## teacher helping two students

##

ESE Policy Brief • December 2017

##

Class Size and Resource Allocation

Small classes are popular, but evidence of their positive impact on student outcomes is disappointing. Both the most well-known study (the Tennessee STAR experiment in the 1980s) and more recent work show that the impact of a broad-based reduction in class size on student outcomes is likely to be small at best and localized to particular grades and types of students. Meanwhile, small classes are an expensive intervention in terms of fiscal cost, recruitment of qualified teachers, and available building space.

The choices districts make about class size have real, though often hidden, costs. This brief aims to help inform those choices by summarizing the research evidence on class size—both its impact and its costs—and putting those findings into the Massachusetts context. It provides specific examples of the resource allocation choices districts face related to class size and poses alternatives for resource redeployment that may be more effective in improving student outcomes.

We address the following questions:

* Are small classes effective at increasing student outcomes?
* How small are Massachusetts class sizes?
* Are classes small by design or by default?
* What resources are required to have small classes?
* When should districts consider small classes?
* What additional resources are available on class size from the Department of Elementary and Secondary Education?

Written by: Amy Ellen Schwartz, Syracuse University; Jeffrey Zabel, *Tufts University;* and Michele Leardo, *New York University*

## Key Findings about Class Size in Massachusetts

Small classes are popular, but evidence of their positive impact on student outcomes is disappointing—and the choices districts make about class size have real, though often hidden, costs. This policy brief aims to help inform district class size choices by summarizing the research evidence on class size and putting those findings into the Massachusetts context.

In this brief, we highlight findings from the research literature on class size:

* Early evidence from the Tennessee STAR experiment was promising, but studies using other data and settings more similar to the current education policy context suggest little effect.
* Most modern studies show much smaller impacts than the STAR experiment or no effects at all.
* Little convincing evidence in the current educational context shows that small classes generate greater improvements in student outcomes for black or low-income students.
* Reducing class size can have unanticipated negative impacts on average teacher quality.
* Districts that reduce class sizes must also have sufficient classroom space to meet higher demand.

We also document several key facts about class size in Massachusetts:

* Across grades, the median size of a core academic class in Massachusetts ranges from 17.7 to 21.4 students.
* The median increases slightly from grade to grade through the elementary and middle school grades and then decreases for high school grades.
* Class sizes in Massachusetts are small relative to those studied in prior research and relative to other states.
* Without controlling for other factors, districts with lower enrollment, districts located in Berkshire County, and districts with higher per pupil expenditures typically have smaller core academic class sizes.
* After controlling for other factors, districts with higher average per pupil expenditures and larger numbers of schools have lower core academic class sizes across all grades, and districts with larger total enrollment have larger class sizes in elementary grades.
* After controlling for other factors, student characteristics and district residential characteristics such as median household income did not play a big role in explaining variation in class sizes.
* Average class sizes are larger for non-core classes than for core classes.

Finally, we provide connections to resources available to Massachusetts schools and districts interested in reconsidering their class sizes as part of a resource reallocation strategy.

## Are small classes effective at increasing student outcomes?

Early evidence from the Tennessee STAR experiment was promising, but studies using other data and settings more similar to the current education policy context suggest little effect.

Any discussion of the impact of class size must begin with the Tennessee STAR study. It was designed to provide a clear answer to the question, and though its relevance today is more limited, it is still cited by many educators in the field. Undertaken in 1985 at a cost of $12 million, the STAR experiment randomly assigned students in grades K to 3 in 79 elementary schools to one of three types of classes: small (13 to 17 students), large (22 to 26 students), and large with the addition of a full-time instructional aide. The initial analyses showed a statistically significant, moderate to large impact on reading and mathematics scores for students enrolled in the smaller classes (Krueger, 1999; Nye et al., 2000). For context, the short-term effects of small classes found in the STAR experiment are roughly the same as the difference in one-year gains between having a highly effective teacher as opposed to an average teacher (as found in Staiger and Rockoff, 2010) and about one-quarter of the size of the disparity in achievement between black and white students. Follow-up data on STAR participants indicated some positive effects endured through middle school, diminishing afterwards (Nye et al., 1999; Konstantopoulos and Chung, 2009). Later studies also showed some evidence of longer-term gains. Students assigned to small classes were more likely to take college entrance exams and more likely to be enrolled in college at age 20 (Krueger and Whitmore, 2001; Chetty et al., 2011). These findings have contributed to the general sense of education practitioners that smaller classes improve student outcomes.

