CLASS SIZES IN ALBERTA

A CLOSER LOOK AT THE ALBERTA EDUCATION 2019 CLASS SIZE INITIATIVE REVIEW

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EXECUTIVE SUMMARY

On 18 October 2019, the Alberta Ministry of Education released the Class Size Initiative Review. This review claimed that the province's Class Size Initiative, started in 2004 to address public concerns over Alberta's increasing class sizes, was ineffective in its intended goal. This conclusion served as the predicate to terminate the program in the 2019-20 provincial budget, released less than a week later. However, the Ministry's analysis was superficial and underutilized the extensive fifteen years of class size data collected by the program. The review reached several easily refutable conclusions that undermine the credibility and objectivity of the Ministry's analysis. In response to these deficiencies, Support our Students Alberta performed our own, more detailed and thorough analysis: we leveraged the depth of data collected in the Class Size Information System, constructing computer models and simulations to investigate the effectiveness of the Class Size Initiative, factors influencing class size, forecasted effects, and possible resolution strategies.

Our analysis shows that, contrary to the Ministry's conclusions, upwards of 80% of the initiative's funds were invested in the estimated 2900 teachers hired and retained, and that these teachers had a demonstrable positive effect on inhibiting class sizes during a period of significant enrollment growth. Without this funding, class sizes would be significantly higher today. Further, we identified that strategies exist with the potential to more efficiently distribute teachers, students and classes to achieve smaller class sizes, but that the realization of these strategies would impose difficult and sometimes impracticable tradeoffs. Ultimately, we found that any strategy to return class sizes to 2007 levels (the smallest class sizes in fifteen years) must include the addition of classes.

As the requirement for school authorities to report on class size data was eliminated along with the initiative's funding, an analysis of this kind will likely be the last. We project class sizes will continue to deteriorate, and without the continued collection of class size data, school jurisdictions will be deprived of information critical for sound, evidence-based decision making. The 2018 Auditor General's Report urged the Ministry to better leverage the available data as part of continuous improvement; eliminating data collection nullifies the Auditor General's salient recommendations. Without future class size data, Albertans are denied the transparency and accountability for an important issue.

Our three main concerns with the 2019 Class Size Initiative Review are:

1. Inaccurate and incomplete analysis of the data available.

    a. The Ministry did not substantiate its claim that "only a small percentage of funding… [was] targeted specifically towards hiring teachers under the Class Size Initiative"; the Ministry made no attempt to quantify this proportion. The Ministry resorted to speculation and hearsay in its conclusions, such as how the funds "may" have been spent, without due-diligence investigation and quantification of the extent and sigificance of these claims.

    b. The Ministry did not examine what may have been effective, or what was limiting effectiveness of the program, preferring instead to reject the program outright without leveraging the extensive data for a more thoughtful and useful analysis.

c. Over-dependence on class size average as a metric: class size averages do not accurately represent the widening distribution of class sizes, especially the worrying increase in the proportion of students in the extreme end of class sizes.

2. No consideration was given to the *null hypothesis*, that is to consider the alternative scenario in which the Class Size Initiative had never existed. Absent a comparison with this scenario, it is irresponsible to discredit an initiative that introduced 2900 teachers into a ballooning system. Consideration and mention must be given to what would have transpired without this important funding. Our own analysis shows that without the Class Size Initiative funding, the proportion of K-3 students in a class size of 23 or more in 2018 would increase from 37% to at least 87%.

3. The report neglects the opportunity to consider important factors such as infrastructure deficit, increasing class complexity, and alternative methods of quantifying class size that better reflect a student-centered perspective. Instead, the report artlessly falls back on improving "teacher quality" as a naïve solution to the complex problem. The Alberta government looked to other provinces (i.e. Ontario and BC) for suggestions in the MacKinnon report; similar considerations should be given here as both those provinces legislated class size caps/ranges. No mention of those initiatives was made in this report.

We hope the Ministry of Education will consider this report as a more detailed analysis of the situation and consider the recommendations made within when looking for strategies to tackle the Alberta's increasing class sizes.

KEY FINDINGS

Contradicting the conclusions of the Ministry's report, our analysis shows upwards of 80% - 93% of the Class Size Initiative funding was appropriated towards retaining teachers. Our own analysis found that the class size initiative funding was effective in reducing class sizes from 2004 to 2008; during this period, the proportion of K-3 students in metropolitan schools with a class size of 23 or more decreased from 27% to 17%. Similarly, this figure for non-metropolitan schools decreased from 24% to 16%.

Our analysis determined that, had 2900 teachers not been hired and retained as part of the Class Size Initiative, the proportion of K-3 public students enrolled in 2018 in a class size of 23 or more would be at least 87%, compared to its actual 2018 value of 37%. The funding more than halves the number of K-3 students that would be in a class size of 30 or more, from almost 3000 to 1300.

Despite the early effectiveness of the funding, it was unable to keep pace with the enrollment growth beyond 2007. From 2007 to 2018, K-3 enrollment in metropolitan areas grew by 50%, in that time, the proportion of K-3 metropolitan students in a class size of 23 or higher soared from 17% to 44%. The same figure for non-metropolitan students grew from 16% to 30%. Our analysis shows that at the current trend of enrollment, class sizes will continue to degrade in future years unless significant action is taken.

To investigate multiple strategies for reducing class size, we developed a software model that simulates various strategies, including adding classrooms, re-distributing teachers, and re-distributing students. We found that re-distributing up to 2.4% of metropolitan K-3 students (such as through re-zoning, while acknowledging the many practical difficulties of doing so) may have a mild impact on reducing the largest class sizes, but would fall significantly short of 2007-era levels as measured by our Class Size Index. Any solution to restore the Class Size Index to 2007-era levels for K-3 metropolitan students would require the addition of at least 390 K-3 classrooms in Calgary and Edmonton, or an approximately a 10% increase from the number of 2018 K-3 classes.

Our modelling shows that without increases to the number of K-3 classes beyond 2018, by 2023, provincially, the proportion of K-3 students in a class size of 23 or higher would be at least 50%, up from the 2018 proportion of 37%.

We found that class size trends were not only measurably different between metropolitan and non-metropolitan authorities, but that there were measurable differences between Calgary and Edmonton, and between the metropolitan jurisdictions. This suggests that a centrally prescribed approach to tackling class sizes may not be efficient, and that targeted strategies should be developed that leverage detailed analysis of class size data.

FUNDING ALLOCATION: WHERE DID THE MONEY GO?

The Ministry's report claims that only a "small percentage" of funding went towards hiring and retaining teachers, but this claim does not withstand elementary scrutiny. The report estimates a total of 2900 teachers hired as part of the program. How much of the $3.4B in funding went towards these 2900 teachers?

To simplify analysis, we assumed that no more than 2900 teachers were hired in the program; further, we assumed that the estimated 370 teachers, for which a year of hire was not specified, to have been hired in 2007; this is a reasonable assumption given the steadily increasing budget in that timeframe.

TABLE 1. ANALYSIS OF CLASS SIZE INITIATIVE FUNDING ALLOCATION

Year	Hired	Cumulative Teachers	Yearly Funding ($M)	Constant 2007 Spending ($M)	3% Annual Increase after 2007 ($M)	Actual Year-over-Year	Funding / Teacher ($K)
2004	1250	1250	90	90			72
2005	450	1700	119	119			70
2006	830	2530	191	191			75
2007	370	2900	197	197			68
2008		2900	215	197	203	9%	74
2009		2900	228	197	209	6%	79
2010		2900	242	197	215	6%	83
2011		2900	225	197	222	-7%	78
2012		2900	238	197	228	6%	82
2013		2900	257	197	235	8%	89
2014		2900	275	197	242	7%	95
2015		2900	290	197	250	5%	100
2016		2900	291	197	257	0%	100
2017		2900	292	197	265	0%	101
2018		2900	291	197	273	0%	100
		Total	3,441	2,764	3,195		
		% of Total		80%	93%		

To lend confidence to our analysis, we calculated the average funding per teacher. In 2004, this amounted to approximately $72k per teacher, within reasonable bounds for a full compensation package for a junior to mid-career educator. This lends confidence to the argument that, at least in the early years, the majority funding was indeed invested in hiring teachers.

We modelled costs in using two different methods:

1. A conservative model: assuming 100% of 2007 funding was allocated to retaining the 2900 teachers, and that cost per teacher did not increase beyond 2007. In this model, $2.76B, or 80% of the total $3.4B would have been allocated to teacher retention.

2. A more realistic model: This model considers indexing, via annual salary increases. In this model, we assume a 3% yearly increase for the initial 2900 cadre after 2007. In this model, $3.2, or 93% of the total $3.4B would have been allocated to teacher retention.

It is plausible that both models are conservative; the actual allocation to teacher retention may be significantly higher. Inconsistent hiring reporting beyond 2006, as identified by the Auditor General, opens the possibility the actual number of hired teachers may be considerably higher than the estimated 2900.

In considering the proportion of funding that cannot be directly attributed to teacher retention, the program intentionally delegated flexibility to school jurisdictions. School boards would reasonably have exercised this discretion to invest in diverse strategies to tackle classroom complexity, such as hiring educational assistants and other classroom supports. No metrics measured classroom complexity or the effectiveness of these investments. The program should not be too quickly faulted for exercising the flexibility that was deliberately built in.

