	$\bar{x}$ = 91.0 Std. Dev. = 4.20 *n* = 1,137	$\bar{x}$ = 91.8 Std. Dev. = 4.38 *n* = 1,731
	English Grade 12	$\bar{x}$ = 83.7 Std. Dev. = 6.94 *n* = 3,198	$\bar{x}$ = 87.1 Std. Dev. = 5.40 *n* = 1,137	$\bar{x}$ = 87.1 Std. Dev. = 4.46 *n* = 1,731

Notes: $\bar{x}$ is a symbol for the arithmetic average; Std. Dev. = Standard Deviation; *n* = the cell counts (number of students) on which the arithmetic average is based. At UBC grades are reported on a 0-100% scale, not as GPAs as at UofT.

In Table 14 (next page), we see that high school graduates differ in the university programs which they enter: IBDP graduates are much more likely to enter Science (45.1%) and much less likely to pursue Arts (25.5%). The pattern of findings here is very much congruent with what we discovered with a similar UofT analysis (Table 5). The fact that students entered different Faculties at different rates complicates our analyses since UBC admission averages vary by Faculty, with different Faculties using different high school courses to compute averages necessary for admission.

Table 14: IBDP graduates gravitate to STEM fields, especially Science (in %, UBC)

	High School Program		
Degree Program on Entry	DW	FI	IBDP
Arts	36.9	39.6	25.5
Business / Commerce	8.3	8.3	9.4
Engineering	10.2	13.6	14.6
Forestry	5.1	0.0	0.0
Human Kinetics	4.8	4.7	1.9
Land & Food Systems	11.0	2.6	2.7
Science	22.9	30.6	45.1
Total (*n*)	100% (3,159)	100% (1,137)	100% (1,731)

A second indicator of different patterns of university entrance by high school pathway is provided in Table 15, which we use to compare admission averages for each Faculty. This allows us to see if the 2.3% higher average for IBDP graduates (on all courses) holds after accounting for differences in admission requirements across Faculties. We find that the initial 2.3% gap in admission average reported above is smaller in almost every Faculty, but nevertheless IBDP graduates have slightly higher averages than DW graduates in every case (it is about 1% or less in Business, Engineering, Human Kinetics, and Science; in Arts, the gap is 1.4%; and in Land and Food Systems, it is 2.3%).

Table 15: IBDP graduates have higher admission averages than do DW graduates, in all Faculties (UBC)

Upon University Entrance		**High School Program**		
Degree Program on Entry	Admission average (%)	DW (%)	FI (%)	IBDP (%)
Forestry	81.8	81.6	--	--
Land & Food Systems	88.1	87.8	89.0	90.1
Arts	88.3	87.8	88.6	89.2
Human Kinetics	90.2	89.7	91.2	90.8
Engineering / App. Sci.	92.4	92.1	92.3	92.7
Business / Commerce	92.5	92.2	92.8	92.9
Science	92.8	92.6	93.1	92.8

Notes: Admission averages are included only for DW graduates in Forestry since IBDP and FI students did not enter this Faculty. At least 10 cases are included in all cells (cell counts for this table can be calculated from Table 14). The same basic pattern repeats if English 12 grades are used in lieu of 'all courses.' App. Sci. = Applied Science.

Thus, two key messages follow from Tables 14 and 15:

- ✓ IBDP graduates have slightly higher admission averages than students from DW programs.
- ✓ Understanding these relations requires one to account for between-Faculty differences in admission averages when observing outcomes across the wider university, since those averages could have implications for later outcomes.

In Table 16, we examine a key university outcome, grades, to see how these vary by high school program. In the top three rows, we compare students average course grades i) at the end of their typical first year ("1st 30 credits of classes taken"); ii) those near the end of their graduation term ("1st 120 credits of classes taken"); and iii) those for all of their classes at UBC ("all classes taken").[22] As can be seen in the table, in all comparisons IBDP graduates have descriptively higher averages than DW and FI graduates, though the gaps are smaller for the later comparisons (i.e., IBDP v. FI).

Table 16: IBDP graduates earn higher university grades than do their peers from other high school pathways (UBC)

		High School Program		
University Outcomes		DW (%)	FI (%)	IBDP (%)
University average	1st 30 credits of classes taken	$\bar{x}$ = 73.2 Std. Dev. = 9.44 *n* = 2,783	$\bar{x}$ = 74.2 Std. Dev. = 9.18 *n* = 1,028	$\bar{x}$ = 76.9 Std. Dev. = 9.55 *n* = 1,582
	1st 120 credits of classes taken	$\bar{x}$ =75.7 Std. Dev. = 8.66 *n* = 462	$\bar{x}$ =77.1 Std. Dev. = 7.72 *n* = 166	$\bar{x}$ =77.2 Std. Dev. = 8.80 *n* = 266
	All classes taken	$\bar{x}$ = 73.4 Std. Dev. = 11.3 *n* = 3,198	$\bar{x}$ = 74.7 Std. Dev. = 9.93 *n* = 1,137	$\bar{x}$ = 77.3 Std. Dev. = 10.1 *n* = 1,731

Notes: Three credits are equivalent to a course taken over one academic term (e.g., September to December); $\bar{x}$ is a symbol for the arithmetic average; Std. Dev. = Standard Deviation; *n* = the cell counts (number of students) on which the arithmetic average is based. Cell counts drop for '120 credits' because of year of entrance (see text).

A key message from Table 16 is that:

- ✓ Using three different ways of measuring university course averages, IBDP graduates consistently achieved higher university averages than DW and FI graduates.

[22] At UBC, grades are reported on a percentage scale (0-100) where an 'A' grade is between 80% and 100%, a 'B' is between 67% and 79%, a 'C' ranges from 60% to 66%, a 'D' is from 50% to 59%, and an 'F' is below 50%.