Other scholars, however, have questioned the applicability of these findings today. They note that STAR was conducted 30 years ago in a different education policy context than today’s standards-based approach. It focused only on early elementary grades and reduced class sizes to a level well below that typically found in schools. Further, it was limited to schools that volunteered to participate and that could accommodate at least three grades per class, so not necessarily typical schools (Goldstein and Blatchford, 1998; Grissmer, 1999; Hanushek, 1999; Blatchford, 2003). Others raise questions about the implementation and analysis of STAR. New students and teachers were added to participating schools during the experiment, and many students did not remain in the experiment through third grade, muddying comparisons of impact (Hanushek, 1999; Krueger, 1999). Most notably, schools participating in STAR had access to an ample supply of qualified teachers, sufficient physical facilities, and additional funds for participating—not typical school conditions (Milesi and Gamoran, 2006). Therefore, many regard the STAR experiment as shedding light on the effect of implementing small classes under ideal conditions, not the results likely to occur at scale or in the current context.

Most modern studies show much smaller impacts than the STAR experiment or no effects at all.

Other research on class size in elementary grades using different data are less sanguine, suggesting little effect on student achievement and revealing the importance of practical considerations. Using data for grade 4 and 6 students in Connecticut, Hoxby (2000) finds no evidence that smaller classes lead to gains in student achievement in reading, writing, or mathematics. Similarly, two studies using nationally representative data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998­–99 and the National Education Longitudinal Study, respectively, find no statistically significant effect of class size on student test scores (Dee and West, 2001; Milesi and Gamoran, 2006). Class size and student achievement data from Israel also reveals no effect (Angrist et al., 2017).

That said, some evidence shows that reducing class size has a positive effect in other settings, but the results are much smaller in magnitude than the results found in the STAR experiment (Bosworth, 2014; Rivkin et al., 2005; Cho et al., 2012). Using detailed data on grade 4 and 5 students in North Carolina public schools, Bosworth (2014) finds that reducing class size by one student leads to very small, but statistically significant, improvements in math and reading. Rivkin, Hanushek and Kain (2005) find similar results for students in grades 4 to 7 using student achievement data from Texas. Finally, using data on grade 3 and 5 students from Minnesota, Cho et al (2012) find small and substantively unimportant impacts of reducing class size.

Few studies focus on class size in high school, and those that do often present anecdotal or correlational, but not causal, findings. One rigorous study examines class size effects in 15-year-old students in the US, finding no impact (Dennya and Oppedisanob, 2013).

Overall, these results suggest much smaller effects than those reported by the STAR experiment, or no effects at all. When small classes have been shown to be effective, it has typically been in early elementary grades and for classes of 15 to 20 students in size. This underscores that the education context and conditions under which small classes occur are a key determinant of potential success.

Little convincing evidence in the current educational context shows that small classes generate greater improvements in student outcomes for black or low-income students.

Is class size particularly important for some students or settings? Again, the evidence is mixed at best. At the elementary and middle school level, findings are inconsistent regarding whether low income and minority students benefit more than other students from smaller classes. Krueger’s (1999) examination of the STAR experiment revealed the now well-known result that black students and students eligible for free or reduced lunch price demonstrated a more notable increase in achievement compared white students and students not eligible for subsidized school meals as a result of being assigned to small classes. On the other hand, other scholars find no convincing evidence of greater effects of class size for students of different races or socioeconomic backgrounds (Hoxby, 2000; Bosworth, 2014; Cho et al, 2012; Milesi and Gamoran, 2006; Jespen and Rivkin, 2009).

Reducing class size can have unanticipated negative impacts on average teacher quality.

Meanwhile, considerable evidence suggests that reducing class size has unanticipated negative impacts for districts. As a prime example, hiring additional teachers can have unintended consequences. As the number of teachers needed increases, the district will have to reach deeper into its teacher pool to fill all their open teaching slots. This is likely to yield a decline in average teacher quality. California experienced this writ large when it implemented a statewide class size reduction effort in 1996. Average teacher quality declined statewide, and the impact was even more pronounced for urban districts with higher shares of low-income students, since suburban and wealthier districts tended to have smaller classes to begin with and also had an easier time attracting good teachers (Schrag, 2006). In a more recent study using data from New York City public schools, Gilraine (2017) isolates the class size effect from the total effect of class size plus hiring a new teacher by taking advantage of random jumps in class size when a small change in enrollment triggers a maximum class size rule and a new class is added. He finds that small classes slightly increase student achievement, but the gains are counteracted by the effect of hiring a new teacher. In other words, the positive effect of class size was offset by a decrease in performance attributable to the newly hired teacher.

This shows that trade-offs like hiring less experienced teachers are important factors when considering the overall effectiveness of small class sizes.

## How small are Massachusetts class sizes?

Across grades, the median size of a core academic class in Massachusetts ranges from 17.7 to 21.4 students—relatively small compared to prior research.

On average, Massachusetts’ school districts have relatively small class sizes, even at the high school level—often close to the size found effective in prior research.