While these models are approximations, they commonsensically refute the Ministry's claim that only a "small percentage" of the funding went towards teachers; our analysis shows the lower bound to be 80% and could reasonably approach 100%.

A CLASS SIZE ANALYSIS: OUR OWN METHODOLOGY

Our analysis utilized the data from the Government of Alberta's Class Size Information System. We constrained our analysis to K-3 for the following reasons:

a. The Class Size Initiative funding was granted only based on the number of K-3 students (but funds could be allocated for any grade);

b. The 2018 Auditor General's report explicitly highlighted K-3 as the grade cohort with the most significant concern;

c. The quality of the K-3 data provides greater confidence; unlike higher grades, K-3 students tend to remain in the same cohort for all subjects, minimizing the number of assumptions and simplifying the model;

d. K-3 was the only grade cohort that received explicit enrollment analysis in the 2019 Class Size Initiative Review; and

e. We assume that class size reduction at the K-3 level will have the largest long-term impact on students.

We further constrained our analysis to public, and separate (Catholic) authorities, excluding all charter and private schools. For brevity, "public" shall refer collectively to both public and separate schools, unless otherwise specified.

As each subject area (Mathematics, Language Arts, Science, etc…) is considered a separate "class" for the purposes of reporting, and as we were concerned with only K-3, we constrained our analysis to only K-3 "Language Arts" classes to avoid multiple counting. We appreciate that in some corner cases, this simplification may be inaccurate; for example, in special programs, such as language immersion programs other than French, this may cause some aberrations. However, at a macro level, we assume these corner cases to be negligible.

Further, we divided the data into two categories: Metro and Non-Metro. The Metro dataset includes only the "Big 4" authorities: Edmonton and Calgary Public and Catholic. The Non-Metro dataset included all other authorities. This is an approximately half-half division of the province's student population. We selected this division under the assumption that the causes and available solutions for a large metropolitan authority could be considerably different from an urban/rural or rural authority. As we progressed deeper in our analysis, we further constrained ourselves to the "Big 4" metro authorities, as adjacent data (such as school location), was easier to compile.

A BRIEF HISTORY OF CLASS SIZES

We analyzed the number of K-3 students from 2005 until 2018, categorizing by the population of students in each class size. This shows enrollment growth over time, and how the increased enrollment placed pressures on the system, causing an increasing proportion of K-3 students to be placed in ever-larger classes.
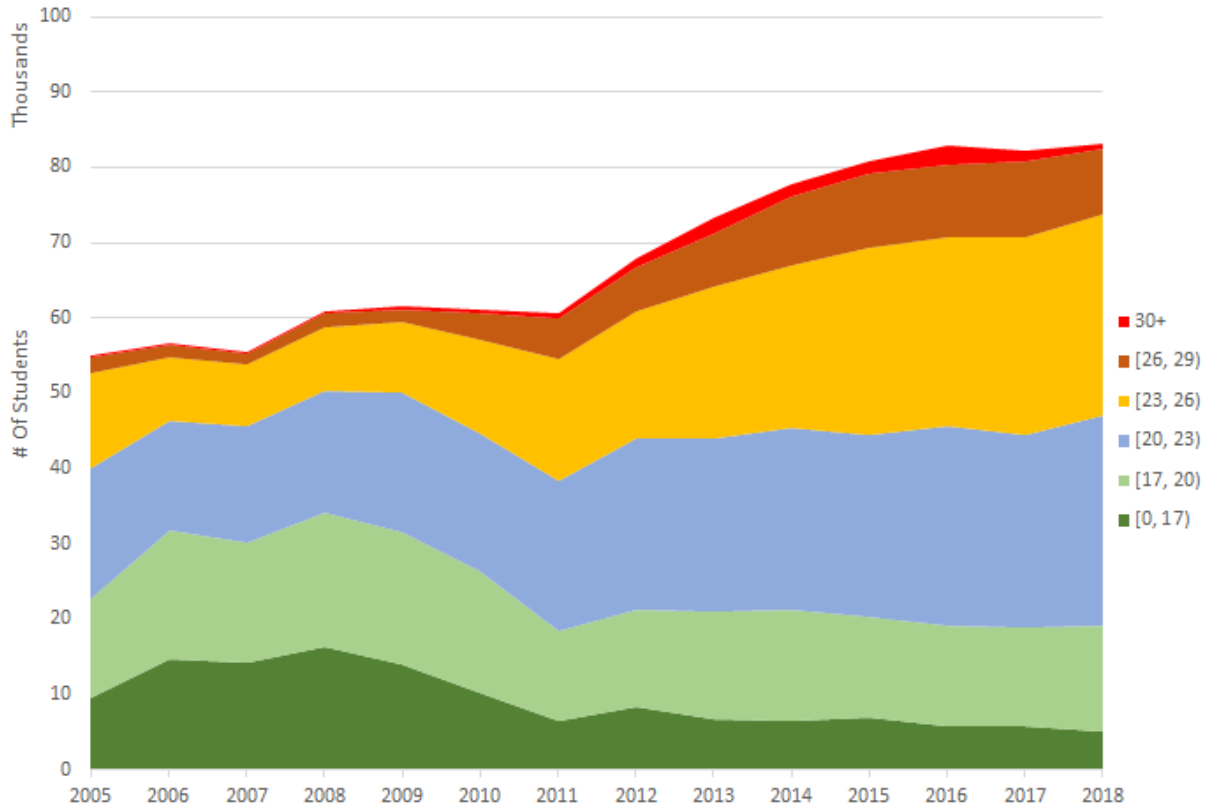

FIGURE 1. NUMBER OF K-3 STUDENTS BY CLASS SIZE OVER TIME, METRO AUTHORITIES ("BIG 4")

From 2007 to 2018, the population of metro K-3 students increased by 50%, from 55,420 to 83,224. This is significantly higher than the government's assertion that overall enrolment only increased by 20%. Comparatively, non-metro K-3 enrollment increased only 17% over the same time period.

Plotting the number of K-3 students per class size for the metropolitan school authorities demonstrates the growing disparity in classroom size. In 2011, the number of metropolitan K-3 students in a class of 23 or more was 22,126; by 2019 this had increased 64% to 36,298. In contrast, the number of metropolitan K-3 students with the benefit of a class size of 19 or fewer has remained nearly constant since, increasing marginally from 18,374 to 19,198 in the same time period.

A similar trend presents in the non-metropolitan schools: the big classes get bigger, while small classes stay the same. In 2011, the number of non-metropolitan K-3 students in a class of 23 or more was 18,621; by 2019 this had increased 42% to 26,571.
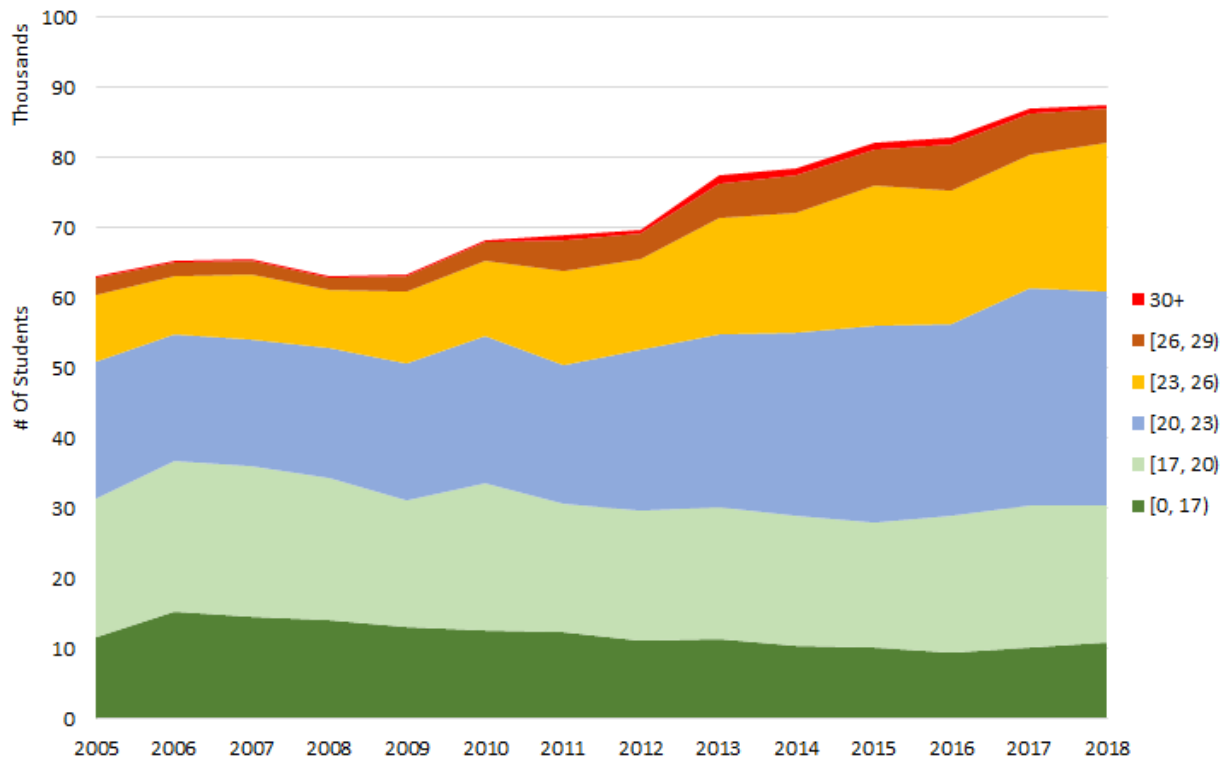
FIGURE 2. NUMBER OF K-3 STUDENTS BY CLASS SIZE OVER TIME, NON-METRO AUTHORITIES

By comparison, Appendix B of the 2018 Auditor General's report shows the evolution of the provincial K-3 class size average over the same time period.

