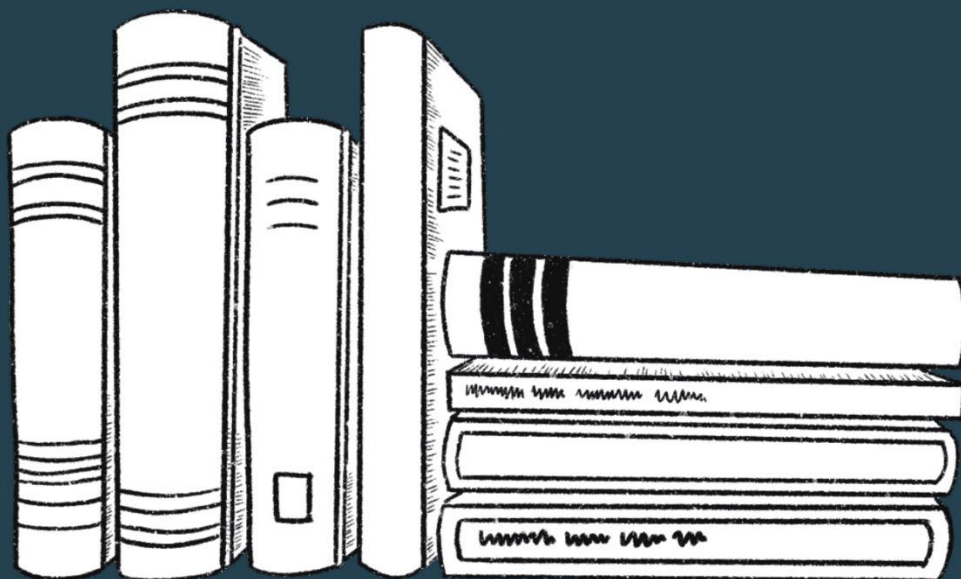


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Exploring the Relationship Between High School Math Achievement and PSE Pathways Using the CRP Dataset

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Introduction and Summary

This research brief draws on data from the Hamilton Community Research Partnership (CRP) to explore whether and how indicators of math achievement in high school relate to postsecondary pathways. The Hamilton CRP is a data-sharing coalition made up of six partners: The Hamilton-Wentworth public and catholic school boards, McMaster University, Mohawk College, the Hamilton Community Foundation and the Higher Education Quality Council of Ontario (HEQCO). The CRP partners joined together to better understand the educational pathways of Hamilton students. In the process, we developed and tested a data-sharing mechanism using the Ontario Education Number (OEN); assembled a dataset that links high school and postsecondary education (PSE) data for Hamilton students who entered Grade 9 in 2010; and established procedures for ongoing, collaborative education research in the Hamilton community.

The Hamilton CRP has so far produced two reports, both published in 2022. [CRP Blueprint: How We Built a Community Data Infrastructure](#) details the steps taken to build the CRP dataset for other interested communities and organizations. Our research report, [The Power of Connected Data: Charting Student Pathways to and through Postsecondary in Hamilton](#), drew from the CRP dataset to examine the educational pathways of Hamilton students from high school to and through postsecondary. It identified Grade 9 credit accumulation and secondary grades as strong determinants of graduation at both secondary and postsecondary levels, and identified two demographic variables, income and stream, as providing advantages along Hamilton educational pathways. [The Power of Connected Data](#) did not explore variables relating to specific subjects in high school.

Here, we draw on the CRP dataset to explore a specific subject, mathematics, and whether and how math achievement indicators — including standardized test results, grades and stream choice — relate to PSE access and success. We chose to focus on math because math skills, and numeracy skills more broadly, are important determinants of students' economic outcomes later in life ([Brumwell & MacFarlane, 2020](#)). Second, while research has provided some understanding of how high school achievement influences PSE access, there has been little Canadian investigation into the relationship between high school math achievement and postsecondary persistence.

In addition, concerns about the state of Ontario students' math skills (EQAO, 2022; Stokke, 2015; 2016) have received significant policy attention in recent years: in 2019-20, the Ontario Ministry of Education (EDU) released a \$200 million, four-year math strategy that included a modernized curriculum (Ontario Newsroom, 2019). To complement the math strategy, EDU announced \$71 million for a new math plan in 2023-24 that will, among other goals, double the number of math school coaches in classrooms and expand access to digital math tools (Ontario Newsroom, 2023). Ontario also made the policy decision in July 2020 to destream Grade 9 compulsory courses, starting with math, and launched the destreamed Grade 9 math curriculum in 2021 (Ontario Newsroom, 2021).