To measure class size, we analyzed Massachusetts’ statewide data from the 2016–17 academic year for the core subjects of English language arts (ELA), mathematics, science, and social studies.[[1]](#endnote-1) We focused on typical classes by limiting the analysis to classes in which less than 75 percent of students were identified as students with disabilities. In grades 1 to 4, students typically have the same teacher for all these subjects, so we counted this as a single general education class. For grades 5 to 12, we focused on math and ELA classes. Classes in grades 5 and 6 are sometimes general classes with a single teacher, like grades 1 to 4, and sometimes taught as separate subject classes with different teachers, in the secondary model. To account for this, we analyzed class size in these grades by including both general education and ELA class sizes in the ELA column, and the same for math. We averaged all class sizes across schools in a given grade for each district to arrive at an average class size for each district and grade; the tables below show the average across districts by grade.

As shown in Table 1, the median (50th percentile) class size for core subjects in elementary grades in Massachusetts ranges from 20 to 21.4. The smallest median class sizes are in grade 12, at 17.7 for English language arts classes and 18.6 for mathematics.

| **Table 1.**  Class Sizes in Massachusetts are Relatively Small  |
| --- |
|  |  | **Percentile** |
|  |  | **5th** | **25th** | **50th** | **75th** | **95th** |
| **General Education Classes** |
| **Grade 1** |  | 16.7 | 18.9 | 20.0 | 21.1 | 22.9 |
| **Grade 2** |  | 17.5 | 19.4 | 20.7 | 21.8 | 23.6 |
| **Grade 3** |  | 17.7 | 19.8 | 21.1 | 22.5 | 24.3 |
| **Grade 4** |  | 18.0 | 20.1 | 21.4 | 22.5 | 24.1 |
| **Math Classes** |  |  |  |  |  |  |
| **Grade 5** |  | 17.8 | 19.9 | 21.4 | 22.8 | 25.7 |
| **Grade 6** |  | 16.6 | 19.5 | 21.0 | 22.6 | 24.8 |
| **Grade 7** |  | 15.5 | 18.2 | 20.4 | 21.9 | 24.3 |
| **Grade 8** |  | 15.5 | 18.3 | 20.4 | 21.6 | 23.6 |
| **Grade 9** |  | 13.6 | 16.9 | 18.7 | 20.5 | 22.4 |
| **Grade 10** |  | 13.0 | 17.5 | 19.9 | 21.2 | 23.1 |
| **Grade 11** |  | 15.3 | 18.5 | 19.9 | 22.0 | 24.5 |
| **Grade 12** |  | 14.0 | 16.1 | 18.6 | 19.8 | 22.8 |
| **ELA Classes** |  |  |  |  |  |  |
| **Grade 5** |  | 16.5 | 18.5 | 19.9 | 21.8 | 24.3 |
| **Grade 6** |  | 16.5 | 17.7 | 20.1 | 22.0 | 24.0 |
| **Grade 7** |  | 15.5 | 18.0 | 19.1 | 21.3 | 24.4 |
| **Grade 8** |  | 15.6 | 18.0 | 19.2 | 21.6 | 24.1 |
| **Grade 9** |  | 12.8 | 16.4 | 18.4 | 19.8 | 22.3 |
| **Grade 10** |  | 13.0 | 17.3 | 19.3 | 21.1 | 22.9 |
| **Grade 11** |  | 12.9 | 17.5 | 19.3 | 20.9 | 23.0 |
| **Grade 12** |  | 10.9 | 15.8 | 17.7 | 20.2 | 23.0 |

The median increases slightly from grade to grade through the elementary and middle school grades and then decreases for high school grades.

Overall, these class sizes are relatively low; indeed, fully 25 percent of Massachusetts grade 1 students are enrolled in a general education class with a district average of 18.9 or fewer students, not much larger than the size of the small classes in the STAR experiment, and only 25 percent are assigned to classes with a district average of 21.1 students or more, close to the size of STAR’s “large” classes. In grade 4, half of Massachusetts’ students are in a class with a district average of 21.4 or fewer students. In grade 7, half of students are in a math class with a district average of 20.4 or fewer students and an ELA class with 19.1 students. In grade 10, classes are even smaller. 25 percent of students are in a math class with a district average of 17.5 or fewer students and an ELA class of 17.3 or fewer students; 75 percent are in a math class with a district average of 21.2 or fewer students; ELA class, 21.1 or fewer.

Student-teacher ratios in Massachusetts—the measure most comparable across states—are small relative to other states.

No national data exists that allows us to compare class sizes across states. However, recent data from the National Center for Education Statistics compares student-teacher ratios, or the total number of students divided by the number of full-time equivalent teachers across all grade levels for each state. Student-teacher ratios are not directly comparable to class sizes for core academic classes because they count all teaching professionals, including teachers who work with special populations such as high needs students or English learners in small groups or who teach smaller elective courses, rather than just typical classroom teachers teaching core academic subjects. Nonetheless, these ratios provide an indirect comparison about teacher staffing choices across states that suggests class size is relatively low in Massachusetts. The student-teacher ratio in Massachusetts (13.6 students per teacher) is well below the national average of 15.5 students per teacher. Only nine states have a smaller student-teacher ratio than Massachusetts.