The findings from Table 16 need to be qualified because each of these three measures offers advantages and disadvantages. The initial measure (first 30 credits) excludes students who stopped out or dropped out very early (and they would likely pull down the average grade) and offers only a truncated picture of students' university performance, perhaps not accurately capturing their performance over their entire career (similar to what we saw at UofT). The second measure offers a more complete picture of students' full university careers, though it serves to reduce the number of students included in the analysis, since it typically requires at least four years to achieve 120 credits, and since only students who started in 2012 to 2014 would typically attain all those credits. Finally, the third measure offers a more complete picture but is distorted by the number of credits taken by a student. The third measure captures the greatest number of students because it includes those who took very few courses (many of whom received low grades), therefore pulling their respective averages down, most noticeably among DW graduates. However, in combination, these three measures have compensatory strengths, and collectively paint a fuller picture suggesting that IBDP graduates attain consistently higher grades than their UBC peers who attended different high school programs.

Table 17: IBDP graduates have strong university outcomes: Less dropping out and switching Faculties, and better rates of graduation (UBC)

		High School Program		
University Outcomes		DW	FI	IBDP
Completion measures	Cohort			
% Leaving early[¥]	All students[†]	7.6	4.9	4.0
	2012 entrants	7.8	5.1	4.6
	2013 entrants	5.4	3.1	4.1
	2014 entrants	6.6	2.9	4.3
	2015 entrants	5.1	4.5	3.5
	2016 entrants	7.5	5.3	3.9
	2017 entrants	12.2	7.1	3.8
% Graduated within 4 years[‡]	2013 entrants	65.7	62.5	71.6
	2014 entrants	65.1	63.6	72.0
% Graduated within 6 years*				
	2013 entrants	83.0	85.9	87.8
% Graduated before 2020	2012 entrants	82.2	84.7	83.7
% Switching Faculties	All students	8.2	5.8	7.0

Notes: [¥]Leaving early is defined as having completed fewer than 30 credits of coursework at UBC;
[†]Only students entering UBC between 2012 and 2017 are included.
[‡]Only students entering UBC between 2012 and 2014 are included in 'Graduated within 4 years'
*Only students entering UBC between 2012 and 2013 are included in 'Graduated within 6 years'

In Table 17 (above), we examine other outcomes among students who entered UBC between 2012 and 2017, namely measures of leaving early (failing to complete at least 30 credits of course work), switching Faculties after entry, and graduation rates. From the first data row of Table 17, we can see that 7.6% of DW graduates left university early, compared to only 4.0% of IBDP graduates. Looking across entry cohorts, the basic pattern holds: in all comparisons, fewer IBDP graduates than DW graduates left earlier. While leaving early does not necessarily constitute dropping out of university – students might later re-enter UBC or switch to another university – an unknown percentage of those students are very likely permanent dropouts.

The headline messages from Table 17 are that:

- ✓ IBDP graduates are less likely to leave UBC for any reason than are graduates of DW or FI.
- ✓ IBDP graduates are more likely to complete their UBC degrees in a timely manner and are less likely to leave UBC early in their higher education careers than are graduates from DW and FI programs.

Graduation rates present a more complicated story, since some students, especially in the earlier cohorts, could enter professional programs at UBC if they had outstanding undergraduate grades (this has changed recently: most UBC professional programs, such as Law or Medicine, now feature requirements that typically mandate an undergraduate degree). By this measure, IBDP graduates fare better than DW graduates across all graduation markers (i.e., within four years, within six years, or prior to 2020). From Table 17, we can also see the percentage of UBC entrants who switch to a different Faculty between university entrance and graduation. About 10% of all students switch Faculties, and that statistic is about the same for DW and IBDP graduates.

Students' academic average, calculated as a percentage grade at UBC (see footnote 19), is another key outcome. In Table 18 (next page), we display results from a series of OLS regressions. The dependent variable is students' average grades from all their courses completed at UBC. As with a similar analysis for UofT, we use a series of models to examine how different combinations of **independent variables** associate with the average grades that students attain in their university coursework. In Model 1, we asked whether student university averages differ by the high school program which they followed with DW graduates as the **reference category**. The coefficient of 3.98 for IBDP graduates suggests that their grades are 3.98 percentage points higher on average than those of DW graduates, and 2.63 percentage points higher than those of FI graduates.[23] Because we know a variety of other factors can influence academic averages, not just high school program, we added gender, year of entry, and total credits earned in Model 2. As noted previously for UofT, and is true at UBC too, gender is important because women typically attain higher university grades than do men and are more likely to come from FI programs (64% of FI graduates were female at UBC, while DW and IBDP graduates were each 55% female). We included year of entry to account for any possible grade inflation at UBC between 2012 to 2018. Finally, since students who complete few credits often leave

[23] The latter is calculated by subtracting the FI coefficient of 1.35 from 3.98, the IBDP coefficient.

due to poor grades, and since students attain higher grades in more senior courses, we added a measure of total credits earned. The results in Model 2 show that after taking account of these factors, IBDP graduates continued to fare better than DW and FI high school graduates, although the former gap shrinks from 3.98 percentage points to 2.59 percentage points.

Table 18: IBDP graduates have higher final academic averages (all courses) than their peers, with controls for other potentially influential factors (UBC)

Independent variables	Model 1	Model 2	Model 3	Model 4
DW graduates	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
IBDP graduates	3.98***	2.59***	1.71***	1.14***
FI graduate	1.35***	.35	-.04	-.51
Gender (female)		1.28***	.90***	.44
Total UBC credits earned		0.18***	0.18***	0.17***
Year of entry to UBC		Included	Included	Included
Student-loan status			2.45***	1.53***
UBC admission average				0.89***
Faculty on entry			Included	Included
R-Squared	0.025	0.241	0.278	0.385
Sample size	6,026	6,026	6,026	6,026

Notes: Cells contain unstandardized regression coefficients. 'Year of entry' is measured as 2012 = 0 up to 2018 = 6; Ref. Cat. = Reference Category; 'Faculty on Entry' includes measures to account for the different Faculties students first entered; Statistical significance – * $p < .05$; ** $p < .01$; *** $p < .001$.