K-3	Average
Target	17
School Year	
2004-2005	19.7
2005-2006	19.4
2006-2007	18.6
2007-2008	18.4
2008-2009	18.2
2009-2010	18.5
2010-2011	18.8
2011-2012	19.4
2012-2013	19.4
2013-2014	19.9
2014-2015	20.2
2015-2016	20.3
2016-2017	20.4

The K-3 class size average dropped from 19.7 in 2004 to 18.2 in 2008, then rose to 20.4 by 2017. At first glance, the class size average does not communicate the full degree of the problem; an average

class size of 20.4 does not *sound* that alarming. However, use of class size average as a metric betrays the concerning increase in the proportion of students in large classrooms.

This begs the question: what is driving, and what can be done to combat, the growing proportion of students in large classes? What is limiting the province's ability to achieve the theoretical "20.4 students/class" with the current number of teachers and students? In lieu of a government analysis to answer these questions, we have provided our own.

THE ACTUAL IMPACT OF THE CLASS SIZE INITIATIVE

Absent in the Ministry's analysis was the consideration: what would class sizes be if this funding *had not* existed? This comparison is necessary for a credible judgement on the effectiveness of the Class Size Initiative. The Ministry's report estimated 2900 teachers were hired as part of the initiative; we modeled the effects on 2018 class sizes should this number of teachers be removed from the system. More specifically, we considered the impact of Alberta public K-3 class sizes.

We assumed the 2900 teachers were evenly distributed among all grades (a conservative assumption), or approximately 892 K-3 teachers out of the 2900.

Our model determined that, absent the funding Class Size Initiative, the proportion of K-3 public students enrolled in 2018 in a class size of 23 or higher would increase from 37% to 87%. The number of students in a class size of 30 or more would more than double to almost 3000. The average K-3 class size would be 23.5.
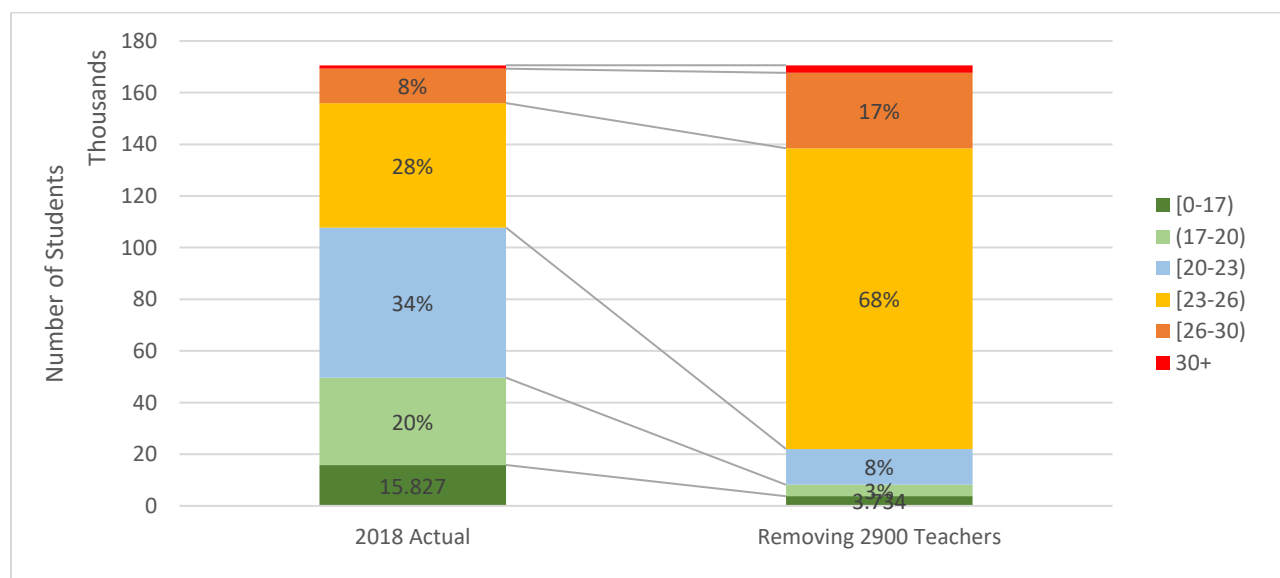

FIGURE 3. EFFECTS OF 2900 TEACHER REDUCTION ON ALBERTA PUBLIC K-3 CLASS SIZE, BASED ON 2018 ENROLLMENT

AN IMPROVED METRIC: THE CLASS SIZE INDEX

As alluded to earlier, the average class size metric, used by both the Auditor General's report and the 2019 Ministry's report, can be misleading: average class sizes do not represent the increasing

proportion of students in the very high end of the distribution. To illustrate this, consider two Kindergarten classes, one with 10 students and one with 30 students:

TABLE 2. HYPOTHETICAL CLASS SIZE AVERAGES

	Class 1	Class 2
# Of Students	10	30
Meets Target	Yes	No

In this scenario, the average class size is a respectable 20, and 50% of classes are meeting the recommended target of 17. Neither of these statistics necessarily indicate a problem. However, most parents would point out that 75% of kindergarteners are experiencing an unacceptably large class size. This example illustrates the need of a metric that better represents the educational experience of all children.

To better quantify and compare the educational experiences of children, we introduce the concept of the "Class Size Index". This index attempts to quantify the impact of class size by considering both the degree of deviation from the ideal class size, as well as the number of students impacted. The Class Size Index is calculated as follows:

a. Each and every student is given a score based on the size of the class they are in; the larger their class deviates from the ideal, the lower the score.

b. A score of "1" is assigned to each student in a class of 17 or fewer - this score is linearly decremented for each student over 17 until a score of 0 is reached at 30 students.

c. The score of all students are summed and averaged over the entire population of students.

Under this scheme, if every student in the province was in a class size of 17 or fewer, the province's Class Size Index would be "1"; if every student were in a class size of 30 or more, the provincial index would be 0. A class size index can be calculated for any subset of the population, i.e. for a school, jurisdiction, geography or whole province.

We posit that this Class Size Index more accurately represents the impact of class size on students, parents, and educators. Additionally, whereas the average class size would remain invariant under student/classroom levelling, the Class Size Index provides a metric that responds to student redistribution.

Future research may refine the model, as the current iteration:

a. assumes a linear decrease from 17 to 30 students, where improved curves may better reflect non-linear effects on the educational experience.

b. does not account for other classroom complexities, such as English Language Learners, coded students, or students requiring other supports.

Using the proposed Class Size Index, we can see how the Alberta index has evolved for metro and non-metro schools since 2005. In the first year, we can see a substantial increase in the index that brought both metro and non-metro schools into alignment at a score of 0.8. After 2008, the index

decreased unevenly for both metro and non-metro schools; non-metro schools decreased to 0.7 while metro schools decreased to approximately 0.6.