Researchers require reliable indicators to monitor the extent to which these policy changes and investments result in improved math skills. Deciding which indicators of system performance to

rely on is complicated, especially in light of pandemic disruptions, evolving grading practices and public discourse about standardized tests. Early in the pandemic, the Government of Ontario instituted a freeze on grades such that students' marks could not decline for the remainder of the academic year after March 13, 2020 — the last day of in-person schooling ([Gallagher-Mackay & Brown, 2021](#)). When COVID-19 variants disrupted learning again in 2022, some boards undertook their own measures to prevent grades from dropping (Thompson, 2022). To keep students engaged throughout emergency remote learning, educators across the province acknowledged evaluating students with increased empathy (Hurley, 2022), and some began experimenting with practices like “ungrading” (Alphonso, 2022).¹ By extension of these policy-, board- and classroom-level factors, despite widespread concern about learning loss due to pandemic disruptions, we saw unprecedented grade increases (Hurley, 2022).²

In 2019-20, Ontario suspended its standardized tests run by the Education Quality and Accountability Office (EQAO) “in light of the ‘immense pressures’ students [were] facing in their academic careers as a result of the COVID-19 pandemic” (Freeman, 2020). EQAO tests also underwent a major reform before being reinstated, first on a voluntary basis in 2021-22 and eventually at scale in 2022-23. As a result of the reforms, the latest results are not comparable with pre-pandemic benchmarks ([Gallagher-Mackay et al., 2023](#)). Critics have also called for EQAO assessments to be canceled, citing potential misuses (e.g., being used to rank schools) and risks to students, such as causing undue stress, particularly during the pandemic (Alphonso, 2018; Teotonio, 2022).

To be clear, the CRP dataset relies on historic data, and therefore cannot be used to evaluate the results of Ontario’s recent four-year math strategy or destreaming policy, or the effects of the pandemic on student learning. However, we can provide insight into relationships between conventional indicators of math achievement in high school — grades, EQAO scores and math stream — and PSE access and success, which a successful policy would facilitate. Indeed, this brief is intended to help inform discussions about the best way to monitor students’ math skills at a system-wide level.³

Research Question and Methodology

This brief explores the question: What is the relationship between indicators of math achievement in high school and PSE student success?

We used the Hamilton CRP dataset to match postsecondary and school board data: a total of 5,376 records. We looked at the relationship, using descriptive statistics, between potential indicators — namely, secondary math grades, Grade 9 Math EQAO results,⁴ and Grade 9 math stream — alongside outcome variables: namely, high school graduation, postsecondary confirmations of acceptance and program choice. For the 2,399 students in our sample who

¹ “Ungrading is a practice which eliminates or greatly minimizes the use of assigned points or letter grades in a course, focusing instead on providing frequent and detailed feedback to students on their work, in relation to the course learning goals” (Kenyon, 2022).

² The *Toronto Star* reports that “between 2007 and 2021, the number of first-year students entering [PSE] with a high school average of 95+ increased, for example, by 885 percent at Western and 700 at Waterloo” (Hurley, 2022).

³ Our paper does not comment on the best approaches to measuring and motivating student achievement at an individual level.

⁴ EQAO tests are administered in grades 3, 6, 9 and 10 and measure student achievement in reading, writing and math in relation to curriculum expectations (EQAO, 2019). The grade 9 EQAO test focuses specifically on math.

studied at either McMaster University or Mohawk College, we also examined relationships between our indicators and grades and graduation rates.⁵

For further details about assembling the CRP dataset, see our companion report, [CRP Blueprint: How We Built a Community Data Infrastructure](#).

Findings and Discussion

Students with higher grades and standardized test (EQAQ) scores tended to graduate high school, access postsecondary, earn higher postsecondary grades and graduate postsecondary in higher numbers, as did students in Academic math (compared to students in non-Academic math).