In Model 3, we added further complexity, and following the UofT analyses, in part, included other measures that may be related to student averages. Here, we added the Faculty a student first entered and their government or **student-loan status**, the latter being a measure unique to the Vancouver case. In this model, the gap between IBDP and DW graduates again declined, from 2.59 percentage points to 1.71 percentage points, likely because averages differ across Faculties, and IB and DW graduates tend to differ in the Faculties they enter (Table 14), and because student-loan status likely approximates differences in students' socioeconomic backgrounds. Finally, we added students' high school averages in Model 4. Recall that in Table 13 we found that IBDP graduates had slightly higher admission averages than did DW graduates; that difference could moderate the association between IBDPs and academic success at UBC. In Model 4, we found that the gap between IBDP and DW graduates indeed shrank to 1.14 percentage points.[24] Thus, this final model boosts our confidence that a significant gap between IBDP and DW graduates persists across a series of model specifications.

[24] Students from higher socioeconomic backgrounds typically achieve higher grades in elementary and secondary school (Davies & Guppy, 2018). The inclusion of admission averages is, therefore, another control for socioeconomic status because the effect of the latter on grades is included when examining university grades (i.e., socioeconomic status affects high school grades and this is now controlled in this model, as is student-loan status). Of course, socioeconomic status could theoretically affect high school grades and also boost university grades net of high school achievement, but this is unlikely, and would probably have a minimal effect at most (see Chow &

We conducted a further robustness check by examining students' early grades at UBC, modeling their averages attained in their first 30 credits of coursework (note this model eliminates students who may have dropped out prior to completing 30 credits, shrinking the pool from 6,026 (see Table 18) to 5,353 students (see Table 19)). This outcome provides an even stronger test of IBDP advantage because it eliminates less-prepared students (most of whom were DW graduates), and thus raises the mean grade average among DW students more than among IBDP students, as shown in Table 16. In Table 19, the basic patterns tell us that the key message from the previous table repeats: over their first 30 credits of coursework, IBDP graduates typically attain an average grade that is 1.45% higher than that attained by DW graduates, controlling for a variety of factors, including their average high school grades and the Faculty in which they were enrolled.

The key message from Tables 18 and 19 are that:

- ✓ IBDP graduates attain higher academic averages at UBC than do their peers from the DW and FI high school programs, even after adjusting for an array of factors, including university admission average.

Table 19: IBDP graduates have higher academic averages across their first-year courses than their peers, with controls for other potentially influential factors (UBC)

Independent variables	Model 1	Model 2	Model 3	Model 4
DW graduates	Ref. Cat.	Ref. Cat.	Ref. Cat.	Ref. Cat.
IBDP graduates	3.70***	3.67***	1.99***	1.45***
FI graduates	1.00**	.85*	.01	-.61*
Gender (female)		.10	.60*	.07
Year of entry to UBC		Included	Included	Included
Student-loan status			2.00***	0.94***
UBC admission average				1.02***
Faculty on entry			Included	Included
R-Squared	0.028	0.037	0.110	0.293
Sample size	5,353	5,353	5,353	5,353

Notes: Unstandardized regression coefficients. Ref. Cat. = Reference Category; 'Year of entry' is measured as 2012 = 0 up to 2018 = 6; 'Faculty on Entry' includes measures to account for the different Faculties students first entered; Statistical significance – * $p < .05$; ** $p < .01$; *** $p < .001$.The measure of total credits used in Table 18 is a constant here (30 credits), so it is not included.

Guppy, 2021). As we noted earlier, and discuss further below, controlling for admission average also controls for the very qualities that the secondary school IBDP is designed to develop (e.g., academic skills).

Another important outcome is whether students choose to study abroad, known colloquially at UBC as enrolling in 'student exchange' programs (so named because of reciprocity agreements with other institutions to exchange students). Because students are not typically permitted to enter those programs until their third year, Table 20 includes only students who entered UBC between 2012 and 2016. In a typical year, just over 13% of UBC students go on international study abroad exchanges, and IBDP graduates fit this pattern perfectly. Indeed, there is no statistically significant differences by students' high school program, even after adjusting for year of entry, Faculty, or student-loan status.

Table 20: IBDP students enroll in international study abroad exchange programs at rates similar to their peers (in %, UBC)

	High School Program		
Enrolled in study abroad opportunity (%)	DW	FI	IBDP
Yes	12.1	16.0	13.5
No	87.9	84.0	86.5
Totals	100% (*n* = 2,205)	100% (*n* = 726)	100% (*n* = 1,233)

Chi square = 7.46, not statistically significantly different ($p > .01$); (Only students entering UBC between 2012 and 2016 are included, given restrictions on studying abroad for first- and second-year students). *n* = the number of students from each high school program.

A key message from Table 20 is that:

- ✓ IBDP graduates pursue opportunities to study abroad at rates comparable to their peers in DW and FI high school programs.

UBC students can also enroll in co-operative education programs where they can gain professional workplace experience by alternating between academic terms and paid, full-time work placements. Just over one-quarter of UBC undergraduates in our dataset pursue that option, though they can do so only after completing their second year of formal coursework. In Table 21 (next page), we again restrict the pool of students to those who entered UBC between 2012 and 2016. Here we examine whether IBDP graduates are significantly more likely to opt for co-operative education programs than were students with either DW or FI diplomas. While participation in co-operative education programs varies significantly by Faculty, a higher proportion of IBDP students chose this route in all Faculties.

Table 21: IBDP graduates enroll in co-operative education programs more frequently than their peers (in %, UBC)

	High School Program		
Enrolled in co-operative education (%)	DW	FI	IBDP
Yes	23.5	28.4	37.3
No	76.5	71.6	62.7
Totals	100% (*n* = 2,205)	100% (*n* = 726)	100% (*n* = 1,233)

Chi square = 73.65, $p < .001$ (Only students entering UBC between 2012 and 2016 are included, given restrictions on entering co-operative education programs). *n* = the number of students from each high school program.

A key message from Table 21 is that:

- ✓ IBDP graduates enroll in co-operative education programs at rates exceeding their peers from DW and FI high school programs.

