Indigenous Students' Access to Post-Secondary Education in British Columbia

Evidence from BC PEN Linked Data

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EXECUTIVE SUMMARY

OVERVIEW

This project analyzes access to post-secondary education (PSE) among Indigenous students in British Columbia (BC). It uses linked administrative data from detailed annual education records to examine trends in access over time and how access is related to a range of student, neighbourhood, K-12 program, school, and skill assessment characteristics.

By observing approximately 45,000+ Indigenous students in terms of their transitions to PSE from age 16 to early adulthood (age 25 specifically), this study provides important new evidence on the background factors related to participation in PSE. The analysis uses both descriptive and statistical modelling approaches to investigate access to any PSE program as well as to specific PSE programs: Bachelor's Degree, Associate Degree, Certificate or Diploma, Apprenticeship, Other programs, or No PSE.

EMPIRICAL FINDINGS

Access to PSE among Indigenous youth in BC has been steadily increasing for successive cohorts of high school students over the period examined (up to 2020). The greatest increase in both the raw rates and after controlling for the student, neighbourhood, K-12 program, school, and skill assessment characteristics included in the regression models is enrollment in Bachelor's programs.

Echoing a common finding in the recent literature on access across many contexts, Indigenous women are significantly more likely to access PSE than Indigenous men.

On-reserve youth have higher post-secondary participation than off-reserve youth. There is no significant difference in rates of access by rural compared to non-rural Indigenous youth. In addition, the interaction of living on reserve and rural location has no independent influence on post-secondary access. These are important findings, especially given the challenges to provide post-secondary enrollment opportunities in rural and remote regions.

Neighbourhood influences on access to PSE include mean family income and an education index. A related location measure captures the percentage of students in the school district that is Indigenous. All effects are positive.

Enrollment in Special Education Needs (SEN) and English as a Second Language (ESL) programming in elementary or secondary school is associated with lower PSE access rates while enrollment in French Immersion is associated with increased access. These findings capture both the direct, causal effects of these programs as well as unobserved student, family, and school attributes associated with selection into these programs which are themselves related to post-secondary pathways. The ESL effect is notable for being in the opposite direction to typical findings for first and second generation non-Indigenous immigrant students, who generally have higher rates of access to PSE than non-immigrants. Indigenous students enrolled in ESL are most likely to be speaking a language native to Canada, which appears to leave them at a disadvantage in terms of accessing PSE in the English-dominant BC education system.

Participating in Indigenous student focussed programming in high school has no significant association with post-secondary access. Again this effect captures both selection into these programs, including signalling those in particular need of the programming, as well as the actual effects of the programs.

The type of school students attend is a significant predictor of student post-secondary access. Participating in schooling at age 16 through an alternative school or via distance education is much less likely to lead to post-secondary enrollment. This effect undoubtedly captures unobserved factors influencing how students come to access secondary education via these means, and possibly that such programs do not support post-secondary access as effectively as other school types. Thus, as with ESL and SEN program participation, alternative and distance learning are potential flags for future targeting of assistance.

Finally, even after controlling for the other student, neighbourhood, K-12 program, and school characteristics, performance on the grade 7 numeracy Foundation Skills Assessment is strongly associated with post-secondary participation. While these assessments are subject to criticism around the uses made of the results, students' numeracy scores provide one of the strongest predictors of post-secondary success for BC Indigenous students.

POLICY IMPLICATIONS AND FURTHER RESEARCH

With strengthening the post-secondary transition rates of Indigenous learners representing a key policy objective in British Columbia and across the country, this research provides insight into the background factors that matter most to Indigenous students' participation in PSE. This not only contributes to the general knowledge base that represents a starting point for developing policy initiatives but could specifically help target initiatives on those students who need them most at the point in their studies such interventions may be of greatest benefit.

For example, initiatives could be targeted on students with particular personal characteristics, in specific types of neighbourhoods or school districts, in designated programs or types of schools, or with (lower) FSA scores given these are associated with low PSE access rates.

For more precision, predictive models that take advantage of all the available information on students could exploit recent developments in advanced statistical techniques including machine learning to generate the best possible predictions of which students need support.

Preferred points to generate such predictions, and to implement associated initiatives, could be as early as grades 5 and 8, when the grade 4 and grade 7 FSA scores (powerful predictors of access to PSE) first become available. Given the critical development students experience and the school transitions they face throughout their years in school, correctly timing the implementation of initiatives would help maximize their effectiveness.

One attractive policy strategy might be to introduce one or more initiatives along with associated evaluation strategies so that over time, the optimal approaches can be identified and implemented on a more general and permanent basis and otherwise built upon to develop a package of initiatives that could substantially increase the opportunities for Indigenous students to pursue PSE. Action of this nature would immediately acknowledge the importance attached to improved schooling opportunities and outcomes in the calls to action of the Truth and Reconciliation Commission and begin to improve life chances for Indigenous youth in Canada.

Further research could also move from the issue of who accesses PSE to subsequent PSE experiences and outcomes following these starting points. Specific research questions could include who successfully completes their first program, who switches programs and what happens there, who leaves PSE without a credential, who graduates and moves on to one or more other programs, and final PSE attainment. An even longer reach could include investigating early labour market outcomes after individuals leave school, both among PSE participants and for the Indigenous population more generally, including the 60 per cent of Indigenous youth (in BC) who do not go on to PSE.

Alternatively (or additionally), research could essentially back up to focus on the K-12 years to analyze how students progress through them, particularly from age 16 when students are legally permitted to leave school. Outcomes could include how far students progress in their studies, how long it takes those who graduate from high school to do so, and the grades they achieve along the way. The justification for this is that the K-12 years are critical to going on to and succeeding in PSE and to post-schooling experiences and life outcomes generally. And once better understood, similar policy strategies for developing predictive models to identify students at risk and implementing initiatives to improve Indigenous youths' experiences and outcomes could be adopted.

INTRODUCTION

Across multiple Canadian jurisdictions, improving the educational outcomes of Indigenous learners is a key policy objective. One of the Calls to Action made by the Truth and Reconciliation Commission of Canada seeks to "eliminate educational and employment gaps between Aboriginal and non-Aboriginal Canadians" (Truth and Reconciliation Commission of Canada, 2015, p. 2). In British Columbia (BC), the 2012 Aboriginal Policy Framework aimed to increase the "number of credentials awarded to Aboriginal learners by 75 per cent" and increase the "percentage of Aboriginal youth making the transition from K-12 to post-secondary education to 90 per cent" by 2020 (Ministry of Advanced Education, 2012, p. 15).

Yet developing new policies to enhance Indigenous student success requires a firm understanding of the educational pathways students follow and the influences that determine the directions they take. This report seeks to add to the existing knowledge base by presenting a new analysis of access to post-secondary education (PSE) in British Columbia (BC) among Indigenous students.[1] The research addresses two main questions:

- What are the trends in access to PSE among Indigenous students in BC?
- How is access to PSE among Indigenous students related to a range of student, neighbourhood, K-12 program, school, and skill assessment measures?

The analysis is based on the remarkably rich BC PEN data, which comprise detailed annual records of all students enrolled in BC at either the K-12 (since 1993) or PSE (since 1998) level, linked longitudinally using students' BC Personal Education Number (PEN). These data provide information on the personal characteristics of students (e.g., gender and year of birth), postal code (which is used to identify urban-rural residence and associated neighbourhood characteristics such as population density, average family income, and an education index), K-12 program designations (Special Education Need, ESL, French Immersion), school type (standard, alternative, distance), school district, Foundation Skills Assessment (FSA) scores (the grade 7 numeracy score is employed here), and PSE enrollment information including program type.

[1] The term "Indigenous" is used to refer to status and non-status First Nations, Métis, and Inuit people. While a distinctions-based approach is generally preferred over a pan-Indigenous identification, separate FNMI identifiers are not available in the PEN data. According to the 2016 Census, of the 257,275 youth in BC aged 15 to 19, 23,215 (9 per cent) reported Indigenous identity (including those living both on and off reserve). Of these, 23,215, 65 per cent reported First Nations identity and 32 per cent Métis. Fewer than 1 per cent reported Inuk (Inuit) identity (Statistics Canada, 2018).

Of particular relevance to this study is the availability of an Indigenous student identifier along with indicators of whether the student was living on a First Nations reserve (and whether that reserve was urban or rural) and enrolled in Indigenous-focused programming concerned with language and culture or student support. We also use the school district identifier to calculate the per cent of students in the district identified as Indigenous.

The BC PEN data yield 45,000 Indigenous students who meet the project criteria of being born from 1987 to 1995 and present in the BC education system at age 16.

Access to PSE is measured based on the first record of PSE enrollment in two ways: i) access to any PSE program, and ii) access to a specific PSE program, these being Bachelor's Degree, Associate Degree, Certificate or Diploma, Apprenticeship, or Other.[2]

This report first presents an investigation into access to PSE using a simple descriptive analysis which reports the distribution of the sample across each of the categorical values of the explanatory variables used in the analysis and the associated PSE access rates.

It then provides an analysis based on regression approaches in which access to PSE is related to the various sets of explanatory variables while taking each of the other factors into account, thereby isolating the independent "effect" on access of each variable.[3] The first model is a logistic regression of the probability of accessing any PSE program versus no PSE. The second is a multinomial logit model of the probability of accessing each specific type of PSE program or no PSE.

The contribution of this report to the existing literature is, therefore, to leverage the power of the BC PEN data to track Indigenous students' rates of access to PSE over time and to advance our understanding of how PSE access rates are related to the rich set of measures available in the BC PEN data, including student, neighbourhood, K-12 program, school, and skill assessment characteristics, all using the most recent data available.

The next section provides a short literature review on access to PSE access among Indigenous students in BC and Canada more broadly. This is followed by a discussion of the BC PEN data, sample selection, variables employed in the analysis, and analytical approach. The report then presents the descriptive findings followed by the regression results in two parts, corresponding to the two sets of models estimated: access to any PSE and access to the specific PSE program of

[2] Access to PSE is conventionally defined in terms of the first program entered, as here. Using alternative measures of access and final PSE (or other schooling) attainment represent other possible focuses of analysis which could represent topics for further research.

[3] The term "effect" is used throughout this report only to connote the empirical relationships between the variables included in the analysis and the outcome variable (i.e., access to PSE) and is not meant to necessarily imply causality in all cases.

entry. The last section summarizes the main findings and discusses the policy implications arising from the study and possible avenues for further research.

RELATED LITERATURE

Although an increasing percentage of Indigenous students have been accessing PSE in both BC and across Canada, rates typically remain lower than those of non-Indigenous students (Association of Universities and Colleges of Canada, 2002; Frenette, 2010a; Heslop, 2016; Ministry of Education, 2020 plus other references below).

These differences are at least in part due to a range of social, economic, geographical, cultural, pedagogical, and financial obstacles associated with colonization that Indigenous learners often face in their pursuit of PSE (Feir, 2016a, 2016b; Mitchell, Thomas, & Smith, 2018). The legacy of assimilationist policies, and the residential school system in particular, includes lingering scepticism of publicly run education systems (Malatest, 2004; Assembly of First Nations, 2012).

Examples of other barriers include a lack of services and supports, no access to PSE near home communities, and educational practices that lack cultural relevance (Preston, 2016; Timmons et al., 2009; Malatest, 2004). Richards (2018) focuses on the growing urban Indigenous population and suggests it is being overlooked by both federal and provincial governments.

In the specific context of the COVID-19 pandemic, DeGagne (2021) identifies attempts to facilitate Indigenous access to PSE by using online delivery to bring PSE to Indigenous communities. However, lagging infrastructure development poses an obstacle to online education: "although 93 per cent of British Columbia households have high-speed internet access (50 megabits-per-second download and 10 megabits-per-second upload), only 38 per cent of non-urban Indigenous communities have access to the same level of connectivity" (p. 3).

A substantial literature has now established that family characteristics represent an important set of determinants of access to PSE in the general population (various papers by Finnie and co-authors) and Indigenous youth tend to be disadvantaged in these respects, such as having low family incomes and not having parents who possess a PSE credential (see also Deller et al., 2019 and Mendelson, 2006).

Considering such factors with a focus on Indigenous youth, Frenette (2010a) uses a regression approach and data from the Youth in Transition Study, Cohort A, to find that a significant portion of the gap between Indigenous and non-Indigenous youth in high school completion and university attendance can be explained by differences in student and family characteristics (e.g., family income, parental education, high school grades). Specifically, 53 per cent of the gap in high school completion and 89.5 per cent of the gap in university attendance is explained by differences in these characteristics. The largest single contributor is academic performance, which accounts for 25.4 per cent of the high school gap and 44.7 per cent of the university gap.