Simultaneously represented on this plot is the class-neutral theoretical maximum: if all class sizes were perfectly equal to the average (an ideal distribution of students), what would the index be?
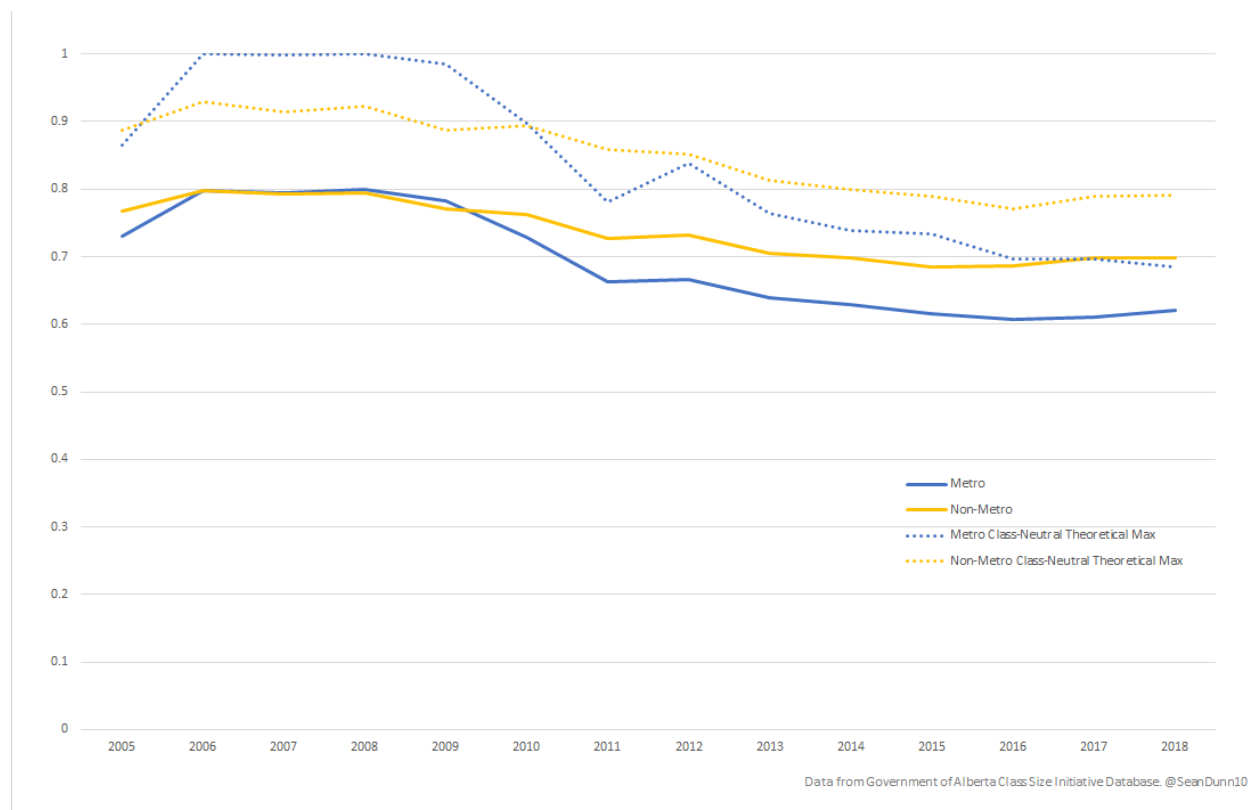

FIGURE 4. PROVINCIAL K-3 PUBLIC CLASS SIZE INDEX VS TIME

The Class Size Index communicates several insights:

a. A substantial improvement between 2005 and 2006;

b. Metro and non-metro students enjoyed parity in Class Size Index until 2009, when the metro score dropped more precipitously;

c. Both metro and non-metro scores have the potential to be significantly higher if students were more evenly distributed. However, in no case could the scores exceed the high-water mark of 2006 - 2008, while holding the number of classes constant.

GEOGRAPHIC DISTRIBUTION

Our analysis mapped the Class Size Index for K-3 Calgary and Edmonton school authorities and compared the evolution between 2007 and 2018.
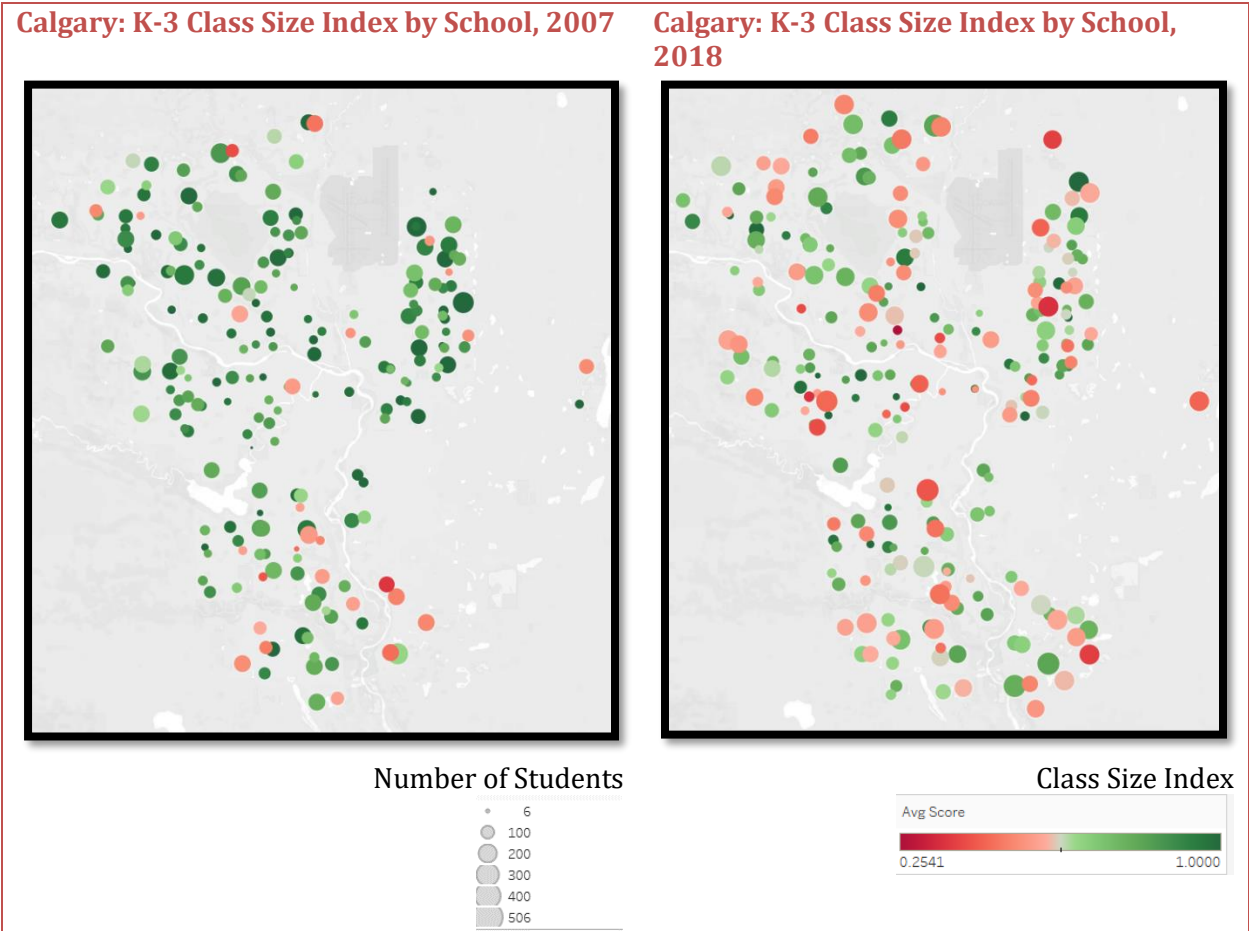

FIGURE 5. GEOGRAPHICAL DISTRIBUTION: CALGARY K-3 CLASS SIZE INDEX BY SCHOOL, 2007 TO 2018

Figure 5 shows the value of the Class Size Index for each public school in Calgary for 2007 (left) and 2018 (right). Each school is colored by its Class Size Index. The size of the symbols represent the number of K-3 students reported enrolled in each school.

From visual inspection, we observe that while there are an increasing number of schools with large class size indexes, they are interspersed with schools that remain within more acceptable index values.

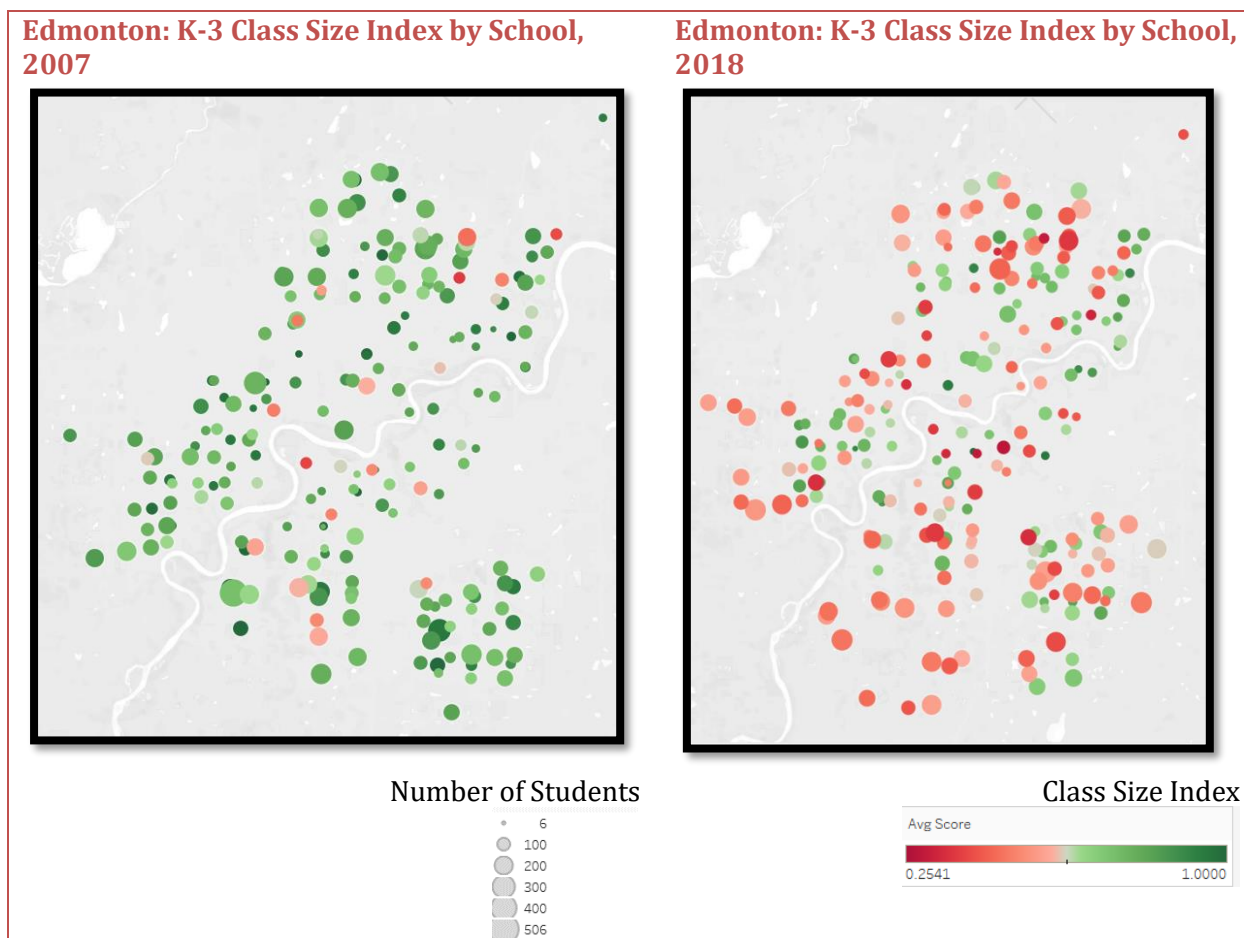Similarly, we mapped the 2007 and 2018 index values for Edmonton:

Edmonton: K-3 Class Size Index by School, 2007

Edmonton: K-3 Class Size Index by School, 2018

Number of Students

· 6
○ 100
○ 200
○ 300
○ 400
○ 506

Class Size Index

Avg Score

0.2541   1.0000

FIGURE 6. GEOGRAPHICAL DISTRIBUTION: CALGARY K-3 CLASS SIZE INDEX BY SCHOOL, 2007 TO 2018

Visually, Edmonton's change between 2007 and 2018 is notable. As of 2018, unlike Calgary, Edmonton has much fewer schools with higher index (less crowded) values, and these are less geographically interspersed with the lower-indexed (more crowded) schools. This suggests that the contributing factors, and possible solutions to overcoming class size, may be different for the two cities.

Comparing the change in index values between 2007 and 2018 by each of the "Big 4" school authorities, we can compare how each was able to cope with increasing enrollment. As of 2018, Calgary Catholic, Edmonton Catholic and Edmonton Public maintain similar Index scores of approximately 0.58. Calgary Public, however, remains an outlier with a score of 0.71.

As can be seen, all authorities experienced a significant decline of scores between 2007 and 2018, with scores decreasing between 0.11 (Edmonton Catholic) and 0.15 (Calgary Public). Edmonton Public, however, experienced a much larger decrease of 0.31 from 0.88 to 0.58. This lends further support for the hypothesis that contributing factors, and possible resolutions, may vary from city-to-city and authority-to-authority.
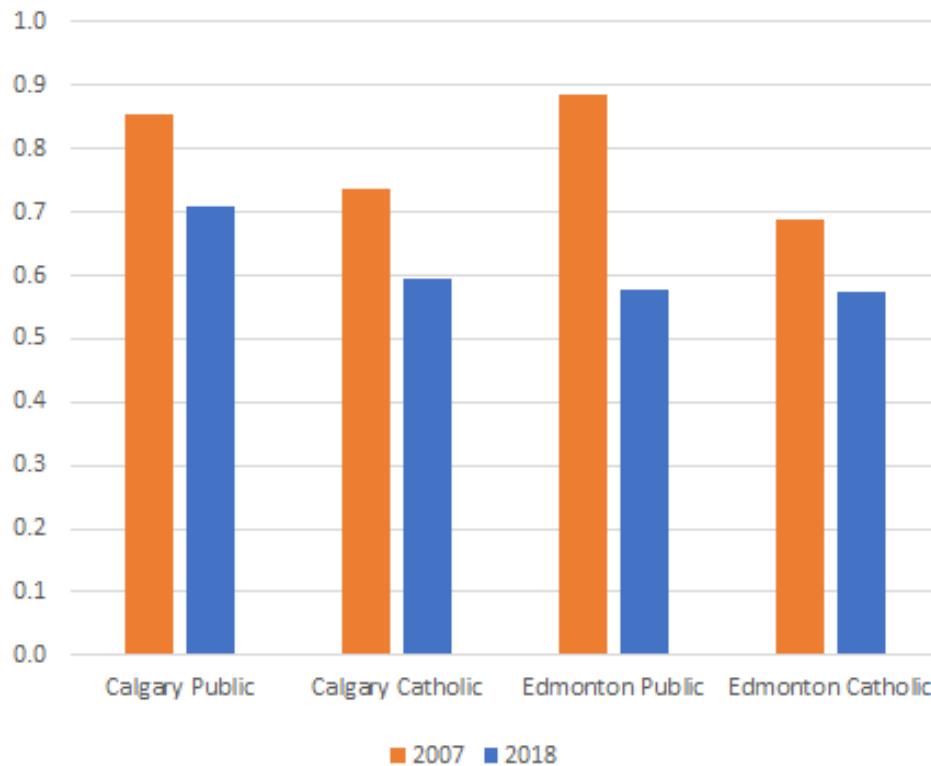
IMPACT OF URBAN SPRAWL

Both Calgary and Edmonton grew considerably in both population and area between 2007 and 2018; during this time, the province built several new schools. School authorities need to consider changing demographics when designing schools and boundaries.

We considered that the effectiveness of new school design or boundary design may influence the Class Size Index. Did new schools help or hinder class sizes? We mapped the K-3 Class Size Index for both Calgary (left) and Edmonton (right) for only new schools that had reported K-3 class sizes after 2007, but not before (presumably as they did not exist before that time).
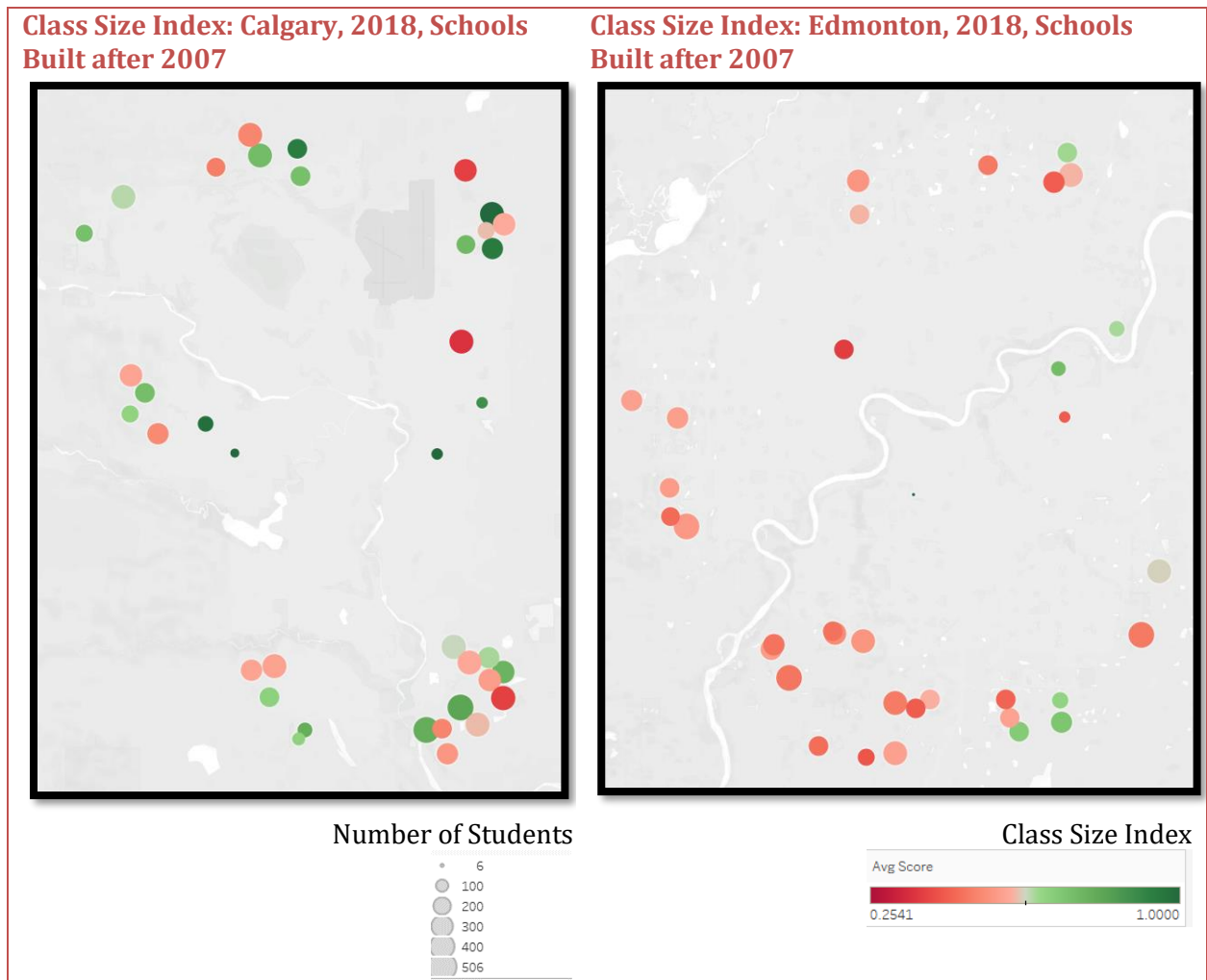
Class Size Index: Calgary, 2018, Schools Built after 2007

Class Size Index: Edmonton, 2018, Schools Built after 2007

Number of Students

- 6
- 100
- 200
- 300
- 400
- 506

Class Size Index

Avg Score

0.2541   1.0000

FIGURE 8. 2018 K-3 CLASS SIZE INDEX FOR CALGARY(L) AND EDMONTON(R) FOR POST-2007 SCHOOLS

Comparing the Class Size Index between Calgary and Edmonton, a visual difference emerges: most Edmonton schools built after 2007 have high a class size index, while the Calgary schools appears more mixed. In both cases, we can see how these new schools tend to appear in new suburban communities on the edges of the city. This suggests that the impact of urban sprawl has been larger on Edmonton than Calgary.