Finally, as we did with the UofT analyses, we examined variations *among* IBDP graduates in their university academic trajectories, focusing on differences in university outcomes across secondary schools. This analysis uses data from 1,731 IBDP graduates who attended one of the 21 schools in the GVRD that offer the IBDP. For the analyses reported in Table 22 (next page), we used measures similar to those listed in Table 18, but we added dummy variables for six high schools (unnamed and unknown to the researchers) that each graduated more than 100 IB students between 2012 and 2018. In Table 22, we then contrast the university academic performance of graduates from these six schools versus those from smaller IBDP schools. The school an IBDP graduate attended turns out to be at least moderately related to university performance. Three of the six IBDP dummy variables are statistically significant, implying that some of the variance in student university performance is associated with the IBDP high schools that they attended. However, the addition of those school indicators explains only a small amount of additional variance (*R*-Squared change = .022) across Models 2 and 3. Graduates from three schools performed better than their other IBDP peers, after controlling for the UBC admission average graduates possessed (Model 4).

Table 22: IBDP graduates only: final university averages vary by IBDP high school, with controls for other potentially influential factors (UBC)

Independent Variables	Model 1	Model 2	Model 3	Model 4
Gender (female)	ns	ns	ns	ns
Total credits earned	0.15***	0.15***	0.15***	0.15***
Student-loan status	2.68***	2.42***	2.27***	1.27***
Year of entry to UBC	Included	Included	Included	Included
IBDP high schools (small)			Ref. cat.	Ref. cat.
IBDP high school 1			-.27	-.41
IBDP high school 2			-.36	-1.05
IBDP high school 3			-.08	1.13
IBDP high school 4			1.13	1.54*
IBDP high school 5			2.04**	2.29***
IBDP high school 6			3.59***	4.16***
UBC admission average				0.96***
Faculty on entry		Included	Included	Included
R-Squared	0.163	0.198	0.220	0.363
Sample size	1,731	1,731	1,731	1,731

Notes: Unstandardized regression coefficients. 'Year of entry' is measured as 2012 = 0 up to 2018 = 6; 'Faculty on entry' includes measures to account for the different Faculties students first entered; Statistical significance – * $p < .05$; ** $p < .01$; *** $p < .001$.The six largest IBDPs are entered as separate dummy variables, with students from the other 15 programs acting as the reference category to represent high schools with smaller IBDP student populations.

A key message from Table 22 is that:

- ✓ IBDP graduates from GVRD high schools that offer the IBDP vary somewhat in the final course averages at UBC, even controlling for their gender, prior grades, credits earned, Faculties upon entry, and year of entry.

c) Comparing UofT and UBC to Canada-wide Outcomes

In this section, we offer a brief comparison of our findings to Canada-wide benchmarks for two university outcomes: entry into STEM fields and graduation rates. We could not find any reliable studies of university grades or GPAs across universities against which to make similar comparisons. We emphasize the term 'brief' in order not to mislead readers into thinking that the benchmarks reported below offer clear, transparent, and reliable comparisons to our own findings. Because we are relying below only on secondary literature, we note that some of the reported statistics likely use different

definitions and measures of the phenomena in question. They are, nevertheless, the best available benchmarks.

First, IBDP graduates at UofT and UBC appear to enter STEM fields at markedly higher rates than do typical Canadian undergraduates. Whereas more than 60% of IBDP graduates in both UofT and UBC samples entered Science and Engineering fields, data from the Postsecondary Student Information System, which Statistics Canada organizes, show that only 22% of Canadian bachelor's graduates overall in 2018 were in STEM fields (CMEC, 2018). Exact definitions of STEM likely differ, however.

Second, in terms of graduation rates, IBDP graduates at UofT and UBC appear to greatly exceed Canadian benchmarks. Statistics Canada (2018) reports that 40% of Canadian undergraduates overall complete their bachelor's degrees within 4 years, while the corresponding figures across our various UofT and UBC entry cohorts of IBDP graduates ranged from 64-84%. Statistics Canada further reports that 74% of Canadian undergraduates overall complete their bachelor's degrees within 6 years, while the corresponding figures across our IBDP cohorts ranged from 81-91%.

Thus, our cursory search for Canada-wide benchmarks lead us to conclude that IBDP graduates at UofT and UBC are exceptional in comparison to their undergraduate peers at other Canadian universities. Their rates of entering and graduating from broadly defined STEM fields are considerably higher than the Canadian average, almost tripling those reported by Statistics Canada. Moreover, their 4-year graduation rates are also far superior to the Canadian average reported by Statistics Canada, though that gap is markedly smaller when looking at 6-year graduation rates.[25] Nevertheless, these two comparisons suggest that IBDP graduates who enter both UofT and UBC are far more STEM-oriented and prone to complete their degrees in timely fashions than are their Canadian peers.

Summary and Conclusions

Overall, our results from Toronto and Vancouver offer several consistent answers to our main research question: Does students' high school program influence their eventual university outcomes in Toronto and Vancouver? The answer is yes: compared to graduates with traditional high school diplomas (OSSD in Toronto or DW in Vancouver), IBDP graduates had significantly better university grades (either as GPAs at UofT or percentage averages at UBC). On other measures, the findings were also generally positive, although sometimes with variations between our two urban cases. Rates of graduation were higher for IBDP graduates than others at UofT and similar at UBC. At UBC, where we had additional measures, IBDP graduates were more likely to enroll in co-operative education programs but no more likely than DW students to participate in international study abroad exchanges. At UofT, we used a measure of winning merit awards, finding IBDP graduates to earn more. In both cases, IBDP graduates showed a greater likelihood of enrolling in Science and Engineering programs as opposed to the Arts streams and were much less likely to enter alternative Faculties (e.g., Forestry, Human Kinetics). Furthermore, many IBDP advantages held after we controlled for an array of additional factors. And cursory comparisons of our findings to national data suggest that IBDP graduates at UofT and UBC are exceptional among Canadian undergraduates.

[25] Graduating in four years, rather than taking longer, reduces both the cost of university attendance (i.e., by not paying for additional years) and the lost earnings that accrue from a delayed labor-market entry.

We take the sum of these results as indicating that IBDPs tend to associate with increased performance of graduates over their peers from traditional high school programs across several university outcomes. We also note that IBDP graduates fared well in comparison to students from another enriched high school program that is popular in English-speaking Canada: FI. On most measures, IBDP and FI students performed similarly, though often in different Faculties, with IBDP graduates being likelier to enter and graduate from Science and Engineering fields, and FI graduates being likelier to enter and graduate from Arts fields. We conclude that high school program pathways to university indeed matter.