## Are classes small by design or small by default?

Small class size may reflect an intentional policy decision or may result from local constraints, habit, or the unintended consequence of other policies.

In the first category, many schools, districts, and states set policies that cap class size. Most Massachusetts teacher union contracts, for example, specify maximum class sizes, sometimes varying by grade level. The purpose is to create targets for class size that have been agreed upon by educators and policymakers as reasonable. For example, the Dover-Sherborn teacher contract holds class size to a maximum of 25 students. The agreement with teachers in Arlington specifies a maximum class size of 25 students for elementary schools, and the one for Mansfield specifies a maximum of 25 students for elementary schools and 30 for middle and high schools. Smaller caps may be set for special classes, such as Structured English Immersion (SEI), bilingual, and English as a Second Language. Our analysis of average class sizes suggests that many districts in Massachusetts have room to increase class size while staying within these negotiated caps.

In some states, statewide policies govern class size. Florida voters, as an example, approved an amendment to the Florida Constitution that sets limits across the state on the number of students in core classes, with a maximum of 22 students in grades 4 through 8 and 25 students in grades 9 through 12. California has had a statewide class size policy since 1964 that prescribes both a limit for average class size and a maximum class size for each class depending on the grade. In 1996, the state also initiated a class size reduction program for kindergarten through grade 3, cutting maximum class size from 33 to 20 students, which reduced average class sizes in those grades by about ten students, from about 29 students to about 19.

Small classes can also result from practical considerations and constraints. For example, districts with lower or declining overall student enrollment have less flexibility in how they serve students. Smaller-than-usual incoming cohorts of students in a particular grade (kindergarten, for example) can yield relatively smaller classes for those students. At higher grades and high schools, a wider array of course offerings will also contribute to smaller classes, even with a steady enrollment in the school.

To better understand how these factors play out in the Massachusetts context, we examined how different district, school, and student characteristics are related to class size. We show findings for grades 1, 4, 7, and 10 as representative of early elementary, later elementary, middle school, and high school grades, and report these in Table 2. We focus on differences across districts, as districts set much of the policy that governs class sizes in their schools.

Without controlling for other factors, districts with lower enrollment, districts located in Berkshire County, and districts with higher per pupil expenditures typically have smaller core academic class sizes.

Comparing median class sizes by grade and type of district is revealing. First, districts with higher per pupil expenditures have smaller class sizes. For example, the median class size in grade 4 in districts with higher per pupil expenditures is 20.4 compared to 21.9 for districts with lower per pupil expenditures. Districts with lower total enrollment also have lower median class sizes, at 17.7 in grade 1, 19 in grade 4, between 18.1 and 18.8 (depending on subject) in grade 7, and between 17.5 and 17.8 (depending on subject) in grade 10. Class size

| **Table 2**. Median Class Size Differs by District Characteristics |
| --- |
|  | **Grade 1** | **Grade 4** | **Grade 7** | **Grade 10**  |
|  | **Gen Ed** | **Gen Ed** | **Math** | **ELA** | **Math** | **ELA** |
| **Statewide** | 20.0 | 21.4 | 20.4 | 19.1 | 19.9 | 19.3 |
| **Per pupil expenditures** |  |  |  |  |  |  |
|  **Bottom 25%** | 20.3 | 21.9 | 21.3 | 21.3 | 20.9 | 21.2 |
|  **Middle 50%** | 20.2 | 21.4 | 20.5 | 19.1 | 20.2 | 18.8 |
|  **Top 25%** | 19.4 | 20.4 | 19.8 | 18.1 | 19.8 | 19.3 |
| **Median household income** |  |  |  |  |  |  |
|  **Bottom 25%**  | 20.5 | 21.7 | 21.2 | 18.1 | 19.7 | 18.6 |
|  **Middle 50%** | 19.4 | 20.6 | 19.6 | 20.0 | 20.2 | 19.7 |
|  **Top 25%** | 20.1 | 20.9 | 20.4 | 20.4 | 20.7 | 20.6 |
| **District enrollment** |  |  |  |  |  |  |
|  **Bottom 25%** | 17.7 | 19.0 | 18.1 | 18.8 | 17.5 | 17.8 |
|  **Middle 50%** | 19.3 | 20.8 | 19.6 | 19.8 | 19.9 | 19.3 |
|  **Top 25%** | 20.7 | 21.6 | 21.2 | 19.1 | 20.4 | 19.3 |
| **Regions**  |  |  |  |  |  |  |
|  **Berkshire County** | 17.6 | 18.6 | 17.0 | 14.5 | 18.1 | 17.5 |
|  **Central** | 19.7 | 22.4 | 20.0 | 20.1 | 20.3 | 20.3 |
|  **Commissioner’s Districts** | 20.8 | 21.7 | 21.5 | 18.1 | 19.9 | 18.6 |
|  **Greater Boston** | 20.5 | 21.2 | 20.3 | 20.1 | 20.8 | 20.3 |
|  **Northeast** | 19.8 | 20.4 | 19.6 | 19.8 | 20.3 | 21.0 |
|  **Pioneer Valley** | 19.5 | 20.4 | 18.4 | 18.2 | 17.5 | 17.4 |
|  **Southeast** | 19.2 | 21.0 | 19.8 | 20.8 | 20.0 | 19.5 |
| **Type of district** |  |  |  |  |  |  |
|  **Traditional** | 20.0 | 21.4 | 20.4 | 19.1 | 19.9 | 19.3 |
|  **Charter** | 21.6 | 21.3 | 22.3 | 22.3 | 16.5 | 18.0 |