High School Grades and PSE Pathways

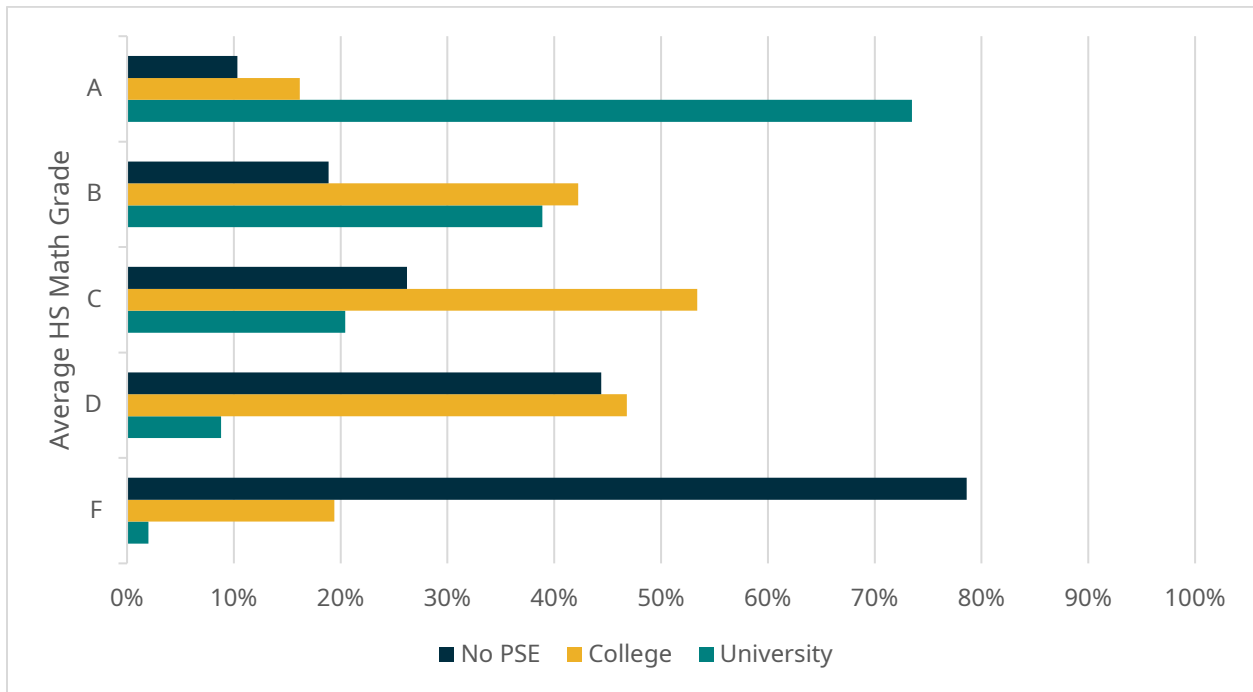
Students who earned higher average high school math grades tended to graduate high school in higher numbers (98% of students who earned an A graduated versus 81% who earned a D) and confirm a PSE acceptance in higher numbers (see Figure 1).⁶ Ninety percent of students who earned an A in math confirmed a PSE offer of acceptance in Ontario, compared with 56% of those who earned a D and only 21% of those who earned an F. Students who earned higher average grades also confirmed university more specifically; 73% of students who earned an A confirmed a university acceptance versus 9% of students who earned a D. This aligns with findings from “A Century of Grading Research” namely, despite large variation in the validity and reliability of grading practices, “grades consistently predict K-12 educational persistence, completion, and transition from high school to college.” The authors note that grades are multidimensional measures, reflecting factors like students’ effort and participation in addition to cognitive ability, making them good measures of future success (Brookhart et al., 2016).

⁵ We note any relationships with secondary level variables are subject to the risk of confounding by selection of students who 1) are accepted to and attend postsecondary and 2) choose a local institution.

⁶ We saw similar associations between secondary grades, generally, and PSE confirmations.

Figure 1

Average High School Math Grades and PSE Pathways



Note: This figure references Ontario application centre data and shows the percentage of students who did not confirm acceptance to an Ontario college or university, confirmed college, or confirmed university by grade earned in high school mathematics, sorted by grades A, B, C, D and F. Table A2 in the Appendix converts letter grades to percentages and provincial levels 1 to 4 (n=5375).

Looking only at those students who studied college or university in Hamilton, we found students who earned higher average high school math grades:

- Enrolled in STEM⁷ programs more often (43% of students who earned an A in high school math enrolled in STEM program versus 6% of students who earned a D in high school math).
- Earned higher grades in PSE (75% of students who earned an A in high school math earned an A or B in PSE versus 31% of students who earned a D in high school math).
- Graduated PSE in higher numbers (80% of students who earned an A in high school math graduated within the timeframe for our analysis versus 46% of students who earned a D in high school math).