Other notable factors include mother's education and having a dependant child at age 19, which account for 5.1 per cent and 8.1 per cent of the high school gap and 9.2 per cent and 6.5 per cent of the university gap, respectively.

Also using the YITS-A to examine underrepresented and minority groups in PSE in Ontario, Finnie, Childs and Wismer (2011) consider similar sets of factors. They find that Indigenous youth are greatly underrepresented in university in Ontario, with an overall participation rate 28 percentage points lower than that of non-Indigenous youth (46.2 per cent versus 17.8 per cent). College participation rates are, in contrast, similar for Indigenous and non-Indigenous youth. Using a multinomial logit model, being Indigenous is associated with a 28 per cent lower likelihood of attending university when examined alone (i.e., with no other factors accounted for) and remains at 22 per cent after controlling for observable background characteristics such as family income, parental education, and family type.

Interestingly, labour market returns to education do not seem to present as barriers. Frenette (2010b) uses regression models and data from the 2006 Census to examine labour market outcomes and finds that the economic benefits to completing a high school diploma or university degree are comparable, if not greater for Indigenous graduates compared to their non-Indigenous counterparts. Combining these results with data from the YITS-A, he also shows that the perception of returns to schooling are comparable for both Indigenous and non-Indigenous youth, indicating that the lower level of Indigenous participation in PSE is not a result of actual or perceived lack of value for Indigenous graduates.

Access rates also differ among groups of Indigenous learners. For instance, results from the 2016 Census show that Indigenous women age 25 to 64 are much more likely to hold a credential at the bachelor's degree level or above compared to Indigenous men (i.e., 13 versus 7 per cent) (Statistics Canada, 2017).

PSE rates have, however, been increasing over time. Across Canada, Indigenous student participation in PSE increased beginning in the 1970s (Battiste, Bell, & Findlay, 2002). Continuing this trend, based on 1996, 2001, and 2006 Censuses and the 2011 National Household Survey, 28 per cent of Indigenous adults aged 25 to 64 held a PSE credential in 1996, a rate that increased to 42 per cent by 2011 (Gordon & White, 2014, p. 7). And according to the 2016 Census, 49 per cent of the Indigenous population age 25 to 64 holds a PSE credential (Statistics Canada, 2017). Although this PSE attainment rate is higher than it has ever been, it still remains lower than the rate for non-Indigenous people in Canada, which is 66 per cent.

Compared to other Canadian provinces, prior research indicates that Indigenous learners in BC have higher PSE transition rates (Richards, 2013). British Columbia is, furthermore, currently the only province in Canada that tracks the learning outcomes of Indigenous students in the

provincial school system (Richards, 2018; Richards & Mahboubi, 2018), and as a result, more is known about their transitions to PSE.

The relatively higher rates of attending PSE among Indigenous students in BC may be due in part to the early establishment of community colleges across the province and, later in 2008, teaching-intensive universities that offer programs with reduced barriers to enrollment (e.g., requiring a lower high school grade point average or allowing concurrent admission for students who have not yet met the high school graduation requirements). Indeed, Indigenous high school students appear to have a similar likelihood of entering a community college or teaching-intensive university as non-Indigenous students, among both high school graduates and non-graduates (Ministry of Education, 2020).

However, differences still exist between Indigenous and non-Indigenous students in BC in terms of both overall PSE rates and specific pathways. According to the 2016 Census, approximately 7 per cent of Indigenous adults age 25 to 64 in BC held a bachelor's degree compared to 20 per cent of non-Indigenous adults (Statistics Canada, 2017). Among the 2011-2012 high school graduating cohort, Indigenous students had a PSE transition rate that was 12 to 9 percentage points lower than non-Indigenous students, depending on the specific year since graduation from high school when access is measured (Ministry of Advanced Education, Skills and Training, 2018, p. 12). The overall difference between the two groups is largely similar to previous graduating cohorts and widens when individuals who do not graduate from high school are included (Heslop, 2009; McKeown et al., 2018).

Following on the point above regarding type of institution attended, a major difference in PSE access in BC is the rate at which Indigenous students transition to research-intensive universities; for instance, among those graduating from high school in 2014-2015, 5.3 per cent of Indigenous students had transferred to a research-intensive university by one year later, compared to 20.6 per cent for non-Indigenous students (Ministry of Education, 2020, p. 41). Although BC colleges and teaching-intensive institutions offer a range of different programs at the degree and associate degree level, the type of institution a student first enters can steer them towards certain types of credentials. The lower percentage of Indigenous students initially attending a research-intensive university may, therefore, help explain their lower rates of entry into bachelor's degree programs, even as initial choice of program may simultaneously be an important determinant of which type of institution is attended.

A key indicator of the transition to PSE in BC and elsewhere is academic achievement as measured by course grades and/or scores on standardized tests. As high GPA students are more likely to attend research-intensive universities, academic achievement directly influences the opportunity to attend specific types of institutions and programs (Heslop, 2020). Furthermore, more than simply a feature of high school, academic achievement is cumulative and prior studies demonstrate that early academic performance observed in childhood impacts long-term

outcomes (e.g., Hanushek, 2002). In BC , the Foundation Skills Assessment (FSA) tests taken by students in grades 4 and 7 represent early measures of academic achievement, and previous research indicates that Indigenous students have lower levels of achievement on the FSA tests compared to non-Indigenous students (Richards & Vining, 2003).

A range of both social and education environmental influences contribute to academic performance among Indigenous learners in BC . Key social factors include the greater proportion of Indigenous children than non-Indigenous children in BC living in poverty (Macdonald & Wilson, 2013) and in foster care (Representative for Children and Youth, 2017; Turpfel-Lafond, 2007)—both of which are associated with lower academic achievement. Factors related to school experiences among Indigenous youth include the relative availability of extra support (Battisti, Friesen, & Krauth, 2014 look at this in the specific context of language skills) and the characteristics of other Indigenous students, including their levels of achievement (Friesen & Krauth, 2010), academic performance on standardized tests (Richards, Vining, & Weimer, 2010), and PSE transition rates (Aman, 2008).

Using regression modelling approaches and the BC PEN data, Finnie et al. (2018) examine the relationship between access to PSE and student characteristics (including gender and an Indigenous identifier), high school programs enrolled in (special needs, ESL, French immersion, gifted) and scores on the BC grade 4 and grade 7 Foundation Skills Assessments in reading, writing, and numeracy. They find that Indigenous students' overall PSE access rate is 16 percentage points lower than non-Indigenous students' (53 versus 69 per cent, respectively), with the greatest difference being a 23 percentage point difference in attending university (20 versus 43 per cent). These differences decrease to 8.4 and 12.3 percentage points, respectively, after student characteristics, programs, and FSA scores are included in the model, meaning that about half of the overall differences are explained by these factors, while the other half is left unexplained by the model.

Although this existing literature provides valuable insight into PSE access rates for Indigenous youth in BC, there is still a need for further investigation. In particular, prior research has not categorically examined the relationship between access both overall and by type of program enrolled in and the student, neighbourhood, K-12 program, school, and skill assessment characteristics as well as factors that apply specifically to Indigenous students such as whether they live on or off reserve, whether they are enrolled in Indigenous language or cultural programs, or the share of students in the school district that is Indigenous considered here.

DATA AND ANALYTICAL APPROACH

THE BC PEN DATA

This analysis is based on administrative data that capture information on an annual basis for all students enrolled in the BC public education system at the K-12 level since 1993 or in PSE since 1998. The final year of data available for this analysis was 2020. The BC PEN data are housed by the BC Ministry of Education and made available through research agreements that comply with the Freedom of Information and Protection of Privacy Act.

These data are linked longitudinally by students' BC Personal Education Number (PEN) and include information on the personal characteristics of students, including gender, year of birth, and postal code; primary or secondary school grade level, school attended, school district, and any special K-12 instructional programs enrolled in; and PSE program, institution and field of study.[4] The dataset also includes grades 4 and 7 Foundation Skills Assessment (FSA) scores for literacy, numeracy, and writing. In addition, neighbourhood level Census long-form data matched with students' postal code provide a number of neighbourhood socio-economic characteristics.

The BC PEN data are thus exceedingly rich, but post-secondary education outside of BC is not captured. Consequently, supplementary analysis has been undertaken using Statistics Canada's BCK12-ELMLP dataset. This links the BC K-12 PEN data to the Education and Labour Market Longitudinal Platform (ELMLP), which includes records for those who attend PSE anywhere in Canada and therefore allows us to determine if this is potentially a significant matter. It turns out that only a very small proportion of the BC Indigenous students in our sample attend PSE out of BC. Also, the BC PEN data have certain advantages in terms of the precise information captured in comparison to the variables available in the national level ELMLP and including more recent years of data, so a more complete analysis based on the BCK12-ELMLP is not presented here.

[4] An analysis of the type of PSE institution first accessed has also been carried out but is not included in this report because i) program of study is deemed the more important choice from a student's perspective, ii) the results are not so uniformly clear, iii) using a combination of program type and institution resulted in too many outcome variables to be tractable, and iv) program of study is typically the focus of access studies.

SAMPLE SELECTION

The sample used in the analysis captures all students who were enrolled in the BC K-12 education system as of September in the year they turned 16, self-identified as Indigenous during or prior to that year, and were born from 1987 to 1995.[5]

The selection of these nine birth cohorts is based on two criteria: 1) the availability of PSE enrollment data up to September in the year the birth cohort turned 25 (ruling out students born in 1996 or later), and 2) the availability of grade 7 FSA scores (excluding those born 1986 or earlier). The age 16 anchoring is intended to capture students from the point they are legally permitted to leave school, while excluding those who may have left the province by that age and would therefore be less likely to attend PSE in BC and thereby captured in the BC PEN PSE data which is the source of our PSE access measures.[6]

Table 1 provides an overview of the standard enrollment patterns among the birth cohorts included in our analysis. For example, those in the 1987 birth cohort were typically enrolled in Grade 7 in September 1999. Among those who remained enrolled, most were in Grade 12 as of September 2004. We then observe if they make the transition to PSE by September 2012 (i.e., the area shaded grey), the year they turned 25. Individuals who first made the transition to PSE after age 25 are counted as non-attendees in our analysis.[7] This treatment ensures that access to PSE is measured up to the same age for all cohorts.[8]

5 In practice, student "self identification" as Indigenous typically requires a form to be completed by a parent or guardian of the student and submitted to the school district. The inclusion of only those who were identified as Indigenous by age 16 precludes the length-biased sampling that would result from also including those who self identified as Indigenous at higher ages, which could happen only if they were still in school, thus over-representing those going on to PSE. As noted below, the BCK12-ELMLP only has a variable indicating if a student ever identified as Indigenous, thus introducing the problem just described.

6 This also, perforce, removes those who had left school by this age, which is unavoidable given that enrollment is identified by being in the BC PEN data (i.e., enrolled in a BC school) in any given year.

7 Tests carried out using the earliest birth cohort in our sample (i.e., 1987), which we can follow the longest, indicate that 37.1 per cent of students (first) access PSE by age 25 (the measure used in this analysis), that an additional 6.2 per cent access by age 30, and that an additional 2.2 per cent access by age 32. Access rates by age are similar for other cohorts.

8 Following students to higher ages for the earlier cohorts for which this is possible would capture more PSE transitions, but (as noted just above) most students make this move by age 25, and an inconsistent age cut-off for measuring access to PSE across cohorts would skew the comparison of access rates across cohorts and otherwise render the sample non-uniform.

Table 1 Standard K-12 enrollment patterns by year of birth

	Typical K-12 grade by year heading																					
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1987	**7**	8	9	10	11	12																
1988	6	**7**	8	9	10	11	12															
1989	5	6	**7**	8	9	10	11	12														
1990	4	5	6	**7**	8	9	10	11	12													
1991	3	4	5	6	**7**	8	9	10	11	12												
1992	2	3	4	5	6	**7**	8	9	10	11	12											
1993	1	2	3	4	5	6	**7**	8	9	10	11	12										
1994	K	1	2	3	4	5	6	**7**	8	9	10	11	12									
1995		K	1	2	3	4	5	6	**7**	8	9	10	11	12								

Students in the sample did not, however, have to follow this grade-typical enrollment pattern to be included in the analysis. Provided a student was observed in the K-12 data at age 16 — regardless of their grade level at that age — they were included.

Finally, the small number of students missing values for the variables used in the analysis were excluded.

Appendix A Table 1 shows the impacts of these exclusion criteria on the final sample.