also varies by region. Class sizes in Berkshire County are notably smaller than elsewhere in the state, with a median of 17.6 students per class as compared to 20 statewide in grade 1.

Some factors have less obvious correlations. Districts with high median household income do not necessarily have smaller classes, though higher spending districts do. And charter schools typically enroll about two more students per class than other schools in middle school grades, and about one and a half more students in grade 1.

After controlling for other factors, districts with higher average per pupil expenditures and larger numbers of schools have lower core academic class sizes across all grades. Districts with larger total enrollment have larger class sizes in elementary grades.

We performed additional statistical analyses to see which of the characteristics above were still related to class size once we controlled for the districts’ student demographics and other factors (see online [appendix](http://www.doe.mass.edu/research/reports/2017/12class-size-appendix.docx) for more details on constructing the data and for tables with the findings described below). We grouped the factors we control for into four categories: district, grade, student, and residential. District characteristics included total enrollment, the five-year change in district enrollment, and per pupil expenditures. Grade characteristics included the number of schools in the district serving that grade, the total grade enrollment, and the five-year change in grade enrollment. Student characteristics included the proportion of English learner students in the district, the proportion of economically disadvantaged students, and the proportion of students with disabilities. Lastly, residential characteristics included median household income and parent education level (the proportion of residents aged 25 or older with at least a bachelor’s degree, obtained from Census data). For regional districts, residential characteristics were weighted averages across the towns in each district. After controlling for these factors, we found some expected and unexpected correlations.

*Per pupil expenditures* is the factor most consistently associated with class size across districts. Districts with higher per pupil expenditures had lower class sizes, holding other factors constant, and this was statistically significant across all grades we examined. *Total district enrollment* was also correlated with class size for some grades, but the direction of the relationship was somewhat unclear. Districts with higher total enrollment had larger class sizes for grade 4 and smaller class sizes for grade 10 math, holding other factors constant. This was not significant for grade 1 or for grade 7 math, though. Districts with higher enrollment and more students per grade can more easily keep class sizes in a given range. However, other factors or mechanisms must explain smaller 10th grade math classes. Differences in the five-year change in total district enrollment were not significantly correlated with class size in any of the grades examined.

The *number of schools in the district* was, however, a significant factor in explaining class size with other factors held constant, particularly for elementary grades. Generally, districts with more schools had smaller class sizes, holding other factors constant. For a similar number of students, having more schools would counteract the efficiencies for districts with large enrollment. Differences in *total grade enrollment* did not prove to be related to class size, except for grade 10 math, where larger grade enrollment was associated with larger class sizes, holding other factors constant. While changes in total grade enrollment are likely to be similar to changes in total district enrollment, they can have different impacts for two reasons. First, the size of the cohort (number of students) may differ across grades. Second, entry and exit from an individual grade may differ from the total entry and exit from the district. The *five-year change in total grade enrollment* was also associated with larger class size for grades 1 and grade 7 math, but the association was small in magnitude.

Interestingly, *student characteristics* were not associated with class size. Differences across districts in the proportion of Limited English Proficient students, economically disadvantaged students and students with disabilities were not statistically significant predictors of class size, holding all other factors constant, in any grades.

Lastly, differences in *district residential characteristics* did not play a big role in class size either. Median household income was not a significant factor in determining class size in grades 1 or 10, holding other factors equal. It was significant for grade 4 and grade 7—districts with larger median household income surprisingly had larger class sizes in those grades—but the association is weaker than other factors with statistically significant associations with class size. The proportion of parents with a bachelor’s degree or higher was not significant for class size in any grades.