Policy Recommendations

In the next two sections, we address what we see as the implications of our findings for both IBDP practice and for future research on the IBDP. We begin with four policy implications for practice and follow this with four recommendations to consider for future research.

Recommendations for Practice

In this section, we highlight possible policy implications for practice, focusing on ideas that follow from four major findings. See Table 23 for a summary.

Table 23: Summary of policy recommendations for practice

Finding	Context	Significance/Implication	Policy Option
IBDP graduates have exceptional success at UofT and UBC.	Other students greatly vary in that success, with many having considerable rates of attrition.	IBDP appears to offer great preparation for university.	Promote this fact among range of stakeholders.
University success rates vary among IBDP high schools.	IBDP schools vary in the ability of their graduates to do well at the two universities in our study.	IBDP is selective, striving for a standardized curriculum at all schools.	Promote communities of practice among IBDP educators, sharing promising practices.
IBDP graduates are significantly more likely to enter STEM fields.	Public policy makers commonly encourage students to enter STEM fields.	IBDPs encourage students to enter both arts and science.	Ensure IBDP graduates are counselled on a range of academic options in Canadian universities.
For the most part, IBDP and FI graduates form distinct, non-overlapping student pools.	FI is a popular and competitive option for Canadian families seeking enriched programming.	Far more primary level students enter FI programs than IB programs.	Further promote IB programs in the primary and middle years in Canada.

1) **Finding of Exceptional Achievement at Universities: Recognize Success of IBDP Graduates in Higher Education**

Finding: IBDP graduates had better outcomes at UofT and UBC in comparison to their Toronto and Vancouver public school peers and compared to Canada-wide benchmarks. This level of success is particularly impressive considering that UofT and UBC are highly competitive institutions, among Canada's top-ranked universities. Thus, IBDP graduates' levels of success implies that these students are good recruits for Canadian universities.

Context: Higher education administrators seek to recruit students they believe can thrive at their institutions and can earn high grades and graduate at high rates. Many administrators, particularly in selective institutions, are wary of high attrition rates among their students, and strive to recruit students who will fit well with the institution whenever possible. Not only do they, and other policy makers, want successful university graduates who will earn good salaries, but they all seek to promote individuals who can also contribute more broadly to their communities, enhancing innovation, networks, and enrichment.

Recommendation for Practice: Various stakeholders in the IB community should reinforce this finding to families when recruiting students, and also to school, Board, university, and Ministry officials when promoting IB programs.

2) **Variable University Outcomes among Graduates from Different IBDP High Schools**: **Promote Discussions of Promising Practices in Communities of Practice**

Finding: In both cities, university outcomes varied significantly by students' previous high school. That variation was significant even in models that contained a series of control variables. We are unsure why university outcomes vary among graduates from different IB high schools in Toronto and Vancouver.

Context: All schools and programs have some variations in their graduates' outcomes. However, within that context, IBDPs have two features that warrant attention. First, they are highly selective, drawing from pools of already-accomplished and highly motivated students. Second, IBDP makes use of standardized assessments to evaluate students, which provides some standardization across the program. Both of those factors should, all other things being equal, somewhat constrain variation in student outcomes at university.

Recommendation for Practice: IB educators should form or strengthen communities of practice in which they can share experiences and challenges and can promote promising practices oriented to program improvement.

3) **Rates of Success among FI Graduates: Promote more enrolments in IB's Primary Years and Middle Years Programs**

Findings: Graduates of high school FI programs also had very good university outcomes, sometimes matching those of IBDP graduates. Further, the numbers of IBDP and FI graduates were comparable in both UofT and UBC samples. At UofT, FI graduates outnumbered IB graduates by 10%, while at UBC IB graduates were 30% more prevalent. While our samples were not necessarily representative of all high school graduates in these programs, IBDP and FI appear to be similarly sized populations at UofT and UBC from enriched high school programs, and so thus offer informative comparisons.

Contexts: While the sizes and outcomes of IBDP and FI graduates were comparable at UofT and UBC, the 'pipelines' by which they enter Canadian universities are markedly different. Far more Canadian IB students enroll initially via high school as opposed to enrolment at the primary level, while the reverse is true for FI. Only one-third as many public elementary schools offer IB compared to public high schools, 57 to 149 (figures obtained at IB website). In 2021, there were 11,748 IBDP candidates in Canada (https://www.ibo.org/globalassets/programme-information/dp/diploma-programme-final-statistical-bulletin-may-2021-assessment-session.pdf). Assuming similar ratios of number of students and programs, there are likely 4,500 Canadian public-school students enrolled in IB's Primary Years Programs. In contrast, FI enrolments are very large in the primary grades, but are smaller at senior high school levels. In 2020, almost 48,000 Grade 1 students in Canadian English language schools were in FI compared to 14,688 students in Grade 12 (calculations by authors from www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3710000901). In other words, FI enrolments are 10 times greater than IB enrolments at the primary level but shrink to 30% of that size by Grade 12, though remaining larger than IBDP enrolments.

When our findings from this report are seen in combination with these enrolment patterns, the popularity of FI appears to signal a sizeable appetite among Canadians for enriched programming at the primary level. IB may wish to attempt to meet more of that appetite. Arguably, IBDP is very well-known at the high school level, but IB programming appears to be less known at the primary level. If true, FI appears to get a 'head start' in their recruiting in the early grades.

Recommendation for Practice: IB may wish to further promote its Primary Years and Middle Years Programs in Canada, since the popularity of FI appears to signal a sizeable demand for enriched programs in the early grades.

4) **Finding of High Rates of STEM Participation: Ensure Broad Counselling about Academic Options**

Finding: In both UofT and UBC, IBDP graduates entered and graduated from STEM fields at rates that were significantly higher than those of a range of peers – compared to others from their local school boards, and other universities across Canada. Those rates are also markedly higher than those for graduates of FI, an otherwise comparable enriched high school program. Indeed, our findings

imply that among students from enriched high school programs, those that are more Arts-oriented graduate from FI and those more Science-oriented graduate from IBDPs.