OUTCOME VARIABLES

The access measures employed in this analysis are based on the first PSE program enrolled in. Program levels considered are Bachelor's Degree, Associate Degree, Certificate/Diploma (short, advanced, or regular), Apprenticeship, or Other – or No PSE.[9] Only enrolments in public institutions in BC are included in the BC PEN data. A list of the PSE institutions covered is given in Appendix B.

Most students enroll in a single program when they first enter PSE. For those who enroll in more than one program in the same term (whether at a single institution or at different institutions),

[9] In a very small number of cases (n=32 or 0.03 per cent of the sample), students were observed to first enter PSE in a post-bachelor's program (i.e., post-degree certificate or diploma, graduate certificate or diploma, master's degree, or first professional degree program). We include these students and categorize them as entering PSE at the Bachelor's Degree level. The Other category includes a mix of programs at the undergraduate level not otherwise classified.

we assign the student the "highest" program attended in the following order: Bachelor's Degree, Associate Degree, Certificate/Diploma, Apprenticeship or Other.[10]

Any remaining duplicate records are differentiated by the "highest" institution attended in the following order: research-intensive university, teaching-intensive university, institute, or community college. For example, if a student enrolled in both research-intensive and teaching-intensive universities in the first term they attended PSE, their institution and program of entry would be based on information from the research-intensive university.

EXPLANATORY VARIABLES

The explanatory variables employed in the analysis capture student, neighbourhood, K-12 program, school, and skill assessment measures. The four student characteristics variables are: sex (male, female), if a student lived in a rural location at age 16 (yes, no),[11] if a student was identified by their school district as living on a First Nations reserve at age 16 (yes, no),[12] and birth cohort. The models also include an interaction of rural and living on a First Nations reserve to allow for that differentiation.

The three Census-based neighbourhood characteristics are: mean family income, population density, and an education index, all as of age 16.[13]

The four K-12 program characteristic are if a student had any Special Education Needs (SEN) designation at age 16 (yes, no), if a student was ever enrolled in an English as a Second Language (ESL) program by age 16 (yes, no), if a student was ever enrolled in a French Immersion

10 This ranking is consistent with that used by the OECD (OECD, 1999).

11 This information comes from a student's postal code, whereby a "0" in the second character of the first three digits of a postal code (representing the forward sortation area) indicates a rural mode of delivery, rather than a strict population size definition.

12 This indicator includes only Status First Nations who live on First Nations Reserves. However, data quality notes for this measure indicate that school districts collect this information (through "1701" forms) in different ways and therefore may not provide complete coverage of all students who live full time on First Nations Reserves and/or include students who live on reserves for only part of the year.

13 These variables, constructed by the BC Ministry of Education, capture information based on the Census long-form related to the dissemination area (DA) where the student was living at age 16. Mean family income is the average total family income before tax in the DA (adjusted for inflation for this analysis). Population density is the DA population divided by the DA area in square km. The education index is generated by Ministry of Education analysts using Principal Components Analysis and combines six education variables representing the percentage of residents in the neighbourhood with no certificate, diploma or degree, with a secondary school diploma, with an apprenticeship or trades certificate or diploma, with a bachelor's degree, with a master's degree, and with a doctorate.

program by age 16 (yes, no), and if a student was enrolled in an Indigenous-based program (none, language/culture, support) at age 16.[14]

The single school characteristic is type of secondary school enrolled in at age 16 (standard, alternative, distance education).[15] Another school-based variable calculated for this analysis is the percentage of Indigenous students in the school district (with a single grouping for independent schools) at age 16.[16]

The performance measure is the quartile rank in the Grade 7 numeracy Foundation Skills Assessment (FSA) for that year (lowest quartile, 2nd quartile, 3rd quartile, highest quartile, present at grade level but missing, not present at grade level). The quartiles were created based on the distribution of the scores of all students in grade 7 in BC in each year; as a result, our sample of Indigenous students is not equally distributed across the four quartiles.

ANALYTICAL APPROACH

We first present descriptive statistics showing the distribution of the sample across each of the explanatory variables along with the associated PSE access rates on a variable-by-variable basis, thus painting a portrait of the characteristics of the Indigenous students in our sample and how PSE access rates differ among students along these dimensions.

We then adopt a multivariate regression approach, which comprises the main part of the analysis. The advantage of regression-based approaches is that they allow the outcome variable(s) to be related to each of the explanatory variables while taking the other variables included in the analysis into account. In this sense, it isolates the independent "effect" of each explanatory variable on a given outcome.[17]

The specific regression models employed are binomial and multinomial logit specifications, which capture the relationship between the explanatory variables and the likelihood of each outcome in comparison to the reference category, which in our case is No PSE. The first model captures the probability of accessing Any PSE program versus No PSE, and the second identifies

14 This information comes from form 1701 information provided by schools in which administrators indicate if a student was enrolled in or received any Indigenous-based program or services in a given school year. Under K-12 Indigenous education funding policy, the intention of these programs and services is that they are established at a local level in partnership with Indigenous communities. The broad classifications employed in the PEN data are language/cultural or (academic) support.

15 Alternative schools are those categorized by the BC Ministry of Education as one of the following: alternative, long term provincial resource programs, continuing education, or youth custody.

16 This was calculated from the full BC student sample provided for the analysis.

17 The term "effect" is used here only to connote the empirical relationship between the variables included in the analysis and the outcome variable and does not necessarily imply causality.

the probability of accessing each specific type of PSE program or No PSE.[18] Because the error term is likely correlated for students clustered within the same schools, standard errors are adjusted accordingly.

For the presentation of the findings, we use standard procedures to transform the estimated coefficients into average marginal effects, which represent the difference in the expected probability of the outcome associated with a one unit change in the variable in question, or in comparison to the omitted, or "baseline" category for the categorical variables employed.

Two key assumptions of multinomial logistic regression are that 1) the choice between any two alternative outcomes is unaffected by the other choices available (also known as independence of irrelevant alternatives, or "IIA"), and 2) the outcome categories are distinguishable. Since the literature now deems that the IIA tests available are not reliable, we define our outcomes assuming that the different PSE programs are distinct and chosen independently by students. We tested whether the outcome alternatives are indistinguishable using Wald and likelihood ratio tests, which indicated that no pair of outcome alternatives should be combined.

[18] The logit model with a binary outcome, or logistic regression, is a special case of the multinomial logit.

EMPIRICAL FINDINGS

The findings are laid out in three sections. The first consists of the descriptive analysis, the second presents the findings of the logit regression where the outcome is access to any PSE program, and the third presents the findings of the multinomial logit regression where the outcomes are the different kinds of PSE program first accessed.

For each of the regression approaches, three models have been estimated. Model 1 includes only the student and neighbourhood variables along with the related (i.e., based on place of residence) per cent of the school district student body that is Indigenous; Model 2 adds the K-12 program and school variables; and Model 3 adds the FSA numeracy score. The results for all three of these models are presented for the bivariate model of access to any PSE since there is only a single PSE outcome, thus allowing for a compact presentation of the full set of findings. In contrast, we focus on Model 3 for the multinomial logit model of access to PSE by program since there are separate sets of estimates for each of the six outcomes (including No PSE) for each model. The results for Models 1 and 2 are presented in Appendix tables 2 and 3. We also provide graphical presentations of the models discussed. The reason for doing the different models is to see the degree to which the overall effects of the background variables (Model 1) are mediated through the K-12 school program and numeracy score variables added in Models 2 and 3, and how much remains after controlling for those factors.

DESCRIPTIVE ANALYSIS

The first column of Table 2 shows the distribution of all students in the sample across the categorical variables included in the analysis, and therefore sums to 100 per cent (allowing for rounding) for each set of variables. The remaining columns of Table 2 show the percentage of individuals who do not pursue post-secondary education (No PSE), the percentage who do Any PSE, and then the percentage who first enter PSE by each of the types of program considered: Bachelor's Degree, Associate Degree, Certificate or Diploma, Apprenticeship, or Other.

The first row of the table shows the overall access rates for the entire sample: No PSE at 59.8 per cent, and Any PSE at 40.2 per cent, with this made up of Bachelor's Degree at 7.2 per cent, Associate Degree at 4.1 per cent, Certificate or Diploma at 20.2 per cent, Apprenticeship at 2.4 per cent, and Other programs at 6.4 per cent.

Our sample is almost perfectly balanced by sex (51/49 per cent male/female), and a fifth (20 per cent with rounding) of both males and females first enrol in Certificate or Diploma programs, the most common PSE program among Indigenous students. Compared to males, female

students are more likely than males to attend Any PSE program (rates of 43 and 37 per cent respectively), and have higher access rates in Bachelor's Degree, Associate Degree, and Other programs. Males are more likely to access Apprenticeship programs than females.

The cohorts increase slightly in size over birth years, and overall PSE access rates also rise, with the single largest increase being Bachelor's degrees.

Students residing in rural locations at age 16 account for 29 per cent of our sample. One fifth (20 per cent) of the students in the sample lived on a First Nations reserve at age 16, with 12 per cent on a reserve in a rural area. PSE access rates are relatively similar for these groups and their comparison groups except for being somewhat less likely to enrol in Associate Degree programs and more likely to be in Other programs.

Students identified as having Special Education Needs at age 16 (24 per cent of the sample) are much less likely to attend PSE than others (77 per cent are No PSE compared to 24 per cent for others), and are especially less likely to enroll in a Bachelor's Degree (1 versus 9 per cent), Associate Degree (2 versus 5 per cent), or Certificate/Diploma programs (13 versus 22 per cent).

Approximately one fifth (21 per cent) of the students in our sample had English as a Second Language (ESL) instruction at some point by age 16. These students have higher rates of No PSE (69 versus 57 per cent for others) and lower rates of accessing Bachelor's Degree and Certificate/Diploma programs in particular (3 versus 8 per cent and 17 versus 21 per cent, respectively).

Students who were enrolled in a French Immersion program at any point up to age 16 account for 5 per cent of the sample and are more likely to access all types of PSE programs than others except for Apprenticeships, with the Any PSE rates being 57 and 39 per cent, respectively.

Most of the sample were enrolled in an Indigenous K-12 program at age 16 (34 per cent in language/culture and 49 per cent in support and other). Their PSE access rates are quite similar to their counterparts not enrolled in an Indigenous program.

Students are enrolled at age 16 in either standard schools (87 per cent), alternative schools (11 per cent), or distance education (2 per cent). Students in non-standard schools, particularly those in alternative schools, are less likely to access PSE overall as well as in all specific types of programs.

Regarding the Grade 7 Foundational Skills Assessment scores in numeracy, there is a clear relationship between how well students perform on these tests and rates of access to any kind of PSE, Bachelor's programs in particular. More specifically, overall (Any) PSE access rates rise (No PSE rates fall) around 10 percentage points across each quartile, while Bachelor's Degree rates rise from 4 to 8 to 14 to 24 per cent. The patterns for the other programs are more mixed, as

higher scores push students towards higher PSE participation rates but also shift students from one program type to another. Being present for the exam but having no score (including those who did not actually do the assessment) or missing the exam completely represent 18 and 6 per cent of the sample, respectively, and are associated with lower PSE access rates (with No PSE rates of 76 and 72 per cent, respectively) than even those in the lowest quartile (65 per cent). These variables are clearly picking up unidentified differences in students that are associated with the tendency to access to PSE.