These findings align with those from a study linking data from the Toronto District School Board (TDSB) with data from Statistics Canada’s Postsecondary Student Information System (PSIS). That study found PSE graduation rates increased in step with Grade 9 math grades (see Table A1 in the Appendix), and approximately two thirds of those who did not complete a Grade 9 math credit did not make the transition to postsecondary (Brown et al., 2021).

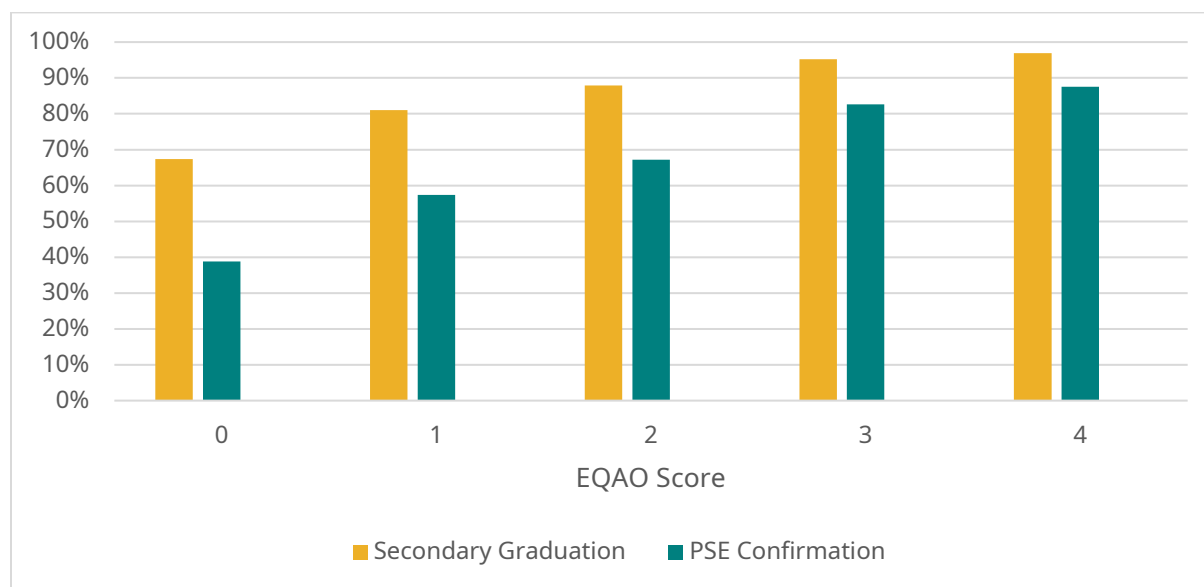
⁷ STEM refers to science, technology, engineering and math. College and university program codes were grouped into the two broad categories of STEM and BHASE, aligned with Statistics Canada’s classification structure displayed in Table 1 on page 19 of *The Power of Connected Data*.

EQAO Scores and PSE Pathways

Our research demonstrates a positive relationship between EQAO scores and student achievement. Students with higher scores on the Grade 9 EQAO test, which focuses on math, graduated high school and confirmed PSE acceptances in larger numbers (see Figure 2). Students who met or exceeded the EQAO Grade 9 math standard (i.e., scored a 3 or 4) confirmed university acceptances at higher rates than those who did not meet the standard.

Figure 2

EQAO Scores and PSE Confirmations



Note: This figure references Ontario application centre data and shows the percentage of students who graduated from secondary school and who confirmed PSE by their EQAO score, showing scores from 0 to 4 (n=5375).

The proportion of students who graduated high school and confirmed a PSE offer of acceptance in Ontario increased in step with the Grade 9 EQAO score earned: 67% of students who scored a 0 graduated high school versus 81% who scored a 1, 88% who scored a 2, 95% who scored a 3 and 97% who scored a 4. Eighty-three percent of students who met the standard confirmed a PSE acceptance versus 64% of those who did not. Of those who confirmed acceptance to a STEM program, 85% met the EQAO standard. Looking at those students who studied college or university in Hamilton only, we found that a larger proportion of students who met the Grade 9 standard in turn earned higher PSE grades and graduated PSE (see Appendix Figures A1 and A2).