We can compare how legacy (existing prior to 2007) schools compare to new (post-2007) schools by school authority.
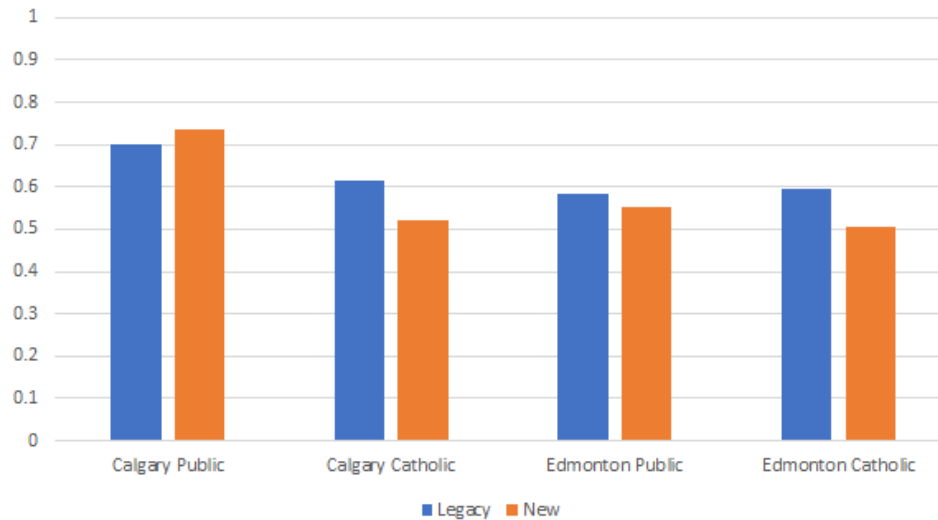
Of the "Big 4" districts, only Calgary Public had a marginally higher score for new (post-2007) schools compared to legacy (pre-2007) schools. For the other three authorities, the class size index for new schools was lower than for legacy schools.

This suggests several factors may be contributing to high class sizes:

a. New schools may be under-designed to support the demand in new communities;

b. School zoning may not adequately be balancing the demands between new and legacy schools.

The data cannot conclusively determine whether one district is "better" at planning, as there is significant mobility between the districts. For example, a new Catholic school in a new community may absorb high demand away from an older public school.

SPECIAL PROGRAMS

We investigated whether special programs benefitted from smaller class sizes, or conversely were burdened with higher class sizes. For simplicity, we only examined Calgary Public schools; these programs included language (French immersion, Mandarin, Spanish, German), science, all-boys, indigenous-focus, and traditional learning programs. We plotted a histogram of the number of K-3 schools by their Class Size Index scores and colored the proportion of the schools that had special programs (orange).

From visual inspection, we can see that the distribution of class size indexes of special program schools approximately mirrors those of regular schools, suggesting that special programs have a similar distribution of class sizes compared to regular programs.

This does not necessarily conclude that special programs do not contribute to the class size problem, only that they are benefitted/hurt in approximately the same way. It is possible that

constraints in teacher and/or student mobility due to special programs constraining more efficient distribution of students and teachers. This is an opportunity for further research.

K-3 Calgary Public Board of Education - Class Size Index Distribution of Schools with/without Special Program
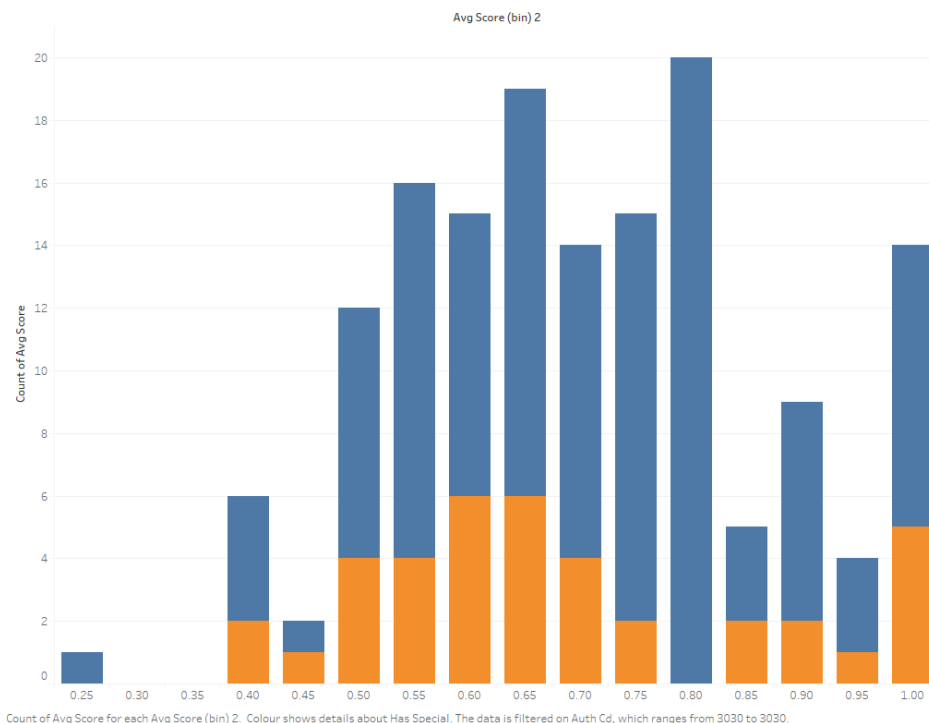(2018)

Avg Score (bin) 2

Count of Avg Score for each Avg Score (bin) 2. Colour shows details about Has Special. The data is filtered on Auth Cd, which ranges from 3030 to 3030.

FIGURE 10. K-3 CALGARY BOARD OF EDUCATION – CLASS SIZE INDEX DISTRIBUTION OF SCHOOLS WITH/WITHOUT SPECIAL PROGRAMS (2018)

FORECASTING CLASS SIZES

Based on trends in K-3 enrollment growth since 2011, we estimate Alberta's public & separate K-3 enrollment to increase by approximately 16,000 by 2023. This is roughly consistent with the Ministry of Education's K-12 forecasted enrollment growth of 15,000 students per year for all grades.

We forecasted class sizes for K-3 Alberta public districts using the following assumptions:

- The number of 2018 K-3 classes remains constant; and

- New students are allocated optimally; that is, new students are first allocated to the classes with the smallest Class Size Index.

Practically, this model is unrealistic, as students will obviously not be placed in any arbitrary class in the province. However, this does illustrate the theoretical best-case scenario.
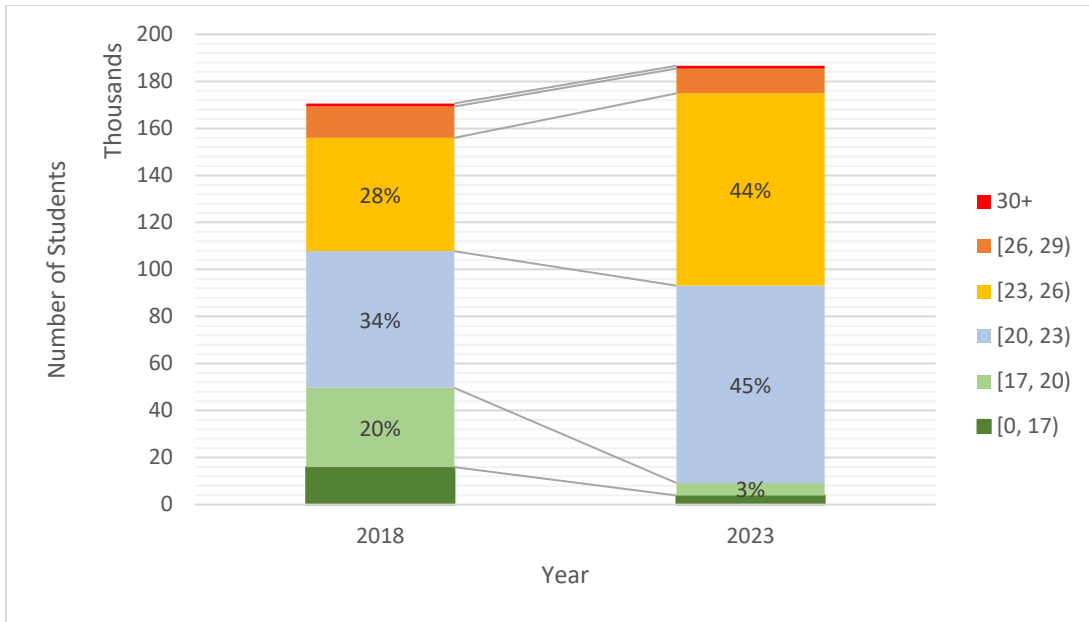
FIGURE 11. 2018 – 2023 PROVINCIAL PUBLIC & SEPARATE K-3 CLASS SIZE FORECAST, OPTIMAL STUDENT ALLOCATION MODEL