Table 2 Distribution (%) and access rates (%) by student characteristics

	Distribution	Access rates						
		No PSE	Any PSE	Bach.	Ass. Deg.	Cert./ Dip.	Apprent.	Other
All (n = 45,563)	100.0	59.8	40.2	7.2	4.1	20.2	2.4	6.4
Sex								
Male	50.7	62.7	37.3	5.1	2.7	20.1	3.9	5.5
Female	49.3	56.8	43.2	9.3	5.7	20.2	0.7	7.3
Birth cohort								
1987	9.8	62.9	37.1	5.6	3.8	18.9	2.0	6.9
1988	10.5	61.2	38.8	6.3	3.7	19.6	2.6	6.6
1989	10.9	62.0	38	6.5	3.7	18.8	2.5	6.6
1990	11.2	59.8	40.2	7.0	3.9	20.6	2.6	6.2
1991	11.6	59.3	40.7	6.9	4.3	20.9	2.4	6.2
1992	11.4	59.4	40.6	7.6	4.3	20.3	2.6	5.9
1993	11.5	57.8	42.2	8.3	4.7	21.1	2.0	6.1
1994	11.5	58.2	41.8	7.9	4.5	21.0	2.5	6.0
1995	11.6	58.2	41.8	8.3	4.4	20.1	2.1	6.9
Residence at age 16								
Non-rural	71.4	60.0	40	7.3	4.6	19.8	2.2	6.0
Rural	28.6	59.2	40.8	7.0	2.9	21.0	2.7	7.2

	Distribution	Access rates						
		No PSE	Any PSE	Bach.	Ass. Deg.	Cert./ Dip.	Apprent.	Other
Residence on First Nations reserve at age 16								
No	80.1	60.0	40	7.5	4.6	19.8	2.4	5.7
Yes	19.9	59.0	41	6.0	2.5	21.4	2.3	8.9
Rural Residence and on First Nation reserve at age 16								
No	88.4	59.9	40.1	7.3	4.4	20.0	2.4	6.0
Yes	11.6	58.6	41.4	6.0	2.2	21.5	2.4	9.3
Special Education Need (SEN) at age 16								
No	76.5	54.1	45.9	9.0	5.0	22.4	2.5	7.0
Yes	23.5	78.3	21.7	1.2	1.5	12.9	1.8	4.4
Ever ESL (by age 16)								
No	79.4	57.4	42.6	8.2	4.5	21.1	2.4	6.4
Yes	20.6	69.1	30.9	3.3	2.8	16.5	2.2	6.1
Ever French Immersion (by age 16)								
No	94.5	60.7	39.3	6.7	4.0	19.9	2.4	6.3
Yes	5.5	43.4	56.6	14.8	6.8	24.9	2.0	8.1
Indigenous program at age 16								
None	16.7	59.4	40.6	8.4	4.1	19.4	2.3	6.4
Language/culture	34.5	61.5	38.5	6.4	3.0	20.0	2.0	6.9
Support and other (only)	48.8	58.7	41.3	7.3	5.0	20.5	2.6	6.0
School type at age 16								
Standard	86.9	56.5	43.5	8.1	4.6	21.6	2.5	6.7
Alternative school	10.8	83.4	16.6	0.9	1.2	9.5	1.2	3.9
Distance education	2.3	73.1	26.9	3.2	2.6	14.2	1.0	6.0

Grade 7 Numeracy FSA score	Distribution	Access rates						
		No PSE	Any PSE	Bach.	Ass. Deg.	Cert./ Dip.	Apprent.	Other
1st quartile	35.1	65.3	34.7	3.7	3.3	19.3	2.4	6.1
2nd quartile	20.3	53.2	46.8	8.2	5.3	23.6	2.7	6.9
3rd quartile	13.6	43.0	57	13.9	6.8	25.9	2.8	7.7
Highest quartile	7.3	32.7	67.3	23.6	6.6	26.5	2.4	8.1
Present, but no score	17.8	76.3	23.7	1.9	1.9	13.0	1.8	5.1
Missing	5.9	71.9	28.1	4.7	2.6	14.1	1.4	5.1

REGRESSION ANALYSIS: ACCESS TO ANY PSE

We begin the regression analysis by looking at the results of the logit model where the dependent variable is whether a student had accessed any PSE program by age 25, which is a 0-1 indicator (or dichotomous) variable representing No PSE (0) or Any PSE (1). Table 3 reports the estimates for this model. Each column corresponds to a different specification. Model 1 includes only the student and neighbourhood characteristics, Model 2 also includes the school and program variables, and Model 3 adds the grade 7 FSA numeracy score.

This approach is adopted in part to first capture the full student and neighbourhood background effects represented in Model 1, including both their direct effects and indirect effects, the latter which may be related to the school and program variables included in Model 2, and which may be further mediated through the numeracy scores added in Model 3, which captures the fuller sets of relationships represented by the additional sets of explanatory variables.

As described above, the results shown represent the average marginal effects, or the average change in the probability of attending PSE associated with a one unit higher value of the specific variable or, in the case of categorical variables, the difference between the indicated category and the omitted reference category. The table also shows the standard error and level of statistical significance of each estimate.

Table 3 Regression results: access to any PSE

	(1)	(2)	(3)
	Model 1	Model 2	Model 3
Female	0.058***	0.035***	0.043***
	(0.0066)	(0.0064)	(0.0063)
Lived in a rural location at age 16	0.0088	-0.015	-0.013
	(0.012)	(0.0096)	(0.0093)
Lived on First Nations reserve at age 16	0.037*	0.057***	0.083***
	(0.016)	(0.013)	(0.012)
Lived in rural location and on First Nation reserve at age 16	-0.019	-0.019	-0.0098
	(0.020)	(0.018)	(0.017)
Neighbourhood population density (0000s) at age 16	-0.014	-0.0053	-0.0032
	(0.0094)	(0.0039)	(0.0037)
Neighbourhood mean family income (0000s) at age 16	0.017***	0.012***	0.0096***
	(0.0016)	(0.0016)	(0.0015)
Neighbourhood education index at age 16	0.015*	0.017***	0.014**
	(0.0059)	(0.0052)	(0.0049)
% Indigenous in SD at age 16	0.00069	0.0011***	0.0012***
	(0.00036)	(0.00028)	(0.00024)
Identified as having a SEN at age 16		-0.20***	-0.14***
		(0.0065)	(0.0062)
Ever in ESL program up to age 16		-0.096***	-0.061***
		(0.0092)	(0.0086)
Ever in French Immersion up to age 16		0.11***	0.088***
		(0.011)	(0.011)

	(1) Model 1	(2) Model 2	(3) Model 3
Indigenous program at age 16 (ref. none)			
Language/culture		-0.012	-0.0077
		(0.0099)	(0.0090)
Support and other only		0.013	0.014
		(0.0094)	(0.0083)
School type at age 16 (ref: standard)			
Alternative school		-0.21***	-0.19***
		(0.011)	(0.011)
Distance education		-0.18***	-0.14***
		(0.015)	(0.016)
Grade 7 Numeracy FSA (Ref: 1st quartile)			
2nd quartile			0.091***
			(0.0071)
3rd quartile			0.18***
			(0.0073)
Highest quartile			0.27***
			(0.010)
Present, but no score			-0.065***
			(0.0068)
Missing			-0.055***
			(0.011)
Observations	45,663	45,663	45,663

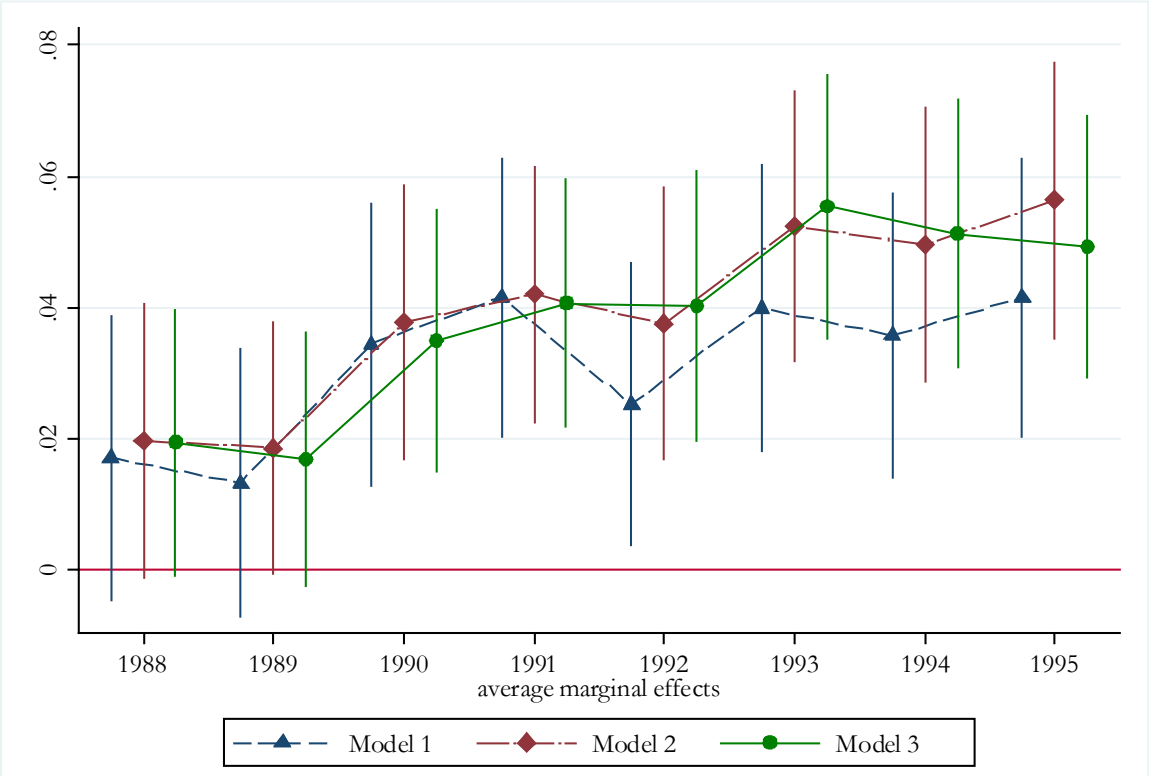
Notes: Average marginal effects shown. Standard errors in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001. Cohort variables included but not shown.

For example, according to the estimates shown in column (1), the 0.058 in the first row means that on average, PSE access rates are estimated to be 0.058 (or 5.8 percentage points) higher for female students relative to male students after taking into account the other factors included in that model. After adding enrolment in the designated K-12 programs and school type, this difference drops to .035, or 3.5 percentage points, meaning that some of the overall gender difference is associated with those added variables – e.g., females are less likely to be in the kinds of K-12 programs or schools associated with lower access rates, such as having a SEN or being in ESL or being in alternative schools or distance education, and/or are more likely to be in high access programs and schools such as French Immersion and standard schools. But then after adding the grade 7 FSA numeracy score included in Model 3, the estimated gender difference rises again, to .043 or 4.3 percentage points, indicating that females with a given set of characteristics, including (as per Model 3) the FSA grade 7 numeracy score, are more likely to attend PSE than males with similar profiles. (The uptick of the final estimate further suggests that females tend to have lower numeracy scores, the effect of which is included in the female variable in Model 2 but controlled for in Model 3.)

All three specifications reported in Table 3 include a set of cohort dummy variables. While the associated estimates are not reported in the table so as to keep the presentation concise, Figure 1 graphs the average marginal effects for each birth cohort variable, all measured relative to the 1987 refence cohort. The horizontal axis shows the different birth cohorts, from 1988 to 1995, while the vertical axis shows the estimated average marginal effects, or differences relative to the 1987 cohort. Each plotted line (and respective colour and point marker) corresponds to a different specification corresponding to columns (1)-(3) in Table 3. The vertical lines show the 95 per cent confidence intervals for the estimates.

Later cohorts have generally been more likely to access PSE than earlier cohorts. In addition, this trend becomes steeper once school and program characteristics are considered (the estimates from Models 2 and 3 in comparison to those from Model 1). According to Model 3, the 1995 cohort was about 4 percentage points more likely to attend PSE than the 1987 cohort after controlling for all the variables included in that model. This could suggest that barriers to PSE for Indigenous students have been diminishing, that Indigenous students have become more interested in attending PSE, or that there have been changes in other influences on PSE choices not captured in these models.

Figure 1 Differences in access to any PSE by birth cohort



Notes: Estimates from the models reported in Table 3. The estimates are for the differences relative to the 1987 reference birth cohort. The vertical lines represent 95 per cent confidence intervals.

Figures 2 through 4 graph the estimates from Table 3 for the student and neighbourhood characteristics, K-12 program and school variables, and numeracy test score, respectively. In these figures, the vertical axis shows the variables while the horizontal axis shows the associated average marginal effects representing the estimated differences in the probability of accessing PSE. Each colour (and corresponding marker) again represents a different specification, from Models 1 to 3. Because the scale used in Figures 2-4 is the same, these show the relative importance of each variable in explaining access to PSE. The horizontal lines represent the 95 per cent confidence internals for the estimates: those lines that do not cross zero can be considered to be statically significant (from zero).