Finally, we also explored how much each of our four groups of measures contributed to differences in class size across districts. *District characteristics* contributed the most to the differences. The added contribution of these characteristics was in the range of 5.7 to 18.7 percent, depending on the grade, after holding the other three groups of measures constant. *Grade characteristics* were also an important factor, adding between 4.2 and 6.7 percent, while neither student characteristics nor district residential characteristics contributed substantially to explaining the observed differences in class size. This means that most of the variation in class size reflects differences across districts, such as per pupil expenditures and total district enrollment, and differences in grade characteristics, such as number of schools in the district serving that grade.

Class size is likely not the best measure of districts’ investment in non-core courses.

The above analysis focuses on core academic classes since roughly 70 percent of FTEs are dedicated to core classes in Massachusetts. That said, non-core classes are also an important part of a district’s budget and educational programming, with roughly 30 percent of FTEs teaching in non-core courses spanning a wide range of subjects. Elementary and middle schools often offer art, music, and physical education; high schools often expand elective offerings to include more specialized topics such as accounting, carpentry, computer literacy, or entrepreneurship.

Class size is likely not the best measure of districts’ investment in non-core courses. For example, at the elementary level, non-core classes such as art may be the same size as core classes, but offered for only an hour or two a week. At the secondary level, electives have a wide range of class size, and large classes are sometimes an integral part of the course experience (e.g., band and orchestra). Instead, analysis should focus on a district’s relative investment in core versus non-core teaching staff, for example by comparing non-core FTEs as a percentage of teachers, or by comparing the ratio of students to non-core teachers. An in-depth analysis of these factors is beyond the scope of this report.

## What resources are required to have small classes?

Class sizes reflect choices about the use of three resources: sufficient funding for teacher salaries, a pool of qualified teachers to fill additional teaching positions, and classroom space.

In 2015–16, the average teacher salary in Massachusetts was approximately $76,000; if we estimate benefits such as health insurance and retirement at 33 percent of salary expenditures, the estimated total cost to a district of the average teacher is roughly $100,000. This number can vary substantially with teacher experience and benefit packages. Table 3 below illustrates the range of average teacher salary and total cost of a teacher for Massachusetts districts.

**Table 3**. The Typical Cost of Employing a Teacher in Massachusetts Is About $100,000

|  |  |  | **Percentile** |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **10th** | **25th**  | **50th**  | **75th**  | **90th** | **Average**  |
| **Salary** | $63,645  | $68,851  | $74,314  | $79,565  | $84,444  | $76,442  |
| **Estimated total cost** | $84,648 | $91,572  | $98,838 | $105,822  | $112,311  | $101,668  |

Adding teachers is costly and can have a substantial impact on district budgets.

Teacher salaries are the key determinant of the cost of reducing class size, as a school would likely need to add an additional class (and therefore hire an additional teacher.) As an example, consider a typical district with three elementary schools, each with three grade 1 classes of 21 students and the usual one teacher per class. If each school adds one more class—thereby reducing class size in grade 1 by roughly five students to 16 or so—the annual cost would be approximately $300,000 just for the additional teachers (3 FTEs), not considering any additional cost for classroom space and so forth. To put that cost in context, the median district for total spending on teacher salaries in the state employed 133 teachers and expended approximately $24 million on total in-district expenditures. Hiring three additional grade 1 teachers would increase total in-district expenditures by roughly 1.3 percent. This increase is substantial, close to the typical total annual revenue increase for districts. The statewide revenue increase from fiscal year 2015 to fiscal year 2016 was 1.7 percent. If adding three teachers costs 1.3 percent, virtually all of a typical district’s additional revenue would be used for class size reduction. This strategy would compete with, for instance, wage and health insurance increases, which generally add up to more than 1.7 percent on their own.

Districts, of course, could choose to make a smaller investment in class size reduction. Take, for example, a district with nine grade 1 classes of 21 students. Adding one more grade 1 class would reduce class size by roughly two students, to 19 students per class, and the annual cost to the district would be about $100,000 for the additional teacher. The cost to this district would be less, but the resulting class size reduction is smaller and still leaves the average class size above the levels studied in prior research.Districts that reduce class sizes must also have sufficient qualified teachers and classroom space to meet higher demand.

In addition, districts that choose to hire additional teachers to reduce class size need to be cautious that dipping deeper into the hiring pool does not result in hiring lower quality teachers. As noted above, prior research suggests that this can have a meaningful impact on the overall effectiveness of class size reduction, because teacher quality is such an important factor in improving student learning. For example, data from Massachusetts shows that compared to an average teacher, a teacher at the 40th percentile decreases student learning by the equivalent of about one month a year (Cowan, Theobald, and Goldhaber, 2017).