The model shows that, with no increase in the number of classes beyond 2018, by 2023 the proportion of K-3 students in class sizes of 19 or under have all but disappeared to 5%. The proportion of K-3 students in a class size of 20-22 will grow from 28% to 44%, and the proportion of students in a class size of 23 or more will increase to 50%.

TABLE 3. FORECASTED ALBERTA K-3 CLASS SIZES, CONSTANT CLASS COUNT, OPTIMAL STUDENT ALLOCATION MODEL

Class Size	19 and under	20-22	23+
2018	29%	28%	37%
2023 (Forecast)	5%	44%	50%

STRATEGIES FOR IMPROVING CLASS SIZES

We question the Ministry's suggestion that focusing on "teacher quality" is a practical alternative to reducing to class size. The report does not consider how an educator, already burdened with a class size well beyond those recommended by the Alberta Commission on Learning, would have the time and space to leverage the full extent of professional capabilities already in their possession, let alone find time to invest in professional development. The Ministry did not consider the detrimental effect increasing class sizes may have on the quality of education and teacher retention.

In order to investigate various strategies to improve class sizes, we developed a software model that simulates the effects of adding classes, moving classes or moving students in Alberta's "Big 4" metropolitan school jurisdictions. As the start state, we instantiated the model with Alberta's 2018 K-3 class size data.

We constrained our model to the "Big 4" Alberta school authorities. Further, we ignored mobility constraints between cities or school authorities: we assumed that a teacher or student could be freely "moved" from one city to another, and one authority to another. While unrealistic, this assumption is useful as it illustrates the upper bound of a strategy's effectiveness.

We also ignored grade levels within the K-3 class; we assumed that schools would split classes as needed to achieve a near-equal distribution of students among K-3 classes.

We also ignored the limitations imposed by physical space; we did not consider whether adding a new classroom to a school could be physically possible. Likewise, we ignored any secondary effects on infrastructure, support staff, or administration.

We investigated three possible strategies:

- Strategy 1: Moving teachers;
- Strategy 2: Adding teachers/classrooms; and
- Strategy 3: Moving students

STRATEGY 1: MOVING TEACHERS

In this scenario, we modelled the effects of "moving" a classroom from a school with low class sizes to a school with high class sizes, essentially attempting to more equally distribute teachers.

Our algorithm was as follows:

1. Let "L" be the school in Alberta with the lowest Class Size Index (most overcrowded)

2. Add a new class to school "L"; evenly re-distribute all K-3 students among classes

3. Let "H" be the school in Alberta with the highest Class Size Index (least crowded) that has at least 2 K-3 classes

4. Remove a class from school "H", evenly re-distributing all K-3 students over remaining classes

5. Repeat

The simulation for moving classrooms did not converge, that is, the algorithm quickly began oscillating in an infinite loop and did not complete. This is because this strategy was equivalent to the adage "robbing Peter to pay Paul" -- removing a classroom from a school would create an equivalent or greater problem. This quickly eliminated this strategy as viable.

STRATEGY 2: ADDING TEACHERS/CLASSROOMS

The second scenario investigated was identical to the first, except that new classrooms were added to the most overcrowded schools, without subtracting from a school elsewhere.
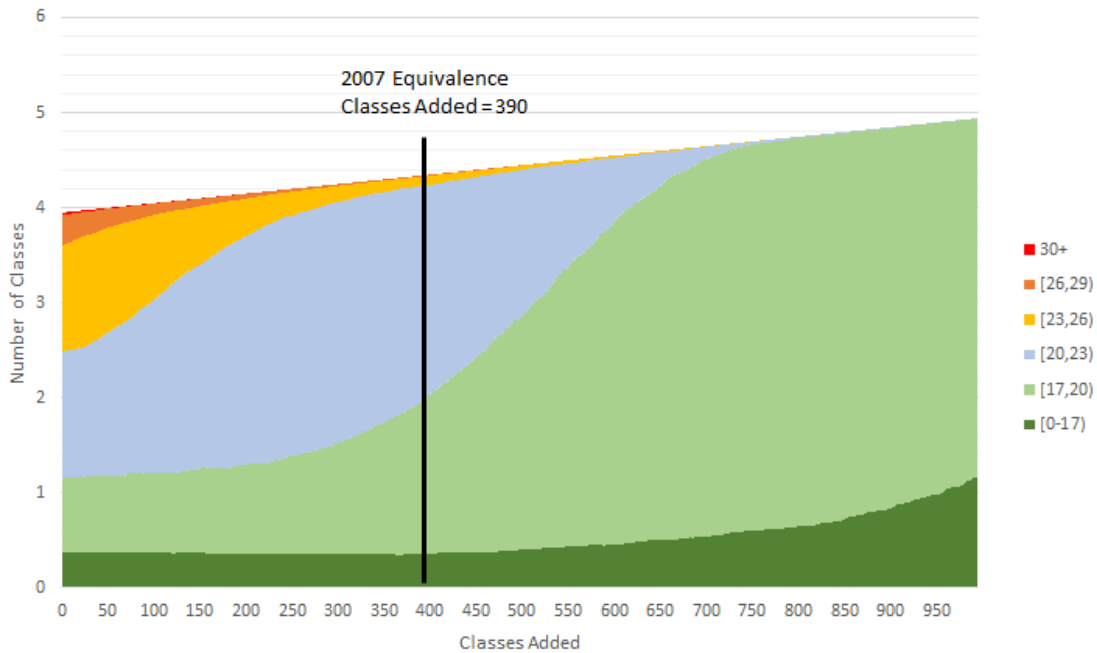
FIGURE 12. ADDING CLASSROOMS SCENARIO, NUMBER OF K-3 METRO CLASSES BY SIZE VS CLASSES ADDED

Plotting the number of students per each class size category, assuming a 2018-constant number of 83,224 K-3 students, we can see the relative number of students in each class size.
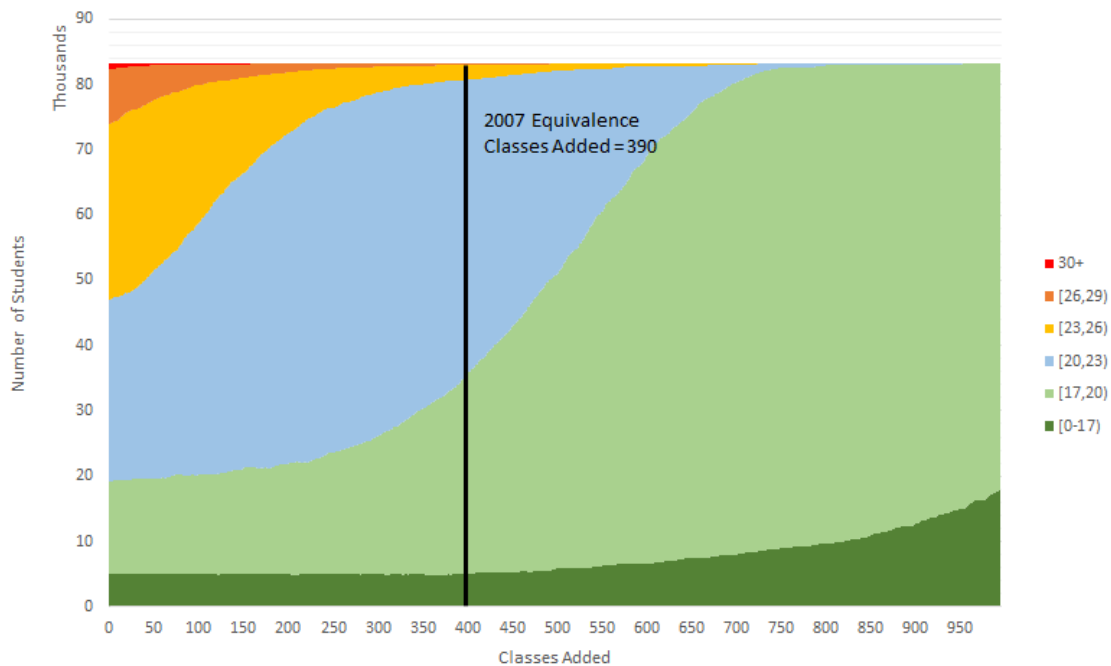