These results align with previous research by Statistics Canada, which used the Youth in Transition Survey (YITS)⁸ and data from the Programme for International Student Assessment (PISA), another standardized test, to explore relationships between math and science high

⁸ The study drew from the Canadian component of the PISA survey from 2000 (when respondents were aged 15) and longitudinal YITS data to age 25 (Hango, 2013).



school test scores and PSE pathways. Researchers found a student with high math ability (as measured by PISA) had a 10% higher chance of securing university admission than a student with low math ability. Youth with strong math skills were also more likely to enrol in STEM programs that require advanced math skills. The results were consistent across genders, suggesting both males and females with high math scores had greater chances of securing university admission (Hango, 2013).

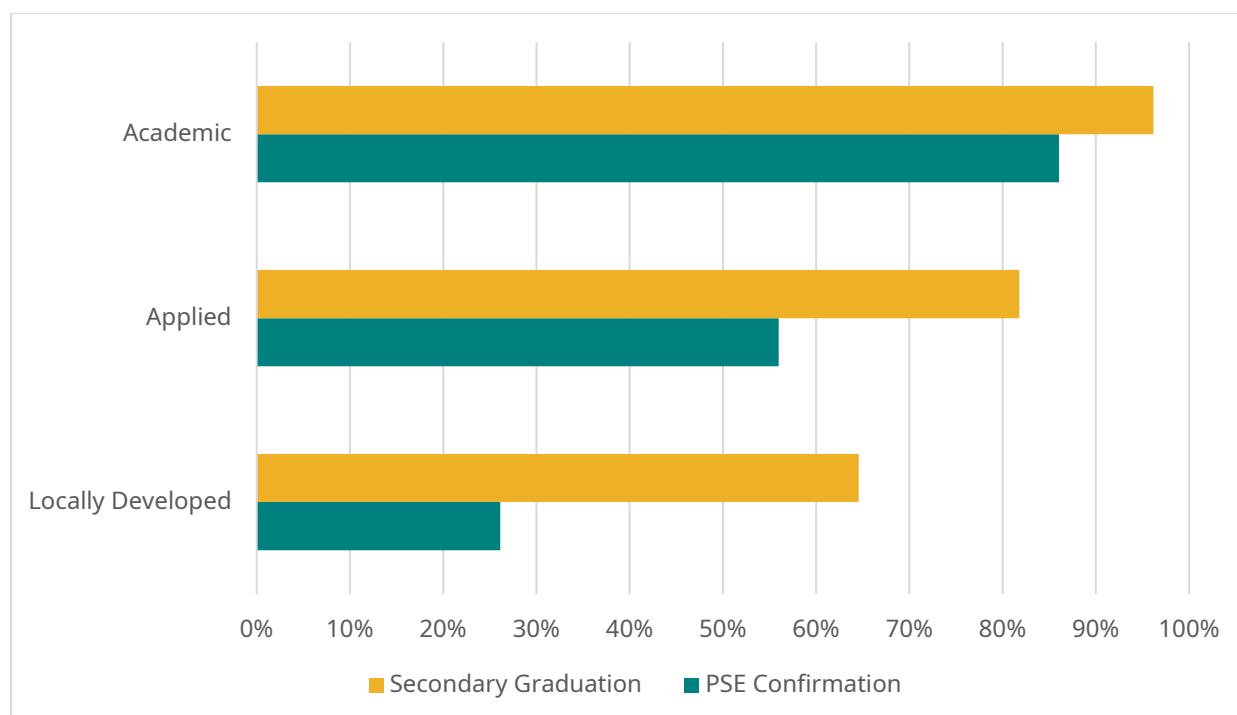
Math Stream and PSE Pathways

Prior to 2021, Ontario Grade 9 math students had the option of taking Academic, Applied, Locally Developed or Open-level courses. Historically, racialized and lower-income students were disproportionately encouraged to pursue non-academic paths ([Pichette et al., 2020](#)), which prompted calls for the province to adjust its policy. The Government of Ontario responded, destreaming the Grade 9 math course in the 2021-22 academic year and delaying students' choice between Academic and non-Academic math streams until Grade 10 (Ontario Newsroom, 2021). Though our results reflect data gathered while Grade 9 math was still being streamed into Academic and non-Academic options, they reinforce this policy decision.

More students who took Grade 9 Academic math (96%) graduated high school than students in Applied (82%) or Locally Developed (65%) streams (see Figure 3). Further, far more students who took Academic math pursued PSE (86%) compared with students in Applied (56%) or Locally Developed (26%) Grade 9 math — a difference of between 30 and 72 percentage points.