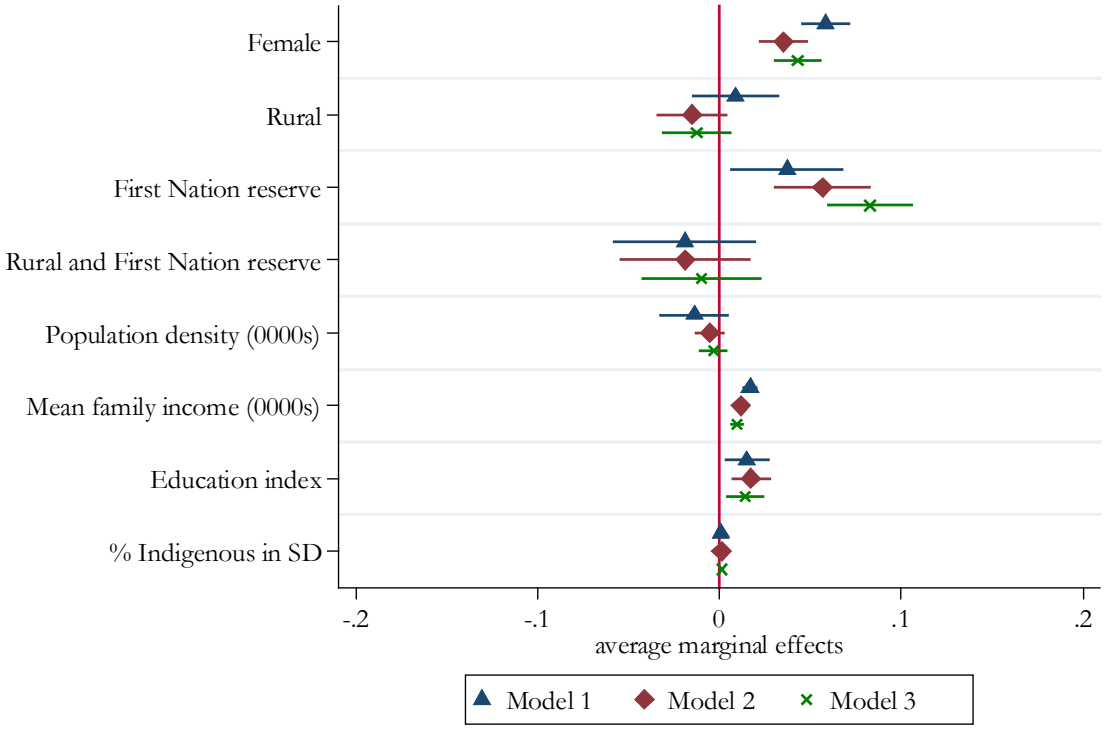
As discussed above, female indigenous students are more likely to access PSE relative to their male counterparts, even after controlling for all variables. While living in a rural location (off reserve) is not significantly related to accessing PSE, students who lived on a First Nation reserve at age 16 are 3.7 to 8.3 percentage points more likely to access PSE than students living off-reserve, depending on the model considered: as more variables are added to the model, the association between living on reserves and PSE access increases. This suggests that on-reserve

students have other characteristics included in the models that reduce their PSE access in comparison to off-reserve Indigenous students, and that once these factors are taken into account, living on a reserve is associated with an even greater tendency to access PSE. Interestingly, whether the First Nation reserve is located in a rural or urban areas does not significantly influence PSE access rates (the corresponding estimates are negative, but not statistically significant).

While the population density of the neighbourhood is not related to the probability of accessing PSE, the average income and education level in the neighbourhood are positively related to PSE access in all models.

The percentage of Indigenous students in a student's K-12 school district is statistically significant in Models 2 and 3. While the estimated effects appear to be small in the figure, the scale of this variable (from 0 to 100) means that, for example, an increase in the Indigenous share of the district of, say, 10 percentage points, is associated with about a 1 percentage point increase in the probability of accessing PSE, while the greatest difference possible, from 0 to 100 per cent Indigenous, would be associated with a 10-percentage point increase in the probability of accessing PSE (based on the estimated coefficient of .0012 for Model 3 shown in Table 3).

Figure 2 Differences in access to any PSE by student and neighbourhood characteristics



Notes: Estimates from models reported in Table 3. The horizontal lines represent 95 per cent confidence intervals.

We next consider school program characteristics, reported for Models 2 and 3 in Figure 3.[19] Having a special needs designation at age 16 is associated with a substantially lower probability of attending PSE, in the order of 20.0 and 14.0 percentage points in Models 2 and 3, respectively.

Indigenous students identified as ever having been in an ESL program by age 16 are 9.6 or 6.1 percentage points less likely to access PSE by age 25, according to the estimates from Models 2 and 3, respectively. The Indigenous students identified in our data in ESL programs are likely to be enrolled in an English as Second Dialect (ESD) program for those who speak a dialect of English sufficiently different from the English taught in school.[20] As discussed in Battisti, Friesen, & Krauth (2014), ESD funding goes almost exclusively to students who self-report Aboriginal identity and these students clearly face special challenges.

While students in special need or ESL programs are less likely to access PSE, students ever identified in French Immersion programs by age 16 have an 11.0 or 8.8 percentage points higher probability of attending a PSE program (Models 2 and 3, respectively). Enrolment in French Immersion can represent streaming in how it captures better students, and this measure is undoubtedly picking up related student, family, and school attributes (possibly among others) that are associated with participating in PSE (see more on this below).

Students enrolled in programs for Indigenous language/culture, Indigenous support, or other Indigenous programs are no more or less likely to enter PSE as students not enrolled in these programs.

The estimates for the school program variables are all attenuated once the grade 7 FSA numeracy test scores are included, indicating correlation of tests scores with the program variables.[21]

Enrollment in the school programs considered here is generally the result of selection mechanisms on the part of students, families, and schools, and the differential PSE access rates associated with these programs are likely capturing at least in part the associated unobserved student, family, and school characteristics along with any effects of the school programs *per se*. For example, French Immersion is (as noted above) often characterized as a proxy streaming mechanism that selects students with attributes associated with strong academic performance and thus more likely to access PSE, while having a SEN works in the opposite direction.

19 These variables are not included in Model 1.

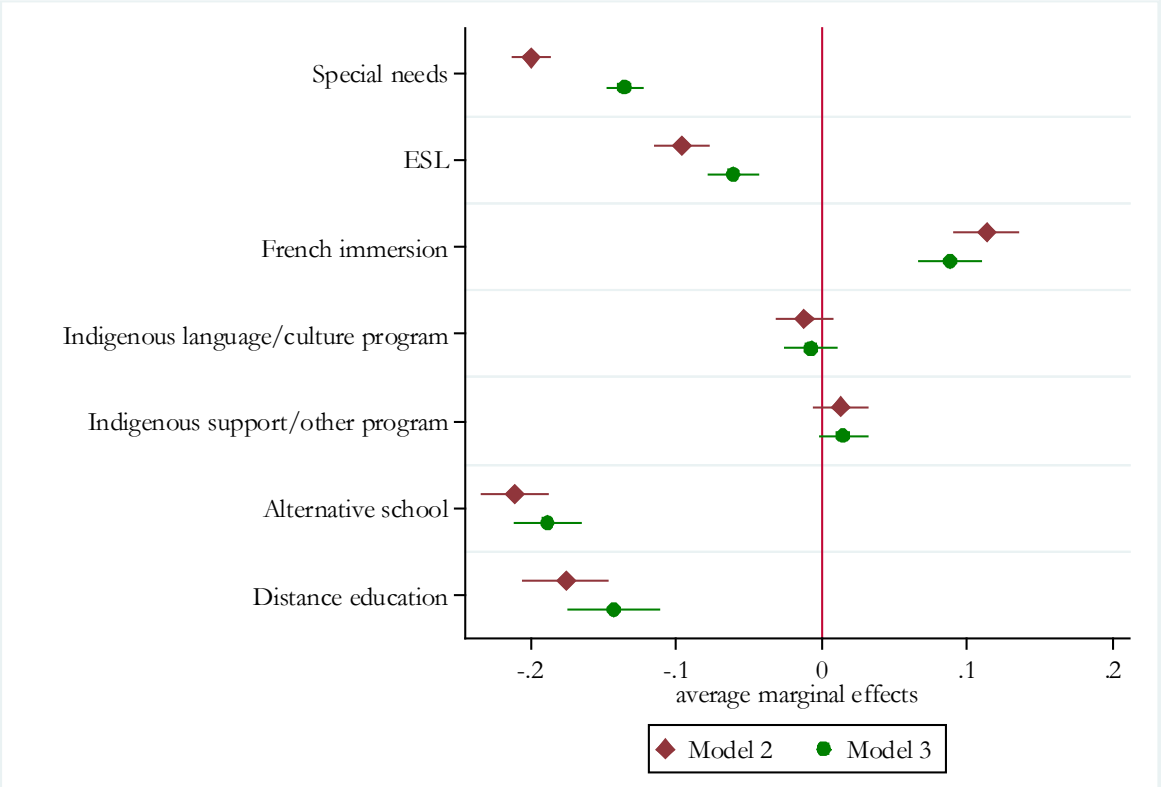
20 In the 1980s, BC started allocating funds under the ESL policy framework to support students who speak dialects of English, or English that differ from the English used in broader Canadian society.

21 That is, these results would be driven by test scores being positively correlated with program variables associated with higher PSE access rates and negatively correlated with programs associated with lower rates, as would be expected.

Identifying the extent to which the school program effects observed here are actually *causal to* changes in the likelihood of students attending PSE is beyond the scope of this study.

School type is also a strong predictor of PSE access. According to Model 2, students enrolled in alternative schools and distance education are 21 and 18 percentage points less likely to attend a PSE program than students enrolled in standard schools, holding other factors constant. With the addition of FSA test scores to the model, the effects of alternative schools and distance education are reduced, which points to students in non-standard schools having lower numeracy scores than students in standard schools.

Figure 3 Differences in access to any PSE by K-12 program and school characteristics



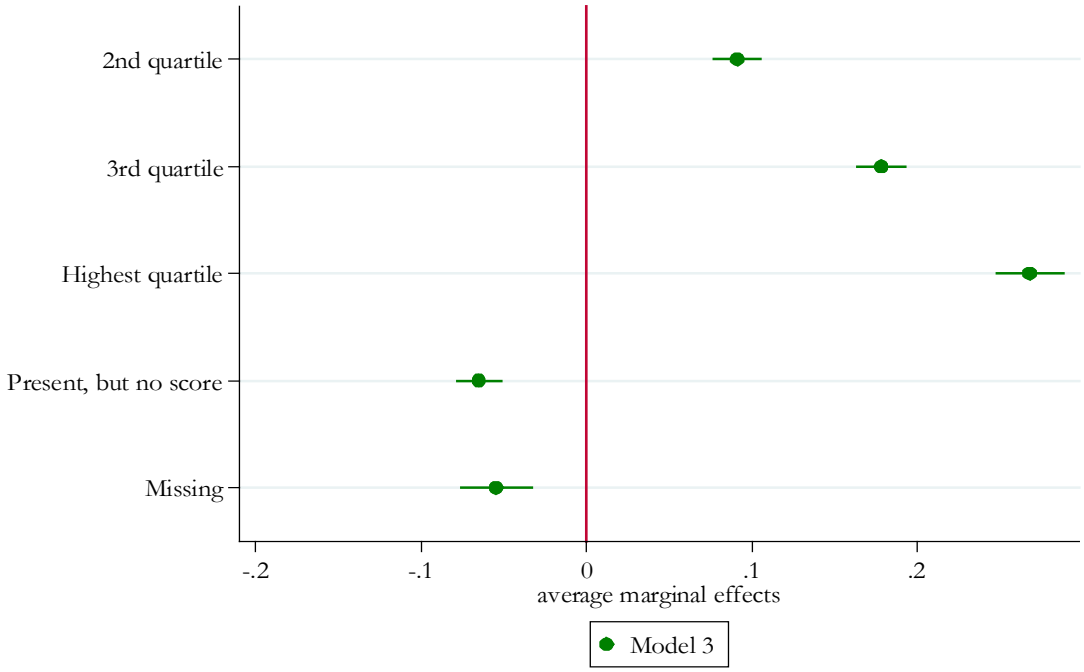
Notes: Estimates from models reported in Table 3. The horizontal lines represent 95 per cent confidence intervals.

The results shown in Figure 4 affirm that higher FSA numeracy test scores are strongly related to PSE access rates. This association follows a linear pattern as progressively higher numeracy scores map into steadily increasing PSE access rates: from 9.1 to 18.0 to 27.0 higher expected probabilities of entering PSE for each quartile relative to the bottom quartile after controlling for all the other variables included in the analysis. As seen in the descriptive analysis above, students who were present with no score and students with missing scores are even less likely to access PSE than students in the bottom quartile of the test score distribution.

The findings reported here identify the types of students who are more or less likely to access PSE and could help with the targeting of government programs intended to increase PSE access rates among Indigenous students. For example, initiatives could be targeted on students enrolled in special need programs, in ESL programs, in alternative schools or distance education, and/or students that either score poorly or have no scores on the FSA numeracy test. This is discussed further in the concluding section of this report.