FIGURE 13 ADDING CLASSROOMS SCENARIO, NUMBER OF K-3 METRO STUDENTS BY SIZE VS CLASSES ADDED

This simulation produced the following insights:

a. At least 390 K-3 classrooms would need to be added to the "Big 4" metro authorities to restore the Class Size Index to 2007-levels. This is equivalent to a 10% increase in the number of 2018 K-3 classes, from 3947 to 4336.

b. At least 949 new K-3 classrooms would need to be added to the "Big 4" metro authorities to achieve the Alberta Commission on Learning recommended K-3 average of 17 students per class.
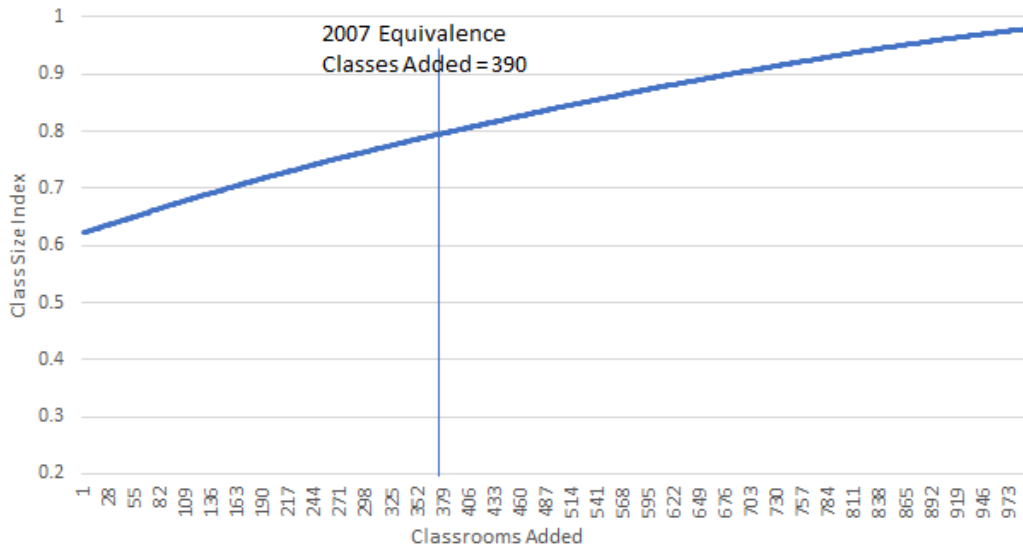

FIGURE 14. ADDING CLASSES SCENARIO, K-3 METRO CLASS SIZE INDEX VS CLASSROOMS ADDED

STRATEGY 3: MOVING STUDENTS

Instead of moving teachers, this model moved students from overcrowded classes to the smallest classes. This model did not honour geography or jurisdictions — it would freely move a student from a Catholic school in Calgary to a public one in Edmonton. Although obviously unrealistic, this model sets an upper bound on the impact moves can make in the absence of any geographic or jurisdiction constraints; once these constraints are factored in, the actual impact of students would be considerably smaller.
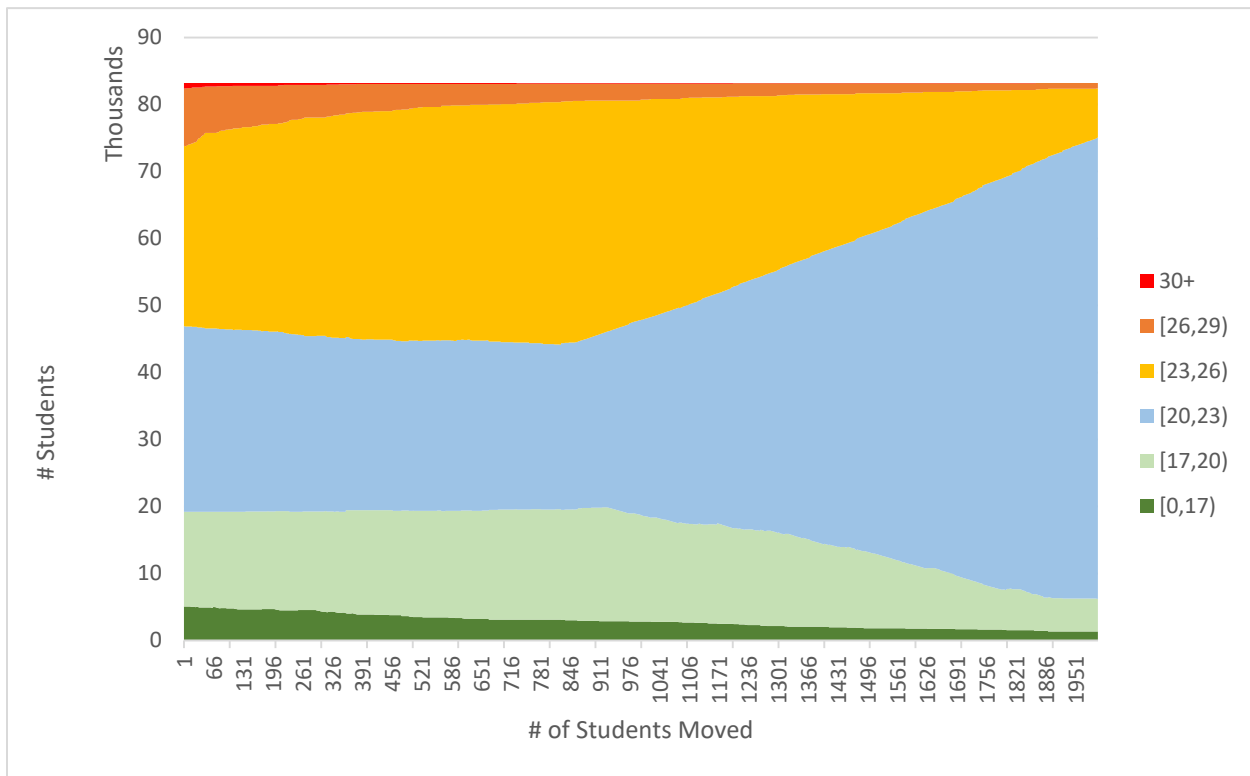
FIGURE 15. MOVING STUDENTS SCENARIO: NUMBER OF K-3 METRO STUDENTS BY CLASS SIZE VS STUDENTS MOVED

We discovered that the model converged after moving 2000 K-3 students – continuing the simulation beyond this point resulted in vanishingly small improvements to class size. Moving these 2000 K-3 students represents approximately 2.5% of the K-3 student population. These changes only marginally improved the Class Size Index from 0.621 to 0.683.

This model suggests that moving students between schools may offer some marginal improvements in class sizes, while impacting approximately 2.5% of students. However, practical geographic and jurisdictional constraints will considerably limit this strategy. Further, even in an ideal world where no such constraints exist, this strategy alone failed to restore 2007 class sizes, let alone ACOL-recommended levels. While shuffling students, via zoning changes, may offer some improvements to class sizes, this strategy alone would be insufficient to restore 2007 class sizes.

RECOMMENDATIONS

In consideration of our analysis, we put forward the following recommendations:

a. The government should sustain the requirement for class-size reporting; the data has proven invaluable to this analysis, is necessary for public transparency and evidence-based decision making and continuous improvement.

b. The government should more seriously consider the need to add new classrooms and teachers to staff them as our analysis showed this to be the only viable strategy in arresting increasing class sizes, especially in consideration of forecasted enrollment growth;

c. The government should re-consider implementing the recommendations of the 2018 Auditor General's report as a salient roadmap for evidence-based decision making with respect to evaluating strategies for controlling class sizes;

d. The government should collect more detailed data on classroom complexity, such as the number of students requiring special needs and whether these students are receiving sufficient support;

e. School authorities and the government should further research the effects of various constraints on teacher and student mobility that limit efficient distribution of students, teachers and classrooms, such as: infrastructure, geographic constraints, zoning, and special programs. School authorities should better leverage available class size data in their analysis.

f. School authorities should more closely examine whether new school designs in expanding urban communities sufficiently meets forecasted demands. Capital funding from the government should be adjusted to match.

g. The government and school authorities should more closely examine the infrastructure and capital demands of increasing class sizes.

h. The government should conduct further research on the impacts of high class sizes on teacher retention, mental health, student success and parent satisfaction;

i. Future analysis in class sizes should include metrics beyond simplistic average class sizes; metrics should better capture the full breadth of impact of class sizes on students and educators;

j. School authorities should seek more opportunities for collaboration and information sharing on planning best-practices;

k. The government should more closely examine strategies implemented in other provinces, such as implementation of class size caps.

CONCLUSION

In our own analysis of class sizes in Alberta, we found that the Class Size Initiative was effective in improving class sizes, however, the unparalleled enrollment growth required increased funding to keep pace. We evaluated other strategies for controlling class size, however, increasing the number of classrooms was the only strategy that was effective in returning to 2007-era levels.

We put forward several sensible recommendations that we strongly urge the Ministry of Education and Alberta's school jurisdictions to consider.

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