Context: The concentration of IBDP graduates in STEM is laudable. Policy makers commonly encourage all students, particularly top-performers, to enroll in STEM fields. Nonetheless, IB also encourages students to appreciate the arts and well-rounded educations. High rates of IBDP graduates entering STEM fields is great as long as those graduates were fully aware of their full range of academic options. The core IBDP curriculum prompts students to take a Science as one or two of its six coursework areas, providing a broad base for students to pursue further study of various kinds at university.

Recommendation for Practice: IB educators should ensure that their students receive sufficient counselling on the full range of academic options, including STEM, Arts, and other fields, when students apply to university.

Recommendations for Future Research

Despite ever-greater curricular choice in modern public high school systems, very few studies have examined the consequences of differentiated secondary school pathways on later outcomes, at least in Canada. Our study followed tens of thousands of students from secondary school through to university completion and inspected whether their high school program selection mattered for their longer-term educational success. Its results inform the following considerations for future research on IBDP students.

1) **Develop a Program of Research on IBDP Graduate Outcomes**

As data-linking initiatives become increasingly practical and prevalent in educational research, we recommend that IBDP embark on a research program aimed at following their graduates over lengthy periods of time. One method of doing this is to link administrative databases, as we have done for the current project. A key advantage of this research design is that it permits strong comparisons of IBDP graduates with students in other high school streams, where measures on key variables come from the same database for all students. Another method would be for IBDP officials to retain contact information of their graduates and use that information to conduct periodic surveys, perhaps probing their graduates' satisfaction with their programs, along with various life outcomes.

2) **Develop Value-Added Measures of IBDPs**

Although we found that IBDP graduates clearly outperformed their peers from traditional high school programs across a range of university outcomes, exactly why this occurs is less clear. That is, it is possible that IBDPs are not 'adding value' in the sense of boosting their students' later performance above and beyond what would be predicted from their performance in high school. Our models that included measures of high school grades tended to find either small but statistically significant differences (UBC), or differences that were negligible and non-significant (UofT). However, that procedure has a limitation. If IBDPs did indeed raise students' skills in high school, and if those boosted

skills also raised their high school grades, adding high school grades as a control variable could 'downwardly bias' or artificially lower estimates of the true impacts of the IBDPs in these models. One solution to this **endogeneity** problem is to add variables that measure student performance *before* they entered IBDPs, allowing examination of whether IBDPs raised skill levels beyond that baseline. We recommend that IBDP commission studies that contain measures of student skills before entering IBDPs.

3) **Compare IBDP Graduates to Graduates from other Enriched High School Programs**:

We observed that graduates from IBDP and FI programs often performed similarly while also going into different fields of study at university. We recommend further research that compares IBDP and graduates of other enriched high school programs, such as Advanced Placement or various schools of choice that specialize in STEM, sports, or the arts. Future research could provide illuminating profiles of IBDP graduates by comparing them to graduates of other enriched programs along an array of variables, including their demographics, schools attended, attitudes, and university outcomes. Such research could help IBDP further enrich the profiles of their students, placing them in context with students from other special programs, and using those profiles to deepen understandings of students' backgrounds, proclivities, preferences, and subsequent academic niches.

4) **Understand Variations Between IBDP Schools**

Both Toronto and Vancouver studies detected variations in university outcomes between IBDP schools. We did not anticipate that finding. Such variations do not necessarily imply that some programs are underperforming relative to others. But if this finding is indeed robust (i.e., that it would be likely found in studies from other cities, not just in Toronto and Vancouver), it does highlight a need for IBDP to understand why university outcomes might vary significantly between schools within the same city. But it is possible, for instance, that any detected variations in outcomes between IBDP schools are artefacts of the limitations of our study, such as omitted variable bias, uncontrolled selection biases that vary between individual schools, and peculiarities of our city settings that may not exist elsewhere. While our study does more to control for selection bias than do most, future research could address whether IBDP schools vary importantly along various dimensions, including the selectivity of student enrollments, neighborhood settings, size, and their capacities to 'add value' to their student outcomes.

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Appendix 1: Author Biographies

Professor Scott Davies: Overall Project Lead and Toronto Lead

He is Canada Research Chair in Data, Equity and Policy in Education, and Professor of Education Policy and Leadership at the University of Toronto. His specialty is Sociology of Education. Dr. Davies has decades of experience analyzing longitudinal student achievement data and has partnered with a variety of organizations, including TDSB, Ontario's Ministry of Education, and Ontario's Council for Articulation and Transfer, on projects examining the impact of summer learning on achievement gaps, varieties of educational organizations, and trajectories of student achievement over several years. He operates a research lab at UofT that houses a wide variety of education data and is becoming a hub for policy-relevant research in the Toronto area. As overall lead for the current project, he coordinated activities among three participating institutions (UofT, UBC, TDSB), obtained Research Ethics Board approval from UofT, and modified an existing legal agreement for data sharing between UofT and TDSB. Davies and Guppy have collaborated on research projects and co-authored publications for more than 25 years.

Professor Neil Guppy: Vancouver Lead

He is Professor of Sociology (emeritus) at the University of British Columbia. He was Associate Dean (Students) from 1996 to 1999, Associate Vice-President (Academic Programs) from 1999 to 2004, and the Head of the Department of Sociology from 2006 to 2013. At UBC, he has received both a University Killam Teaching Prize and a University Killam Research Prize. He has been a member of the UBC Faculty Pension Plan Board of Trustees, the Board of UBC Press, a Senior Advisor to the Provosts on Academic Freedom, and the Acting Principal of Vantage College (at UBC). He has published extensively in the area of the sociology of education and education policy, including with Scott Davies, *The Schooled Society* (2018, 4th edition). As Vancouver lead, he received Research Ethics Board approval from UBC, merged student admission data from UBC with university data on individual student programs and performance, analyzed Vancouver data, and co-authored this report.