A more fully developed strategy could involve the development of formal predictive models that simultaneously take all factors into account using advanced statistical methods, including machine learning techniques, to most accurately identify those students at greatest risk of not accessing PSE. Predictive models of this type could also include other variables available in the PEN data including, in particular, the other FSA scores and possibly the grade 4 as well as grade 7 sets of scores. Related work using the PEN data for all students (i.e., both Indigenous and non-Indigenous) resulted in the development of highly accurate predictions of which students were likely to graduate from high school on time (as defined by the BC Ministry of Education) as early as grades 5 and 8 (when the grade 4 and grade 7 FSA scores first become available), and very similar approaches could be used to predict the probability of accessing PSE among Indigenous students.

Figure 4 Differences in access to any PSE by student FSA numeracy test score quartiles



Notes: Estimates from Table 3. Omitted reference category: scoring in first quartile on FS numeracy test.

REGRESSION ANALYSIS: ACCESS TO PSE BY PROGRAM

We now move from the analysis of access to PSE in any program to consider the specific type of program first entered by age 25: Bachelor's Degree, Associate Degree, Certificate/Diploma, Apprenticeship, or Other program, all as compared to No PSE.

Table 4 presents the results for Model 3, which includes all the variables considered in the analysis (Appendix A Tables 2 and 3 present the findings for Models 1 and 2). In the multinomial specification employed, a different set of coefficients is estimated for each access outcome, including No PSE. Similar to the logit models previously seen, the results shown represent the transformation of the estimated coefficients into average marginal effects, or the average difference in the probability of accessing that type of program associated with a one unit change in the explanatory variable (as compared to the omitted reference category for the categorical variables), along with the estimated standard errors and associated levels of statistical significance.

Figure 5 graphs the average marginal effects and related confidence intervals for the estimated differences across birth cohorts (included in the model but not reported in Table 4) relative to the 1987 refence cohort after controlling for all the factors accounted for in the model. Not surprisingly, there has been a negative trend for the "No PSE" outcome, which mirrors the positive trend for accessing any kind of PSE shown in Figure 1. We can now see, however, that this trend is explained to a large degree by the increasing access rates into Bachelor's programs. For the other programs, most of the cohort effects are not statistically significant and/or move up and down over time. According to the estimates, the 1995 cohort was just under 5 percentage points more likely to attend any kind of PSE (i.e., the reverse of the difference shown for the No PSE outcome) and 2.8 percentage points more likely to enrol in a Bachelor's program than the 1987 cohort.

Figure 6 presents the results for the student and neighbourhood characteristics. After accounting for all variables included in Model 3, female students are still more likely than males to attend PSE (seen in the negative effect on No PSE), which we previously saw in the simple model where Any PSE was the dependent variable (where the effect was positive). But what we now see is that this is driven by higher rates of entry into Bachelor's Degree, Associate Degree, and Other programs, while females are less likely than males to enrol in Apprenticeship programs and have similar rates in Certificate/Diploma programs.

We also saw earlier that students living on reserve are more likely to access PSE. Figure 6 now shows that this mostly represents higher rates of access in Certificate/Diploma and Other programs, along with a smaller effect on entry into Bachelor's programs. Other notable findings shown in Figure 6 include a negative effect of the neighbourhood education index on No PSE and corresponding positive influences on access to Bachelor's Degree and Other programs; a negative

effect of neighbourhood mean family income on No PSE offset by positive effects on Certificate/Diploma and Other programs; and a negative effect of the Indigenous student share of the school district's student body on No PSE (again the scale of this variable needs to be kept in mind – Table 4 clearly shows the effect to be statistically significant) which is now seen to be offset by increases in participation in Bachelor's and Apprenticeship programs.

Figure 7 graphs the estimates of the program and school variables. The lower likelihood of attending PSE among students enrolled in special needs programs is spread across all programs but is particularly strong for Bachelor's Degree programs, followed by Associate Degree and Certificate/Diploma programs. Enrollment in ESL programs is also a strong predictor of not attending PSE. In particular, it is associated with a lower probability of attending Bachelor's or Certificate/Diploma programs. Enrollment in Indigenous programming is (again) generally not significantly related to access to PSE, neither overall nor in any particular program.

Relative to standard schools, enrollment in alternative schools and distance education are again strongly related to PSE non-attendance (almost all estimated effects are statistically significant), with the greatest differences being in Bachelor's and Certificate/Diploma programs.

Figure 8 shows the estimates for the numeracy FSA scores. Our results indicate that the higher the numeracy test scores quartile, the lower the probability of No PSE, which is mirrored in the increasingly positive effects for enrolling in Bachelor's programs. Linear (positive) relationships also hold to a smaller and less precise extent for Certificate/Diploma and Associate Degree programs. Missing test score data is associated with not attending PSE, and this is almost exclusively explained by its negative relation to enrollment in Certificate or Diploma programs.

Table 4 Regression results: access to PSE by program, Model 3

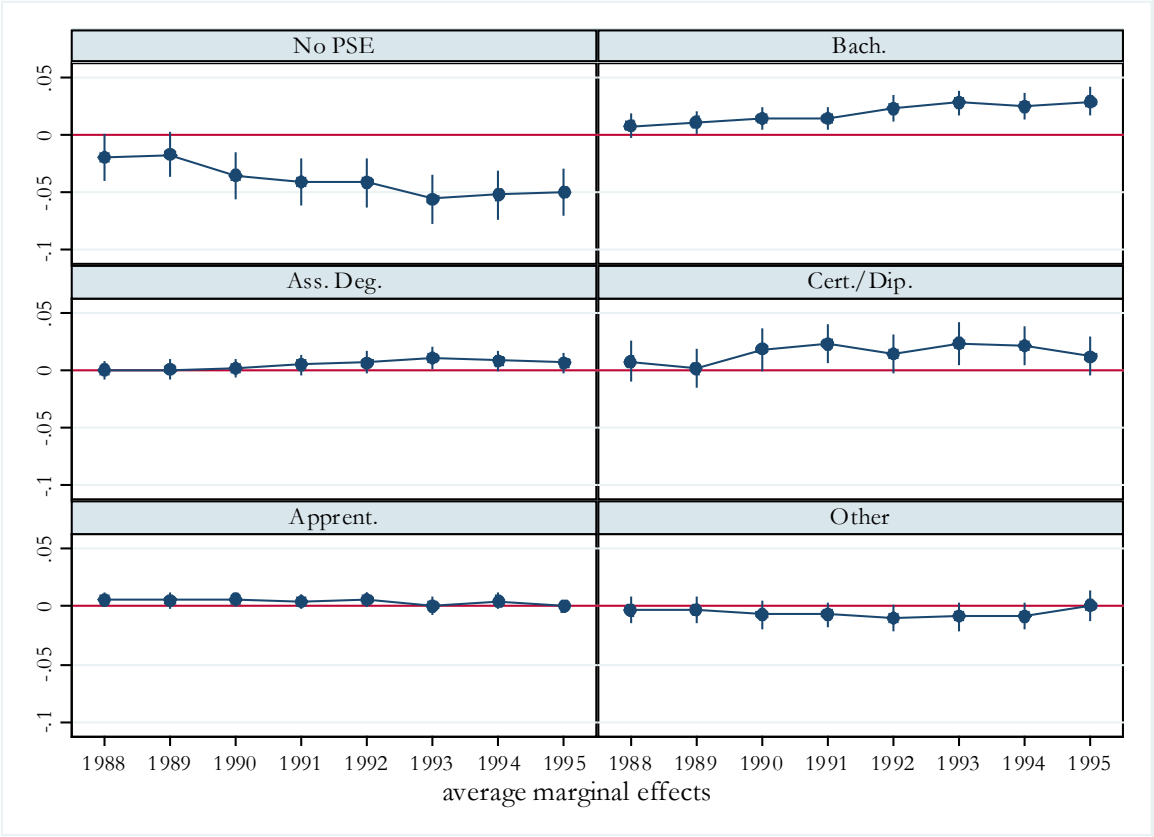
	No PSE	Bach.	Ass. Deg.	Cert./Dip	Apprent.	Other
Female	-0.043***	0.039***	0.027***	-0.0067	-0.033***	0.016***
	(0.0062)	(0.0035)	(0.0026)	(0.0051)	(0.0020)	(0.0028)
Rural location at age 16	0.015	-0.0059	-0.016*	0.00083	0.0013	0.0047
	(0.0094)	(0.0063)	(0.0063)	(0.0097)	(0.0027)	(0.0046)
On First Nations reserve at age 16	-0.078***	0.015*	-0.014	0.046***	-0.000048	0.031***
	(0.012)	(0.0076)	(0.0074)	(0.010)	(0.0041)	(0.0051)
Rural and on First Nation reserve at age 16	0.0095	-0.0018	0.0088	-0.014	-0.0072	0.0046
	(0.017)	(0.010)	(0.0094)	(0.014)	(0.0055)	(0.0073)
Neighbourhood population density at age 16 (0000s)	0.018*	-0.024*	-0.0094	0.015***	-0.0022	0.0019
	(0.0072)	(0.0093)	(0.0066)	(0.0043)	(0.0034)	(0.0017)
Neighbourhood mean family income at age 16 (0000s)	-0.0099***	0.0014	0.00066	0.0059***	0.00021	0.0018***
	(0.0016)	(0.00080)	(0.00058)	(0.0011)	(0.00030)	(0.00053)
Neighbourhood education index at age 16	-0.015**	0.011***	0.0015	-0.0050	0.00075	0.0067**
	(0.0048)	(0.0028)	(0.0019)	(0.0038)	(0.0017)	(0.0022)
% Indigenous in SD at age 16	-0.0011***	0.00054*	-0.00038	0.00069	0.00034***	-0.00014
	(0.00023)	(0.00021)	(0.00022)	(0.00037)	(0.000086)	(0.00016)

	No PSE	Bach.	Ass. Deg.	Cert./Dip	Apprent.	Other
SEN at age 16	0.15***	-0.073***	-0.025***	-0.036***	-0.0065***	-0.0090*
	(0.0066)	(0.0072)	(0.0040)	(0.0058)	(0.0018)	(0.0038)
Ever ESL up to age 16	0.063***	-0.030***	0.00034	-0.030***	-0.0035	0.00029
	(0.0087)	(0.0070)	(0.0038)	(0.0068)	(0.0024)	(0.0039)
Ever French Immersion up to age 16	-0.084***	0.029***	0.0079*	0.032***	-0.0013	0.016***
	(0.010)	(0.0054)	(0.0038)	(0.0085)	(0.0032)	(0.0048)
Indigenous program at age 16 (ref. none)						
Language/culture	0.0075	-0.012*	-0.0060	0.0084	-0.0041	0.0063
	(0.0089)	(0.0050)	(0.0044)	(0.0069)	(0.0028)	(0.0046)
Support and other only	-0.014	-0.0074	0.012**	0.011	0.0015	-0.0027
	(0.0082)	(0.0047)	(0.0038)	(0.0063)	(0.0023)	(0.0040)
School type at age 16 (ref: standard)						
Alternative school	0.19***	-0.057***	-0.027***	-0.086***	-0.0089***	-0.015***
	(0.012)	(0.0065)	(0.0059)	(0.0081)	(0.0025)	(0.0039)
Distance education	0.14***	-0.046***	-0.017*	-0.061***	-0.014***	-0.0034
	(0.016)	(0.0073)	(0.0067)	(0.012)	(0.0035)	(0.0076)

	No PSE	Bach.	Ass. Deg.	Cert./Dip	Apprent.	Other
Grade 7 Numeracy FSA (Ref: 1st quartile)						
2nd quartile	-0.090***	0.035***	0.014***	0.032***	0.0017	0.0084**
	(0.0071)	(0.0032)	(0.0028)	(0.0064)	(0.0022)	(0.0030)
3rd quartile	-0.17***	0.079***	0.024***	0.052***	0.0011	0.018***
	(0.0073)	(0.0053)	(0.0038)	(0.0069)	(0.0025)	(0.0042)
Highest quartile	-0.26***	0.16***	0.021***	0.059***	-0.0037	0.026***
	(0.010)	(0.0079)	(0.0052)	(0.0088)	(0.0025)	(0.0057)
Present, but no score	0.068***	-0.0082*	-0.0075**	-0.043***	-0.0049*	-0.0039
	(0.0068)	(0.0032)	(0.0028)	(0.0056)	(0.0020)	(0.0038)
Missing	0.055***	0.016**	-0.0050	-0.047***	-0.0099***	-0.0080
	(0.011)	(0.0048)	(0.0037)	(0.0087)	(0.0027)	(0.0046)
Observations	45,663	45,663	45,663	45,663	45,663	45,663