Figure 3

Math Stream and Secondary and Postsecondary Attainment



Note: This figure shows the percentage rate of secondary school graduation and PSE confirmation by Grade 9 math stream, sorting the total group of 5340 by Academic (n=3511), Applied (n=1561) and Locally Developed (n=268).

Looking at those students who studied college or university in Hamilton only, we found more students who took Grade 9 Academic math pursued STEM programs (32%) compared to students who took Applied math (13%). Students of Academic math also tended to have higher PSE grade averages and graduation rates: 67% of students who were in the Academic stream graduated PSE within our 10-year timeframe versus an average of 53% of students who took either Applied or Locally Developed math.

These results are unsurprising given prior research illustrating the connection between high school course selection and achievement. For example, the College Student Achievement Project (CSAP), which included data from 11 Ontario colleges and a variety of school boards, found that over 70% of students who took Academic math in high school achieved good grades in college (i.e., a grade of A, B or C). Fewer than 50% of those who took Applied math did so (Schollen et al., 2009).

Unlike the other two variables of interest — grades and standardized test scores — existing research suggests stream choice does more than merely indicate or predict PSE pathways; it can also depress achievement and effectually block pathways (People for Education, 2019). Indeed, EQAO’s interim Chief Operating Officer noted:

a persistent achievement gap between students enrolled in the applied course and those enrolled in the academic course, regardless of early learning experiences, and students

enrolled in an academic course of study demonstrate higher achievement, regardless of past experiences with large-scale assessment. (2021)

From 2014 to 2019 (the last year prior to Grade 9 being destreamed), an average of 44.5% of students who pursued Applied math met or exceed the provincial standard, compared to 83.5% of students who pursued Academic math (EQAO, 2019).

Discussion and Conclusion

The Government of Ontario has made several recent policy announcements intended to help improve high school math achievement and set students up for success after graduation. Our findings on the relationship between math stream and PSE attainment reinforce the importance of destreaming Grade 9 math. Ontario should continue working towards a system where students select pathways when they have more clarity about their skill levels and career interests ([Pilla et al., 2023](#)).

Evaluating whether policy changes, like destreaming, and investments to improve math education have been sufficient will require reliable indicators of system-level improvement. Our previous report, [The Power of Connected Data](#), highlighted the predictive value of grades and credit accumulation in the early years of high school. This data brief suggests that, alongside those indicators, standardized tests provide an important indication of how well Ontario's education system is preparing students for success. While imperfect on their own, and problematic if used to rank or compare individual schools, American research suggests standardized test scores are a solid measure of learning and predictive of outcomes later in life, including in PSE and the labour market (Chetty et al., 2014; Goldhaber & Ozek, 2018; Dynarski et al., 2013). Math-focused tests in particular have been shown to be reliable predictors of postsecondary success (Scott-Clayton, 2012; Hodara & Lewis, 2017), and add to the predictive ability of grades — together providing more reliable information about system-level performance (Allensworth & Clark, 2020).

The pandemic accentuated the need for a well-rounded set of metrics that monitors students' knowledge and skill development. The situation described in the introduction — suspended and adapted EQAO tests, alongside unprecedented grade increases — has left Ontario without a clear understanding of how learning disruptions tied to the pandemic affected students. In jurisdictions that have conducted large-scale, comparable assessments, “the impact of the pandemic on student learning has been seen to be both serious and unequal” ([Gallagher-Mackay et al., 2023](#)). These studies call into question the extent to which rising grades during the pandemic reflect actual increases in knowledge and skill development. Without well-rounded metrics we remain uncertain about the extent of learning lost during pandemic disruptions, and unaware of the subjects and regions that most require intervention to ensure students succeed after high school.

It is important to bear in mind that indicators should be used as a tool to monitor system-level achievement and inform strategies for improving PSE access and success (e.g., investments or policy adjustments). To ensure indicators continue being useful monitoring tools, the province must avoid viewing them (high grades or EQAO scores) as ends in themselves. Requiring schools to meet pre-determined goals in relation to either grades or standardized tests, and

publicizing progress towards those goals, may have the unintended effect of diminishing the utility of the indicators we have available.