Appendix 2: Notes on Secondary Schools and UBC admission processes

a) IBDP and FI Schools:

The vast majority of Toronto IBDP students attended the following seven TDSB high schools: Monarch Park Collegiate Institute, Parkdale Collegiate Institute, Sir Wilfrid Laurier Collegiate Institute, Victoria Park Collegiate Institute, Weston Collegiate Institute, AY Jackson Secondary School and Vaughn Road Academy. Note that Vaughn Road Academy closed in 2017 and A.Y. Jackson Secondary School now offers Advanced Placement programs instead of the IBDP. The vast bulk of FI students attended one of these 10 TDSB high schools: Agincourt Collegiate Institute, Cedarbrae Collegiate Institute, Harbord Collegiate Institute, Humberside Collegiate Institute, Lawrence Park Collegiate Institute, Leaside High School, Malvern Collegiate Institute, Newtonbrook Secondary School, Richview Collegiate Institute, York Mills Collegiate Institute. The majority of identified Vancouver IBDP students attended the following secondary schools: Sir Winston Churchill, Britannia Community, Carson Graham, Johnston Heights, New Westminster, Richmond, Seaquam, West Vancouver, and King George. FI students came from a variety of secondary schools, including, for example, Sir Winston Churchill, Kitsilano Secondary, and Vancouver Technology Secondary.

b) UBC Admission Processes:

For admission, all Faculties require English 12; other required courses, and their number, vary by Faculty and change over time. For instance, the Science Faculty in 2018 might have required English 12, Pre-Calculus 12, and one of Biology 12, Chemistry 12, or Physics 12, and one other Grade 12 course for general admission, whereas the Arts Faculty might have required English 12, a Grade 12 Social Studies course (e.g., History or Geography), and two other Grade 12 courses. This example comparison illustrates that different Faculties require different courses for admission and that those requirements can vary somewhat year by year. Furthermore, admission average cutoffs are calculated from courses required in each Faculty and also vary by Faculty and year. So, admission averages needed to enter Science or Arts will differ and can change from year to year.

Comparing students' averages across their UBC courses is also complicated for a host of reasons. First, very few students take exactly the same combination of courses in exactly the same sequence and in exactly the same terms, which muddies comparisons. Second, while grades do not vary too much by Faculty, there is some difference and hence there is always a risk of comparing apples with oranges (or at least Galas with Ambrosias!). Third, some courses occur over a single academic term, while others continue into a second term (the latter more common in 2012 than in 2018). Thus, course duration needs to be included when calculating averages. Fourth, IBDP courses taken in high school will be granted university credit if a student specifically asks for this credit, and provided that an IBDP grade of at least 5 on a 7-point scale is achieved (many students with qualifying IBDP grades still opt to take the equivalent university course, especially if they believe doing so will raise their averages). For these reasons, we calculated multiple averages to present a full, detailed, and comprehensive assessment of student performance.

Both GVRD high schools and UBC use a percentage grade scale with 50% representing a passing grade in almost all cases. UBC considers a grade of 80% or better to be in the 'A' range. We report all high school and UBC grades on a percentage scale. One complication is that IBDP students receive grades on a 7-point scale, with 7 being highest. UBC converts these courses into an equivalent percentage grade to ensure that all entering students are assessed on a comparative scale.

Nomenclature is also important to fully understand university processes. UBC uses a system of credit hours to determine the weighted value of each course. In short, a typical class will run for one academic term (i.e., September to December). Most often, a student will attend class for three hours in each of 13 weeks. These classes are counted as contributing three credits to the full-credit load UBC requires of students for graduation. In many programs, graduation occurs once students achieve 120 credits from appropriate courses, although in some programs this number is larger (e.g., in Engineering, it is typically 132).

Appendix 3: Acronyms and Glossary of Terms

Acronyms — **1st Page Occurrence**

CGPA: Cumulative grade-point average 5

DW: Dogwood Diploma or British Columbia Certificate of Graduation (secondary school) 5

FI: French Immersion high school program 5

GPA: Grade point average 11

GVRD: Greater Vancouver Regional District 5

IBDP: International Baccalaureate Diploma Program 5

OEN: Ontario Education Number 15

OLS: ordinary least squares regression 22

OSSD: Ontario Secondary School Diploma 5

PISA: Program for International Student Assessment 10

STEM: Science, Technology, Engineering, and Mathematics 7

TDSB: Toronto District School Board 5

UBC: The University of British Columbia 5

UofT: The University of Toronto 5

VSB: Vancouver School Board 5

Definitions of Terms

Admission average: Calculated from the relevant high school grades used by either UofT or UBC to determine whether a specific student was admissible. The precise calculation of the admission average varied by both university and the Faculty into which a student was admitted. For example, Applied Science or Engineering requires Physics at both institutions, but this course would not necessarily be used to calculate an admission average for students entering Arts (and 'not necessarily' because it could be used as an elective course for admission in some cases).

Bivariate statistics: measures that examine the relation or association between two variables; distinguished from Multivariable Statistics.

Chi square: a statistical measure that compares an observed distribution with an expected distribution (e.g., where no differences occur), and tests whether the two distributions are likely or not due to chance (i.e., random) differences.

Confidence / Confidence Levels: level of trust, based on probabilities, that one can have in a particular statistical result. For example, a confidence level of 95% means that one can comfortably expect that if one repeated an analysis twenty times, results would be similar at least 19 times. All random probability samples, as used in this report, are subject to uncertainty since the results come from samples as opposed to entire populations.

Confounders: additional factors or variables that may distort or complicate the understanding of relations or associations between variables.

Continuous quantitative variable: measure of a variable or indicator that can take on a range of values within a given interval (e.g., a percentage grade is continuous between 0 and 100 whereas passing or failing is a binary measure of 0 (fail) or 1 (pass)).

Co-operative education programs: **o**ptional programs at the university level that combine academic study with periods of paid employment, where the latter is linked in structured ways with a student's field of study.

Cumulative grade-point average (CPGA): The grade-point average (GPA) that a student has accumulated over a range of courses in their academic studies at the UofT (i.e., it is a summation of all grades a student has attained in completed courses). We used two different measures of CGPA, one that considers only typical first year courses and one that considers all the courses a student ever completed at the UofT.