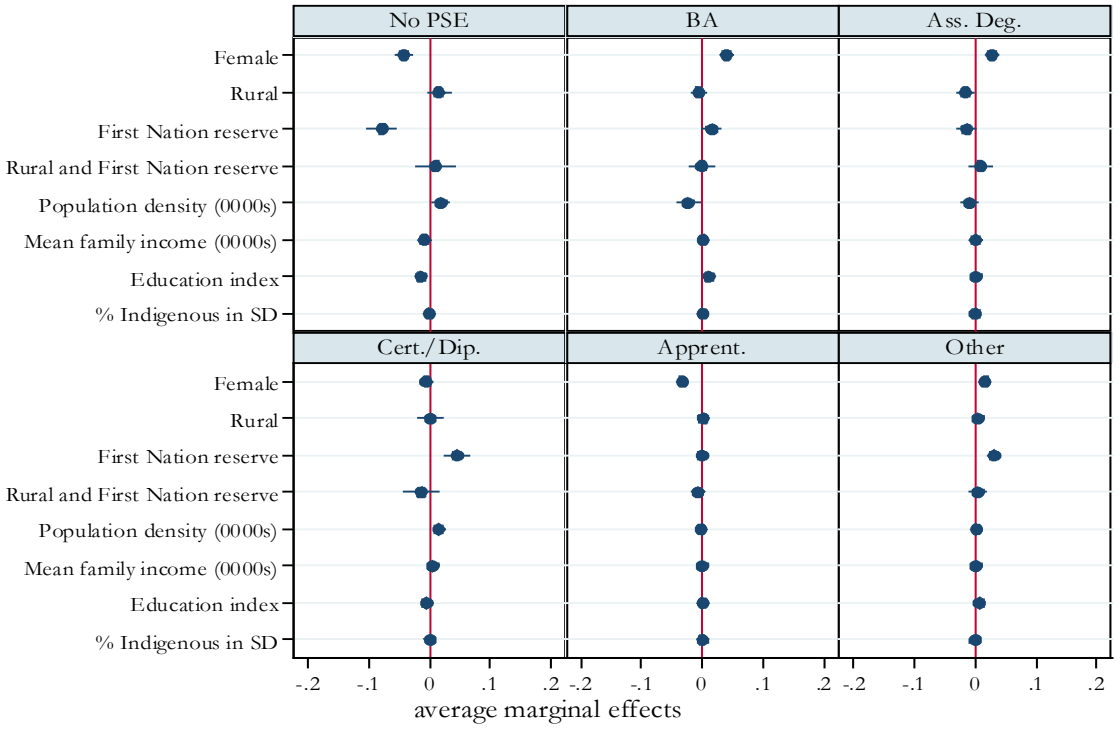
Notes: Average marginal effects shown. Standard errors in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001. Cohort variables included but not shown.

Figure 5 Difference in access to PSE by program by birth cohort



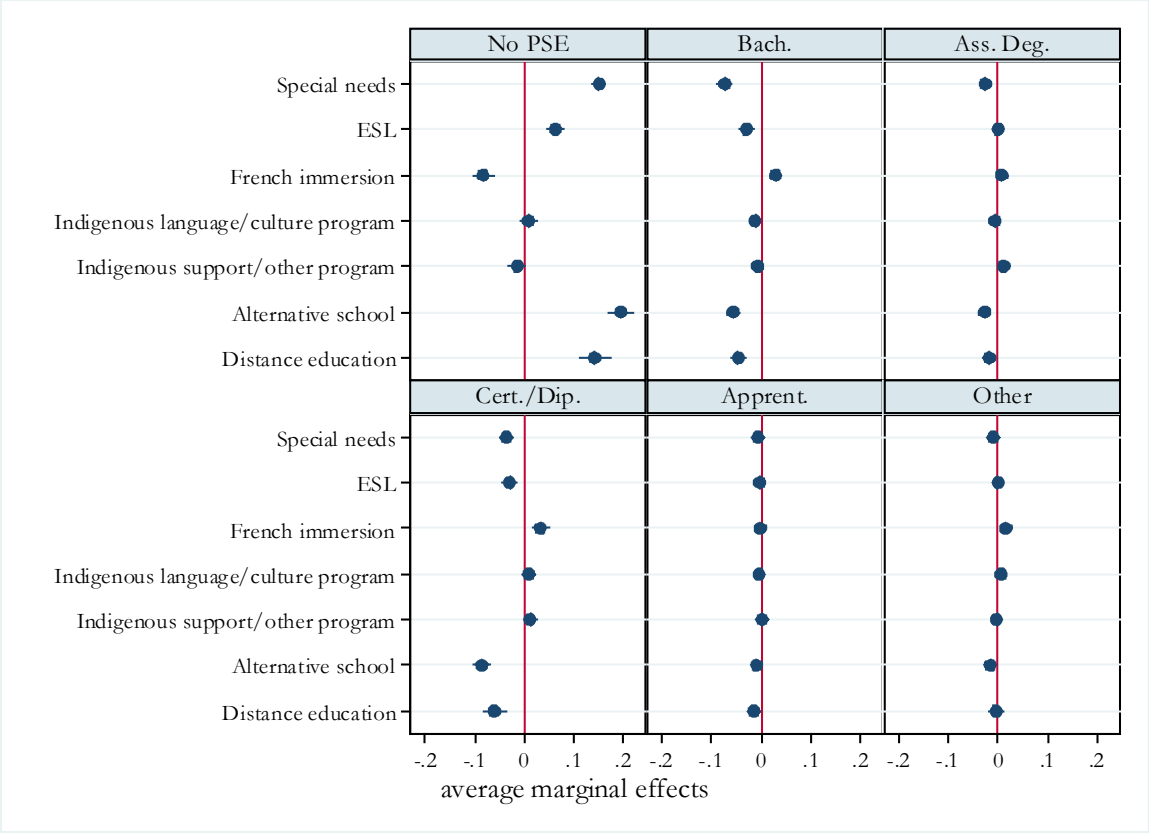
Notes: Estimates from the models reported in Table 4. The estimates are for the differences relative to the 1987 reference birth cohort. The vertical lines represent 95 per cent confidence intervals.

Figure 6 Difference in access to PSE by program by student and neighbourhood characteristics



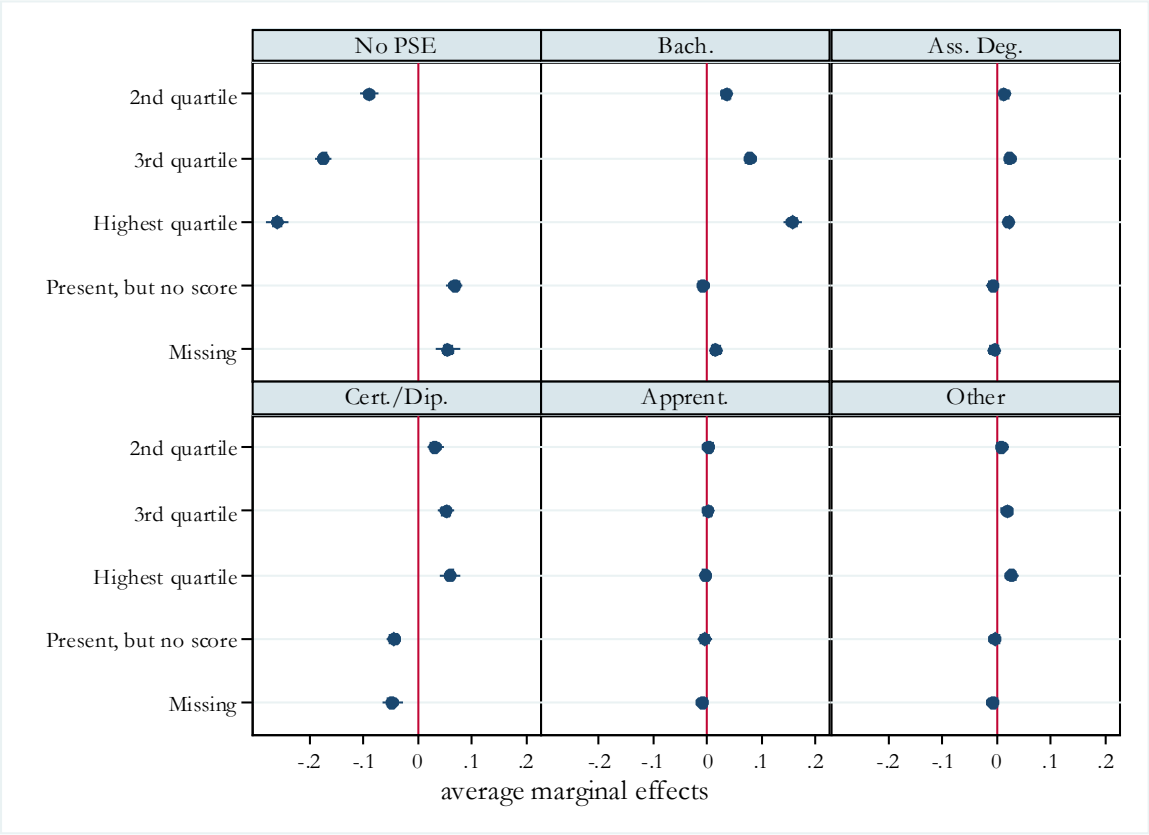
Notes: Estimates from model reported in Table 4. The horizontal lines represent 95 per cent confidence intervals.

Figure 7 Difference in access to PSE by program by K-12 program and school characteristics



Notes: Estimates from model reported in Table 4. The horizontal lines represent 95 per cent confidence intervals.

Figure 8 Difference in access to PSE by program by FSA numeracy test score



Notes: Estimates from model reported in Table 4. The horizontal lines represent 95 per cent confidence intervals.

INCLUDING ACCESS TO PSE OUT OF BC

As mentioned earlier, the BC PEN data do not capture post-secondary education outside of BC, so a supplementary analysis has been undertaken using Statistics Canada's BCK12-ELMLP dataset, which captures PSE at the national level. Unfortunately, it does not cover the full period of our BC- supplied data. We have narrowed our supplementary analysis to the cohorts born between 1987 and 1991, whose post-secondary participation can be fully tracked in both datasets to age 25. Table 5 shows the access rates of this older portion of our sample based on the BCK12-ELMLP, including those identified as attending BC PSE institutions specifically and then adding those who enroll elsewhere in Canada.

According to the BCK12-ELMLP, 35.3 per cent of the sample (first) accessed PSE in BC, and 38.1 per cent accessed PSE anywhere in Canada, or a difference of just 2.8 percentage points (allowing for rounding). We therefore conclude that our analysis based on the PEN data alone is likely to be highly representative of the general patterns of access to PSE among Indigenous BC

students wherever they may attend PSE in Canada (PSE outside of Canada is not captured by either dataset).

Furthermore, the BC PEN data have more detail than what is included in the ELMLP. First, the Other PSE category included in our PEN analysis includes a range of entry level PSE programs which BC Ministry of Education and other PEN data experts with experience in the analysis of Indigenous student participation in PSE advised us to include in our analysis, and these programs are not comprehensively included in the ELMLP.

Secondly, the BC PEN data provide the precise starting date of each program, whereas the ELMLP only has the academic year in which a program started, thus potentially confounding the ordering of first programs.

In addition, the ELMLP does not include the information on specific Indigenous programs taken which is included in the BC PEN data, thus limiting any BCK12-ELMLP analysis. Neither is the neighbourhood education index in the PEN data available in the national sample, which means we had to construct a comparable index which is necessarily different from the original measure.

Finally, the only Indigenous identifier is "Ever Indigenous", as opposed to the identification of Indigenous status by age 16 employed in our PEN data analysis, which is not subject to the kind of bias related to PSE attendance discussed above. This means the sample of Indigenous students is different in the BCK12-ELMLP analysis.

These factors may help explain at least some of the differences in the access rates obtained in the ELMLP even for BC institutions alone, including the lower overall access rates, the particularly low rate of entry into Other programs, and the other shifts across specific PSE programs, Apprenticeships versus Certificate/Diploma programs in particular.

While a full investigation of how the BC PEN data on their own compare to the BCK12-ELMLP would be worth undertaking, such a methodological study lies well beyond the scope of this initial consideration of access to PSE based on the BCK12-ELMLP data, and we remain nonetheless confident that our BC PEN analysis stands as a good representation of access to PSE among BC Indigenous students.