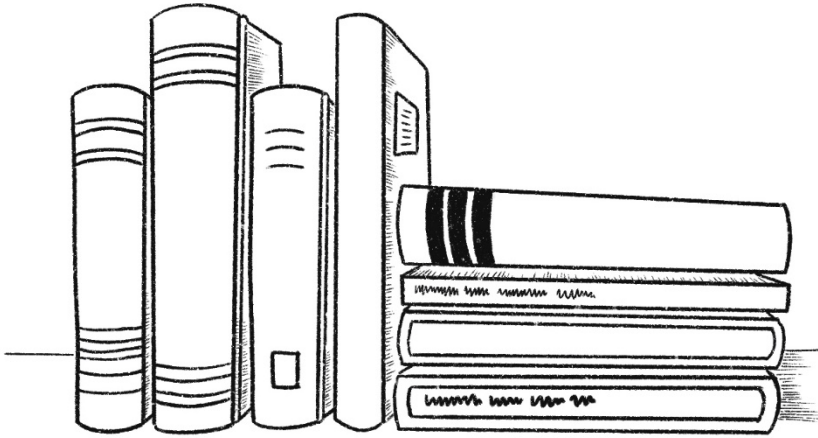
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Exploring the Relationship Between High School Math Achievement and PSE Pathways Using the CRP Dataset

Appendix

Table A1

TDSB Student Grade 9 Achievement in Mathematics (originally appeared in Brown et al., 2021)

Grade 9 Achievement in Mathematics	No Postsecondary in Canada	Postsecondary but Did Not Graduate	Graduated College	Graduated University	Total (%)	Total (N)
No Math Credit in Grade 9	65.6%	19.1%	10.7%	4.5%	100%	6170
Math Mark of 50–59	33.9%	25.4%	19.4%	21.2%	100%	10650
Mark of 60–69	22.5%	23.7%	17.9%	35.9%	100%	9640
Mark of 70–79	15.0%	20.1%	13.6%	51.2%	100%	10110
Mark of 80 Plus	9.3%	11.6%	6.8%	72.3%	100%	13880