Dependent variable: variables that, as the name implies, depend upon, or are assumed to be influenced by, other variables. A variable is defined as dependent based on the logic or rationale for a particular analysis. For example, winning university merit awards depends, at least in part, on academic grades. Merit awards is the dependent variable, and the winning of such awards is thought to be influenced by academic grades, which in this example serve as an independent variable.

Descriptive analyses: provide information about a variable or a relation between variables without trying to account, or test, for an explanation as to why a particular relation may occur.

Difference-in-difference: quasi-experimental research design that attempts to replicate the effect of treatment versus control groups in non-experimental, observational studies.

Dummy variables: binary or dichotomous variable, often indicating a categorical measure (e.g., attended or not attended) that takes on one of two values, either a 0 or a 1. This approach makes interpretation of results clearer.

Effect size: measure of the strength or likely influence of one variable on another. Some relations may be statistically significant (i.e., not likely to be due to chance) but nevertheless relatively minor in terms of influence or strength (especially if the sample size is large). Effect size allows researchers to distinguish between statistical significance and practical significance.

Endogeneity: Any estimates of *causal* effects of variables on outcomes need to go beyond their associations or correlations and also account for impacts of relevant observed or unobserved variables. If relevant variables are not included properly in statistical models, they will generate causal estimates that will be 'biased' and artificially too large or small. For example, models that use graduates' high school grades to predict their grades later in university could inflate the former's actual impact if those models omit factors such as intelligence, learned skills and abilities, effort and so forth. Endogeneity represents a particular form of bias. Endogenous comes from the Greek for 'produced from within.' Conceptually, endogeneity speaks to ways causation is theorized to operate in the world, and is used to inform statistical models aimed at corresponding to those theories. For instance, one might believe that high school grades are partial products of high school programs, since programs themselves teach the very kinds of skills and abilities that could later boost university grades. Given that theory, it would be unwise to estimate causal effects of a high school program on a university outcome while also controlling for high school grades, since the coefficient for that control variable could capture part of the program effect, and thus would bias that latter estimate downwards (i.e., make that coefficient artificially smaller than it should be). We do not discuss the issue of endogeneity and causation at length in this report because our data are observational rather than experimental, and because our datasets lack the kinds of variables needed to fully account for endogeneity in our models.

Faculties: organizational units within the university that aggregate like-minded fields of study or disciplines (e.g., Science – Biology, Chemistry, Physics, etc.).

Field of study: specialized programs of academic study that focus upon discrete areas of scholarly interest (e.g., English, Physics).

Grade-point average (GPA): grade assigned to a student for a particular course that a student passed or failed at the UofT, where a four-point (0-4) scale is used for student assessment in most individual courses. When summed over a range of courses, this leads to the cumulative grade point average (CGPA).

Independent variable: variables that are assumed to influence other variables, but, at least in the scope of a specific investigation, are treated as though they do not themselves depend upon any other study variables. Typically, researchers wish to study the effects independent variables have on dependent variables.

International study abroad exchange programs: opportunities for university students to study at a foreign university for a prescribed period of time (typically between four months and one year). In Canada, these are exchange programs where students from foreign universities come to UofT and UBC to 'trade places' with domestic students, hence the "exchange" moniker.

Logit regression models: When dependent variables are dichotomous or binary measures (often '0' and '1'), ordinary least squares assumptions are violated and hence another type of statistical modelling is required. Logit models (or logistic regression models) are used to model the probability of an event with two possible

outcomes such as win award/don't win award or graduate/don't graduate. It can be thought of as a special case of ordinary least squares linear regression (or multiple regression models).

Merit awards: financial scholarships students receive based on academic performance, sometimes combined with other accomplishments (e.g., athletics, leadership), and often distinguished from needs-based monetary awards.

Multiple regression models: statistical analyses where the values or levels of one variable or measure (a dependent variable) are predicted from a set of additional variables (the independent or explanatory variables).

Multivariable analyses: measures that examine the relation or association between variables, while simultaneously accounting for or controlling for other variables that may influence the relations or associations.

Observed and unobserved: variables or indicators that are observed have measures associated with them (e.g., grade-point averages [GPAs]), whereas unobserved variables or indicators do not have measures associated with them (i.e., are unknown or unmeasured, such as, in this study, student academic effort).

Ordinary least squares: a common approach for estimating coefficients in linear regression equations where the idea of least squares references a line, or plane, that minimizes the squared distance of all observations from the fitted values of the line or plane.

Program for International Student Assessment (PISA): an international collaborative program where, every three years, samples of 15-year-old students are tested using standardized examinations in mathematics, reading, and science literacy capabilities. The program is organized under the auspices of the Organization for Economic Co-operation and Development (OECD), although includes some countries from outside that organization.

Reference category: In regression analysis, a reference category is used in order to be able to compare categorical variables (variables measured as classification; from example, high school pathway (standard provincial curriculum v. IBDP or FI)). To compare categorial variables, one of the categories is designated as the reference category against which the other categories can be compared (in practice, it normally does not matter which category is used as the reference category, the resulting interpretations will be the same).

Socioeconomic status: We understand this concept as a multifaceted indicator of a family's relative social standing or position, where that standing or position is understood as a reflection mainly of family wealth, income, occupation(s), and levels of education. More affluent and more educated families, typically those with professional occupations, tend to be of higher socioeconomic standing than others.

Standard deviation: a measure of the dispersion or variation in a set of numbers, calculated relative to the mean or central tendency of the set.

Statistical power: the probability or likelihood of being able to detect effects or associations among variables, if there are, in fact, effects or associations. Larger sample sizes, everything else being similar (e.g., sample representativeness), provide greater power.

Student-loan status/eligibility: flags whether a student was eligible to receive a student loan, based on their ability to access sufficient family financial resources to support their university studies.

Stopped out: students who withdrew from a program of study for a limited time but who eventually returned to the same or a different program.

***t*-Test**: statistical test used to examine whether the difference between two means or averages is likely due to chance or not (the test uses the dispersions around the two means to estimate the likelihood that the means are, in fact, different).

Unstandardized regression coefficient: measure of the effect of a one-unit change in an independent variable on the change in the dependent variable. For example, at both UofT and UBC, year of entry, an independent variable, is associated with increasing university grades.