Table 5 Access rates (%) based on the BCK12-ELMLP (cohorts born 1987 through 1991)

	No PSE	Any PSE	Bach. or Ass. Deg.	Cert./Dip.	Apprent.	Other
Programs anywhere in Canada	61.9	38.1	9.5	14.7	10.3	3.6
Programs in BC only	64.7	35.3	8.9	14.0	9.3	3.1
Difference	-2.8	2.8	0.6	0.7	1.0	0.5

DISCUSSION AND CONCLUSION

This report presents the results of an analysis of access to post-secondary education (PSE) among Indigenous students in British Columbia using longitudinally linked administrative data at the K-12 and PSE levels. We consider both access to any PSE program and access to specific PSE programs: Bachelor's Degree, Associate Degree, Certificate or Diploma, Apprenticeship, or Other. In both cases we relate access to PSE by age 25 (by which time most students have made their first transition to PSE) to a range of student, neighbourhood, K-12 program, school, and skill assessment characteristics.

Access to PSE among Indigenous youth in BC has been steadily increasing for successive cohorts over the period examined. The greatest increase in both the raw rates and after controlling for other influences in the regression models is enrollment in Bachelor's Degree programs. Other findings include the following.

- Indigenous women are significantly more likely to access PSE than Indigenous men.
- On-reserve youth have higher PSE participation once the regression has controlled for the other factors.
- There is no significant difference in rates of access by rural compared to non-rural Indigenous youth. Importantly, the interaction of on-reserve residence and rural location has no independent influence on post-secondary access. These are important findings, given the challenges to provide post-secondary enrollment opportunities in rural and remote regions.
- Neighbourhood influences on access to PSE include mean family income and an education index. A related location measure captures the percentage of students in the school district that identify as Indigenous. All effects are positive.
- Among Indigenous students, enrollment in Special Education Needs (SEN) and English as a Second Language (ESL) programming in elementary or secondary school is associated with lower access while enrollment in French Immersion has a positive effect. ESL programming may be less than perfectly effective in equipping Indigenous youth for navigating the English-dominant BC education system, or the variable may be picking up other omitted influences correlated with ESL. French Immersion may be similarly picking up both the actual effect of this program on PSE as well as other effects related to selection into these programs, which in this case are positively related to PSE participation. The SEN effect speaks to associated disadvantages as well, again, as other omitted factors with which it is correlated.

- Participating in Indigenous student programming in high school exhibits no significant association with post-secondary access.
- Participating in schooling at age 16 through an alternative school or via distance education is associated with a lower probability of post-secondary enrollment. This effect again undoubtedly captures unobserved correlated factors influencing access to PSE as well as the extent to which such schools do not support post-secondary access as effectively as other school types.
- Performance on grade 7 numeracy Foundation Skills Assessments is strongly associated with post-secondary participation. Not taking the test likely signals various unobserved student or school characteristics associated with the decision not to, or inability to, take the test, and is significantly associated with not accessing PSE.

These findings point to the types of students more and less likely to access PSE, which could help guide further investigation of these tendencies in more detail and also pave the way for the implementation of policy initiatives aimed at increasing PSE participation rates, focusing on those students who may be less likely to access PSE.

For example, initiatives could target students with particular personal characteristics, in specific types of neighbourhoods or school districts, in designated programs or types of schools, or with (lower) FSA scores given these are associated with low PSE access rates.

For more precision, predictive models that take advantage of all the available information on students could exploit recent developments in advanced statistical techniques including machine learning to generate the optimal predictions of which students may be in greatest need of assistance at any grade level. Preferred points to generate such predictions, and to implement associated initiatives, could be as early as grades 5 and 8, when the grade 4 and grade 7 FSA scores (powerful predictors of access to PSE) first become available. Given the critical development students experience and the school transitions they face throughout their years in school, correctly timing the implementation of initiatives would help maximize their effectiveness.

One attractive policy strategy might be to introduce one or more initiatives along with associated evaluation strategies so that over time, the optimal approaches can be identified and implemented on a more general and permanent basis and otherwise built upon to develop a package of initiatives that could substantially increase the opportunities for Indigenous students to pursue PSE. Action of this nature would immediately acknowledge the importance attached to improved schooling opportunities and outcomes in the calls to action of the Truth and Reconciliation Commission and help to improve life chances for Indigenous youth in Canada.

Further research could also move from the issue of who accesses PSE to subsequent PSE experiences and outcomes following these starting points. Specific research questions could include who successfully completes their first program, who switches programs and what happens there, who leaves PSE without a credential, who graduates and moves on to one or more other programs, and final PSE attainment.

An even longer reach could include investigating early labour market outcomes after individuals leave school, both among PSE participants and for the Indigenous population more generally, including the 60 per cent of Indigenous youth (in BC) who do not go on to PSE.

Alternatively (or additionally), research could essentially back up to focus on the K-12 years to analyze how students progress through them, particularly from age 16 when students are legally permitted to leave school. Outcomes could include how far students progress in their studies, how long it takes those who graduate from high school to do so, and the grades they achieve along the way. The justification for this is that the K-12 years are critical to going on to and succeeding in PSE and to post-schooling experiences and life outcomes generally. And once better understood, similar policy strategies for developing predictive models to identify students at risk and implementing initiatives to improve Indigenous youths' experiences and outcomes could be adopted.

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APPENDIX A: ADDITIONAL TABLES

Appendix Table 1 Sample exclusions from starting sample of students born between 1987 and 1995

Number of students	Number excluded	% excluded	Reason for exclusion
631,290	572,318	91	Not identified as indigenous across any K-12 enrollment year.
58,972	10,440	18	Not present in Sept. 30 the year in which they turned 16.
48,532	2,139	4	Identified as Indigenous only after age 16.
46,393	730	2	Have missing values in one or more covariates.
45,663	*Final sample*		

Appendix Table 2 Regression results: access to PSE by program, Model 1 (student and neighbourhood characteristics)

	No PSE	Bach.	Ass. Deg.	Cert./Dip	Apprent.	Other
Female	-0.058***	0.042***	0.030***	0.0011	-0.032***	0.018***
	(0.0066)	(0.0037)	(0.0027)	(0.0052)	(0.0020)	(0.0029)
Rural location at age 16	-0.0041	-0.0021	-0.013*	0.011	0.0028	0.0055
	(0.012)	(0.0067)	(0.0064)	(0.010)	(0.0026)	(0.0047)
On First Nations reserve at age 16	-0.029	-0.011	-0.019*	0.032**	-0.0012	0.029***
	(0.016)	(0.0076)	(0.0079)	(0.011)	(0.0042)	(0.0053)
Rural and on First Nation reserve at age 16	0.018	-0.0045	0.0074	-0.018	-0.0080	0.0048
	(0.020)	(0.010)	(0.0096)	(0.015)	(0.0056)	(0.0074)
Neighbourhood population density at age 16 (0000s)	0.043***	-0.043***	-0.014	0.016***	-0.0043	0.0024
	(0.011)	(0.011)	(0.0075)	(0.0048)	(0.0039)	(0.0019)
Neighbourhood mean family income at age 16 (0000s)	-0.017***	0.0039***	0.0017**	0.0088***	0.00049	0.0023***
	(0.0017)	(0.00086)	(0.00057)	(0.0011)	(0.00032)	(0.00054)
Neighbourhood education index at age 16	-0.016**	0.013***	0.0012	-0.0056	0.00058	0.0073**
	(0.0057)	(0.0030)	(0.0019)	(0.0041)	(0.0017)	(0.0023)
% Indigenous in SD at age 16	-0.00052	0.00018	-0.00041	0.00056	0.00032***	-0.00013
	(0.00035)	(0.00024)	(0.00022)	(0.00037)	(0.000082)	(0.00018)
Observations	45,663	45,663	45,663	45,663	45,663	45,663

Notes: Average marginal effects shown. Standard errors in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001. Cohort variables included but not shown.

Appendix Table 3 Regression results: access to PSE by program, Model 2 (adding K-12 program and school variables)

	No PSE	Bach.	Ass. Deg.	Cert./Dip	Apprent.	Other
Female	-0.035***	0.034***	0.027***	-0.0077	-0.033***	0.015***
	(0.0064)	(0.0035)	(0.0025)	(0.0051)	(0.0020)	(0.0028)
Rural location at age 16	0.018	-0.0069	-0.016*	-0.00031	0.0012	0.0046
	(0.0097)	(0.0065)	(0.0064)	(0.0096)	(0.0028)	(0.0046)
On First Nations reserve at age 16	-0.051***	0.00093	-0.017*	0.038***	-0.00025	0.029***
	(0.013)	(0.0077)	(0.0075)	(0.010)	(0.0041)	(0.0052)
Rural and on First Nation reserve at age 16	0.018	-0.0057	0.0078	-0.017	-0.0073	0.0036
	(0.018)	(0.010)	(0.0097)	(0.014)	(0.0055)	(0.0073)
Neighbourhood population density at age 16 (0000s)	0.023**	-0.028**	-0.0098	0.015***	-0.0023	0.0018
	(0.0077)	(0.0097)	(0.0066)	(0.0042)	(0.0035)	(0.0017)
Neighbourhood mean family income at age 16 (0000s)	-0.012***	0.0025**	0.00095	0.0066***	0.00024	0.0020***
	(0.0017)	(0.00087)	(0.00058)	(0.0010)	(0.00031)	(0.00053)
Neighbourhood education index at age 16	-0.018***	0.013***	0.0017	-0.0045	0.00070	0.0069**
	(0.0050)	(0.0029)	(0.0019)	(0.0037)	(0.0017)	(0.0022)
% Indigenous in SD at age 16	-0.00099***	0.00047	-0.00040	0.00072*	0.00035***	-0.00013
	(0.00028)	(0.00024)	(0.00022)	(0.00035)	(0.000088)	(0.00017)
SEN at age 16	0.22***	-0.11***	-0.033***	-0.059***	-0.0076***	-0.013***
	(0.0070)	(0.0079)	(0.0043)	(0.0061)	(0.0018)	(0.0037)

	No PSE	Bach.	Ass. Deg.	Cert./Dip	Apprent.	Other
Ever ESL up to age 16	0.099***	-0.050***	-0.0038	-0.040***	-0.0037	-0.0022
	(0.0094)	(0.0074)	(0.0036)	(0.0069)	(0.0024)	(0.0038)
Ever French Immersion up to age 16	-0.11***	0.038***	0.011**	0.041***	-0.00072	0.019***
	(0.011)	(0.0057)	(0.0038)	(0.0087)	(0.0032)	(0.0049)
Indigenous program at age 16 (ref. none)						
Language/culture	0.011	-0.014*	-0.0063	0.0072	-0.0041	0.0058
	(0.0098)	(0.0055)	(0.0045)	(0.0069)	(0.0028)	(0.0046)
Support and other only	-0.013	-0.0083	0.012**	0.011	0.0016	-0.0028
	(0.0093)	(0.0051)	(0.0039)	(0.0064)	(0.0023)	(0.0041)
School type at age 16 (ref: standard)						
Alternative school	0.21***	-0.063***	-0.029***	-0.095***	-0.0095***	-0.019***
	(0.011)	(0.0058)	(0.0055)	(0.0078)	(0.0024)	(0.0038)
Distance education	0.17***	-0.053***	-0.020**	-0.075***	-0.015***	-0.0082
	(0.015)	(0.0067)	(0.0062)	(0.011)	(0.0033)	(0.0071)
Observations	45,663	45,663	45,663	45,663	45,663	45,663

Notes: Average marginal effects shown. Standard errors in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001. Cohort variables included but not shown.

APPENDIX B: PSE INSTITUTIONS INCLUDED IN THE BC PEN DATA

COMMUNITY COLLEGES

- Camosun College
- Coast Mountain College
- College of New Caledonia
- College of the Rockies
- Douglas College
- Langara College
- North Island College
- Northern Lights College
- Okanagan College
- Selkirk College
- Vancouver Community College

INSTITUTES

- British Columbia Institute of Technology
- Justice Institute of British Columbia
- Nicola Valley Institute of Technology

TEACHING-INTENSIVE UNIVERSITIES

- Capilano University
- Emily Carr University of Art + Design
- Kwantlen Polytechnic University
- Royal Roads University
- Thompson Rivers University
- Vancouver Island University
- University of the Fraser Valley

RESEARCH-INTENSIVE UNIVERSITIES

- Simon Fraser University
- University of British Columbia (Vancouver & Okanagan
- University of Northern British Columbia
- University of Victoria

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