A final consideration is that small classes require sufficient classroom space. Schools must have available classrooms and may need to restructure or reassign existing space to accommodate new classrooms. In some cases, schools and districts will need extra funding to build school building or classroom additions if there is not sufficient classroom space. As an example, space constraints hindered California’s class size reduction efforts; this was even more pronounced for urban districts with less physical space to accommodate additional classes and that tended to be overcrowded already (Schrag, 2006). The requirement of additional classrooms that many schools do not have can lead schools to use gyms, cafeterias, special education classrooms, and other spaces as classrooms. Areas surrounding the schools, such as playgrounds, may get obstructed by portable classroom units.

## When should districts consider small classes? What additional resources on class size are available from the Department of Elementary and Secondary Education?

In the current climate with limited revenue increases, districts face choices between keeping class size low and implementing other strategic initiatives such as developing stronger curriculum, improving teachers’ effectiveness, investing in technology, and supporting students’ non-academic needs. When resources are limited, district and school leaders must not simply consider whether an educational policy or strategy will have a positive effect, but whether it is the most effective use of resources. Current class sizes, grade level, student demographic characteristics, and available funding are all important considerations as districts make class size decisions. More generally, other options for reform, enrichment, or expansion may offer greater impact on student outcomes than small classes. Indeed, it might even be worth increasing class size slightly in some areas to free up resources for more cost-effective interventions.

What might alternatives be? While a full inventory and assessment of educational interventions is not warranted here, promising interventions might include those focused on more effectively deploying teachers, for instance by redeploying teachers freed up by increased class sizes to serve as coaches, master teachers, or tiered intervention specialists. Alternatively, schools or districts might strategically increase class sizes for the most effective teachers to allow more struggling students opportunities for access to those teachers. As positions become vacant through retirement or attrition, districts might also use resources that would have otherwise gone to refilling positions in other ways that support student learning: for example, implementing more effective curricula or increasing access to non-academic resources such as social-emotional supports, free meals, or summer jobs that have evidence of increasing student performance.

Districts can begin the process of determining their expenditures on current class sizes and modeling other sizes by using information in the Department’s [RADAR Benchmarking](http://www.doe.mass.edu/research/radar/), [DART](http://www.doe.mass.edu/dart/), and [Profiles](http://profiles.doe.mass.edu/) reports. The Department is currently developing additional RADAR reports about class size that will allow districts to compare class sizes with other districts by grade level and subject. Reports can provide insight on questions such as how a district’s overall teacher staffing level and its average class sizes compare to similar districts. ESE also has launched a [How Do We Know? Initiative](http://www.doe.mass.edu/research/howdoweknow/) website that includes information on using, building, and sharing evidence to improve student outcomes. This may be a useful resource for districts looking for evidence-based, cost-effective improvement strategies.

Considering class size when making decisions about planning and budgeting is complex but important. District reforms, interventions, and policy decisions often translate into changes, albeit unintended, in class size. As an example, an expansion in elective offerings aimed at increasing student engagement can have a collateral effect of decreasing class size and increasing teacher costs. Alternatively, increasing the proportion of inclusion placements for students with disabilities might be done while lowering some class sizes, but some small, substantially separate classes would be eliminated. Thus, class size differences may reflect the interaction of a host of policies, programs and educational decisions that are not directly aimed at changing class size. The resulting distribution of class size—whether small or large—may reflect unintended consequences and be worthy of reconsideration by districts seeking to best use their resources to support student learning.

Links to additional resources

RADAR Benchmarking: <http://www.doe.mass.edu/research/radar/>

DART: <http://www.doe.mass.edu/dart/>

Profiles: <http://profiles.doe.mass.edu/>

How Do We Know? Initiative: <http://www.doe.mass.edu/research/howdoweknow/>

## References

Angrist, J., Lavy, V., Leder-Luis, J., & Shany, A. (2017). Maimonides Rule Redux (NBER Working Paper No. 23486). National Bureau of Economic Research.

Blatchford, P. (2003). The class size debate: Is small better? McGraw-Hill Education (UK).

Bosworth, R. (2014). Class size, class composition, and the distribution of student achievement. Education Economics, 22(2), 141–165.

Chetty, R., Friedman, J. N., Hilger, N., Saez, E., Schanzenbach, D. W., & Yagan, D. (2011). How Does You Kindergarten Classroom Affect Your Earnings: Evidence from Project STAR. The Quarterly Journal of Economics, 126(4), 1593–1660.

Chingos, M. M. (2011). The False Promise of Class-Size Reduction. Center for American Progress.

Chingos, M. M. (2012). The impact of a universal class-size reduction policy: Evidence from Florida’s statewide mandate. Economics of Education Review, 31(5), 543–562.

Cho, H., Glewwe, P., & Whitler, M. (2012). Do reductions in class size raise students’ test scores? Evidence from population variation in Minnesota’s elementary schools. Economics of Education Review, 31(3), 77–95.

Cowan, J., Goldhaber, D., and Theobald, R. (2017). Teacher Equity Gaps in Massachusetts. ESE Policy Brief, Massachusetts Department of Elementary and Secondary Education.