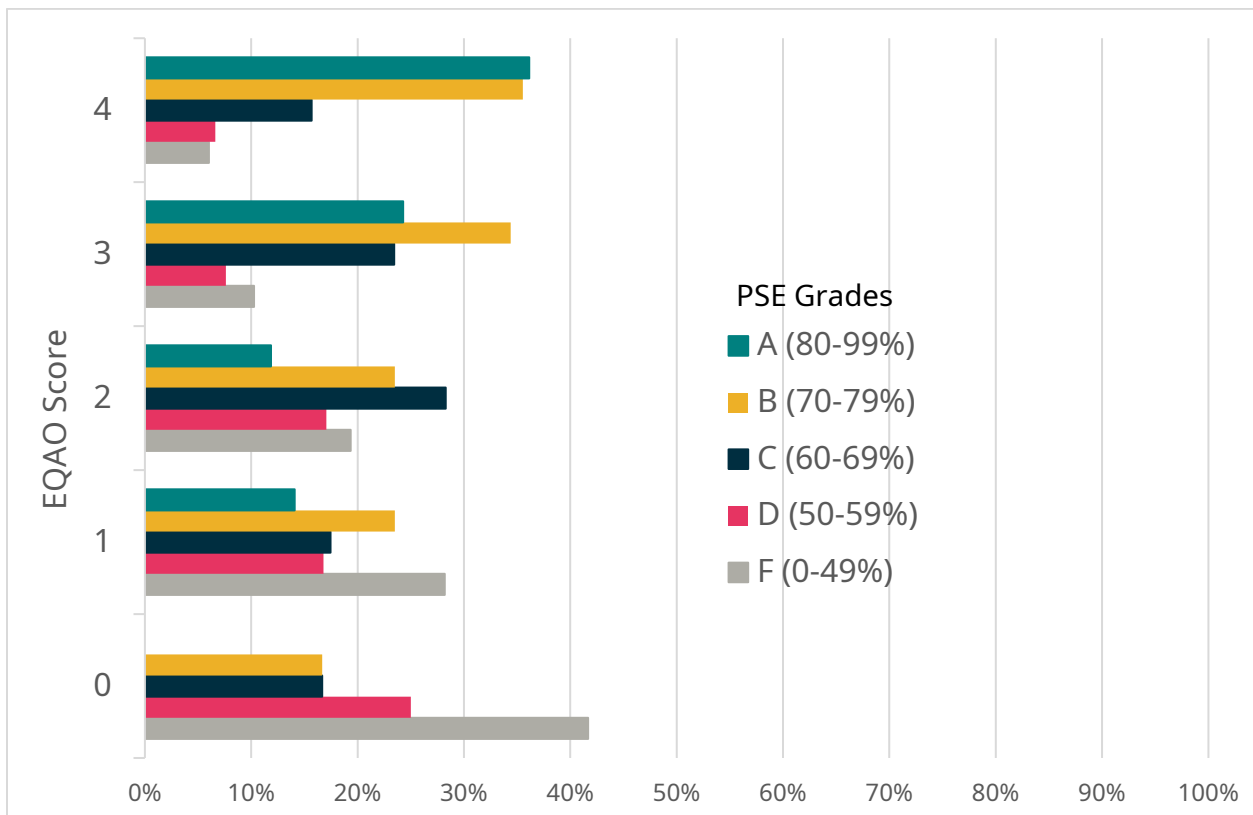
Table A2

Grade Conversions

Letter Grade	Percentage Grade	Provincial Level	Provincial Standard
A	80–99	4	Meets provincial standard
B	70–79	3	
C	60–69	2	Does not meet provincial standard
D	50–59	1	
F	0–49	R	

Figure A1

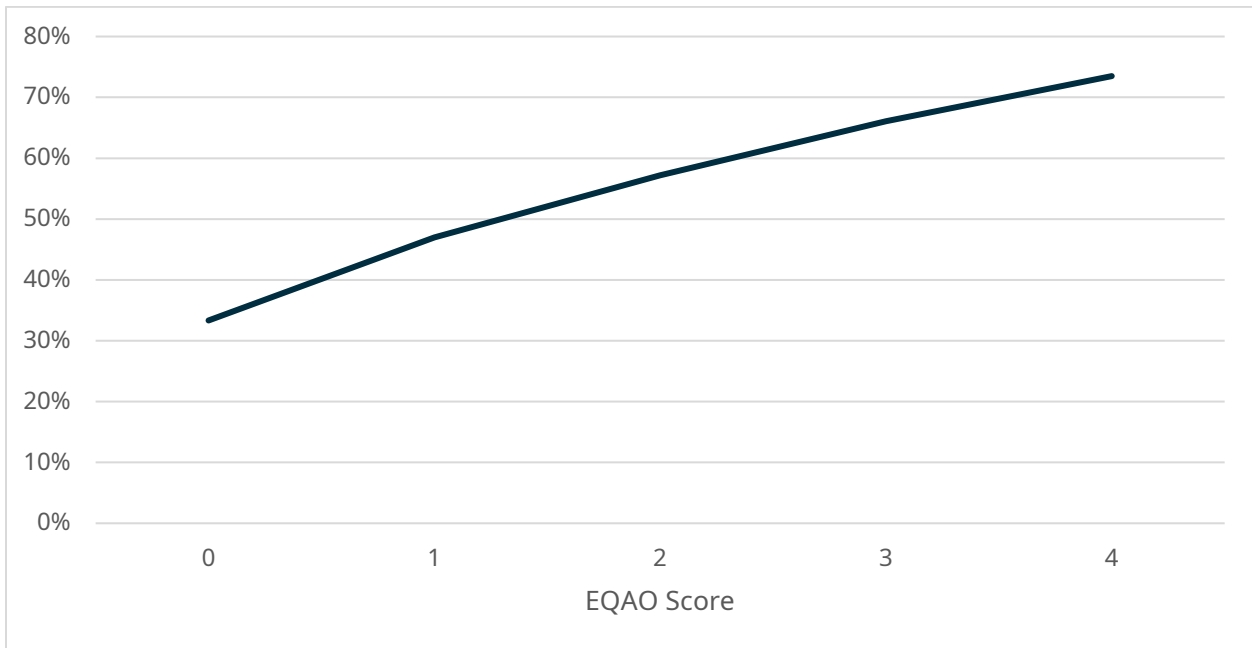
EQAO Score and PSE Grades



Note: This figure shows the varying percentages of students who earn an A, B, C, D and F in PSE by their EQAO scores, rated from 0 (lowest) to 4 (highest) (n=2399).

Figure A2

EQAO Score and PSE Graduation



Note: This figure shows the overall percentage of students who graduate PSE according to their EQAO scores, rated from 0 (lowest) to 4 (highest) (n=2399).