Dee, T. S., & West, M. R. (2011). The non-cognitive returns to class size. Educational Evaluation and Policy Analysis, 33(1), 23–46.

Dieterle, S. G. (2015). Class-size reduction policies and the quality of entering teachers. Labour Economics, 36, 35–47.

Funkhouser, E. (2009). The effect of kindergarten classroom size reduction on second grade student achievement: Evidence from California. Economics of Education Review, 28(3), 403–414.

Gilraine, M. (2017). Multiple treatments from a single discontinuity: An application to class size. University of Toronto.

Goldstein, H., & Blatchford, P. (1998). Class size and educational achievement: a review of methodology with particular reference to study design. British Educational Research Journal, 24(3), 255-268.

Grissmer, D. (1999). Conclusion: Class size effects: Assessing the evidence, its policy implications, and future research agenda. Educational Evaluation and Policy Analysis, 21(2), 231-248.

Harris, D. (2009). Toward policy-relevant benchmarks for interpreting effect sizes: Combining effects with costs. Educational Evaluation and Policy Analysis, 31(1).

Hedges, L. V., Laine, R. D., & Greenwald, R. (1994). An exchange: Part I: Does money matter? A meta-analysis of studies of the effects of differential school inputs on student outcomes. Educational Researcher, 23(3).

Hoxby, C. M. (2000). The effects of class size on student achievement: New evidence from population variation. The Quarterly Journal of Economics, 115(4), 1239–1285.

Jepsen, C., & Rivkin, S. (2009). Class size reduction and student achievement: The potential tradeoff between teacher quality and class size. The Journal of Human Resources, 44(1), 223–250.

Konstantopoulos, S., & Chung, V. (2009). What are the long‐term effects of small classes on the achievement gap? Evidence from the Lasting Benefits Study. American Journal of Education, 116(1), 125–154.

Krueger, A. (1999). Experimental estimates of education production functions. The Quarterly Journal of Economics, 114(2), 497.

Krueger, A. (2003). Economic considerations and class size. The Economic Journal, 113(485), 34–63.

Krueger, A. B., & Whitmore, D. M. (2001). The Effect of Attending a Small Class in the Early Grades on College-Test Taking and Middle School Test Results: Evidence from Project STAR. The Economic Journal, 111(468), 1–28.

Milesi, C., & Gamoran, A. (2006). Effects of Class Size and Instruction on Kindergarten Achievement. Educational Evaluation and Policy Analysis, 28(4), 287–313.

Molnar, A., Smith, P., Zahorik, J., Palmer, A., Halbach, A., & Ehrle, K. (1999). Evaluating the SAGE Program: A Pilot Program in Targeted Pupil-Teacher Reduction in Wisconsin. Educational Evaluation and Policy Analysis, 21(2), 165–177.

Normore, A. H., & Ilon, L. (2016). Cost-Effective School Inputs. Educational Policy.

Nye, B., Hedges, L. V., & Konstantopoulos, S. (1999). The Long-Term Effects of Small Classes: A Five-Year Follow-Up of the Tennessee Class Size Experiment. Educational Evaluation and Policy Analysis, 21(2), 127–142.

Nye, B., Hedges, L. V., & Konstantopoulos, S. (2000). The Effects of Small Classes on Academic Achievement: The Results of the Tennessee Class Size Experiment. American Educational Research Journal, 37(1), 123–151.

Rivkin, S., Hanushek, E., & Kain, J. (2005). Teachers, Schools, and Academic Achievement. Econometrica, 73(2), 417–458.

Roza, M., & Ouijdani, M. (2012). The Opportunity Cost of Smaller Classes: A State-By-State Spending Analysis. Center on Reinventing Public Education, University of Washington.

Schrag, P. (2006). Policy from the Hip: Class-Size Reduction in California. Brookings Papers on Education Policy, (9), 229–243.

Sharp, M. A. (2002). An analysis of pupil-teacher ratio and class size. EdD Dissertation. Ypsilanti, MI. Eastern Michigan Univeristy.

Staiger, D. O., & Rockoff, J. E. (2010). Searching for effective teachers with imperfect information. The Journal of Economic Perspectives, 24(3), 97-117.

Whitehurst, G., & Chingos, M. M. (2011). Class Size: What Research Says and What it Means for State Policy (pp. 1–14). Brown Center on Education Policy at Brookings.

Woods, D. (2015). The Class Size Debate: What the Evidence Means for Education Policy. Berkeley Public Policy Journal

1. Specifically, we report on class size data from the October 1, 2016 data collection, using data only from classes with less than 75 percent students with disabilities and with class sizes in the middle 90 percent of the range of sizes. More information on the methodology is available in the online [appendix](http://www.doe.mass.edu/research/reports/2017/12class-size-appendix.docx). [↑](#endnote-ref-1)