



Buffalo Public Schools

Putting children and families first to ensure high academic achievement for all

RESEARCH CAPSULE

Research Services

Vol. 2
November, 2016

Erica J. Boyce, Program Evaluator

CLASS SIZE REDUCTION

AT A GLANCE

The American education system has grappled with the potential cost-benefits of reduced class size since at least the 1920s. Currently, the Buffalo Public School (BPS) District has moved forward in this realm by identifying and implementing strategies to reduce early elementary class size as a component of BPS's New Education Bargain. This research capsule summarizes both positive outcomes and challenges associated with reduced class size. Most of the studies reviewed in this capsule found that small class size produced effective student-level outcomes. However, additional research is needed to clarify the underlying mechanisms supporting this relationship and for whom a reduced class works best.

This research capsule provides a summary of the literature examining the impact of class size on academic achievement. Attention to issues of class size is not a new concern for school administrators. During the turn of the century, schools were faced with the decision of hiring more teachers or increasing class sizes to accommodate the influx of registered school children (Chingos, 2013). Alternatively, when districts are faced with favorable economic conditions, class size typically begins to decrease. Based on a constant struggle to maintain appropriate class size for effective student learning and meet district fiscal responsibilities, there have been ongoing efforts to measure the effectiveness of reduced class since the 1920s (Biddle et al. 2002).

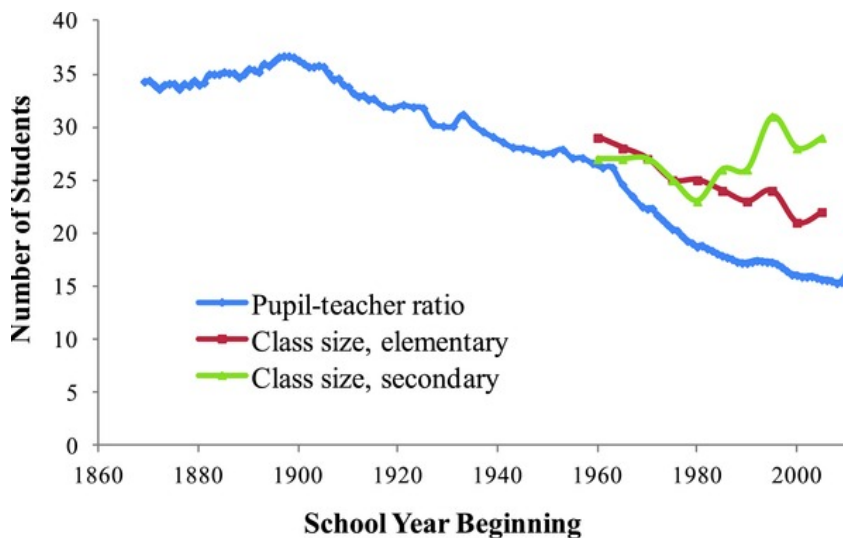
The United States has experienced a fluctuation in class size over the last century primarily due to the availability of education-based funding. As long as tax revenues allowed, communities were eager to capitalize on this political support by enacting class-size reduction policies. In recent decades, at least 24 states have mandated or incentivized class-size limits in their public schools (Chingos, 2013). The federal government also has its own program, which provided \$1.2 to \$1.6 billion per year from 1999-2001 for class-size reduction, with the goal of reducing class size in grades K-3 to an average of 18 students per class (Millsap et al., 2004). Funds were provided to states, which distributed them to districts using a formula

Research Services
Office of Shared Accountability
808 City Hall, Buffalo, NY 14202
(716)816-3035 Fax (716)851-3044

that incorporated poverty and enrollment data. Districts were required to spend most of the funds on teacher salaries, recruitment, and training of new teachers. This program was absorbed into Title II of the No Child Left Behind Act in 2001 (Millsap et al., 2004). As a result, districts are free to spend their Title II funds to reduce class size but are no longer required to allocate a specific pot of money toward this goal (Millsap et al., 2004).

The following graph depicts a general trend in attention toward the class size issue. Graph 1 shows that class sizes reported by elementary school teachers in self-contained classrooms fell by 24 percent between 1960 and 2005, during which time the pupil teacher ratio fell by 41 percent. Over this time period the gap between average class size and the pupil-teacher ratio grew by about three students.

Graph 1: Pupil-Teacher Ratio and Class Size in U.S.



Public Schools, 1860–2010. Sources: Keaton (2012, Table 4), Snyder and Dillow (2012, Table 69), Snyder (1993, Table 14), National Education Association (2010, Tables 20 and 22)

As the graph displays, the pupil-teacher ratio is consistently smaller than average class size. For example, in the 2007-2008 school year, the average pupil-teacher ratio was 15.3, but the federally administered Schools and Staffing Survey found average class sizes of 20.3 in self-contained elementary classes and 23.3 in subject-area high school classes (Chingos, 2013). To further understand this comparison, take for example a school with self-contained classes of 25 students with one teacher. The class size in this situation would be 25. However, if the school employs two full-time teachers to instruct subjects such as science or math, then the pupil-teacher ratio is decreased to 12.5 (Chingos, 2013) even though the class size is still 25.

Although debate among scholars continues regarding the extent of the effectiveness of class size reduction and the associated underlying mechanisms, a large portion of the research finds various positive outcomes attributable to smaller classes. One of the most consistent overall findings in the literature is that smaller classrooms experience fewer student disruptions (Blatchford et al., 2002; Blatchford, 2003; Biddle and Berliner, 2002; Finn, 2002; Finn et al., 2003; Englehart, 2007; Halbach et al., 2001; Milesi, 2006; Mueller, 2013; Rice, 1999). Such a shift in classroom environment allows for increased teacher interaction with students and increased student engagement. As a result of better regulated classrooms, teachers are able to spend less time addressing potentially disruptive behaviors and more time on classroom instruction

(Biddle et al., 2002; Englehart, 2007; Finn et al. 2003). The increased ability to provide instruction also increases teachers' sense of efficacy and morale in the classroom (Englehart, 2007; Bourke, 1986). Additionally, research has shown that teachers get to know students better individually in smaller classes and are able to increase the amount of time spent delivering one-on-one assistance (Bruwhiler, 2011; Finn et al., 2003, 2005). Teachers in small classes have also been found to provide more educationally beneficial experiences for students (Blatchford et al., 2007).

The importance of a teacher's role in relation to reduced class size commonly cited in the research has contributed to discussions regarding the necessity of teacher preparedness and professional development opportunities. Some studies have shown that teacher experience increases the effectiveness of small classrooms (Meuller, 2013). In other words, more experienced teachers have shown greater student-level outcomes in some studies. Jepson and Rivkin (2009) found that having a first-year teacher as opposed to a teacher with at least two years of experience reduced achievement by an average of 0.10 and 0.07 standard deviations in mathematics and reading, respectively, almost identical to the benefit of the smaller classes.

Other researchers have argued that it may not be experience alone, but rather teaching techniques. Some teachers, such as those who emphasize personal relationships with students and who employ many hands-on activities, may benefit from class size reduction without changing how they teach (Ehrenberg et al., 2001). Others, however, may need to change what they do in the classroom to match the newly presented teaching environment. However, often times teachers do not always adapt their teaching to meet the opportunities provided by small classes (Blatchford et al., 2007), preferring to use their usual teaching approaches. This might be one reason for the sometimes weak effect found in research on class size and academic outcomes (Bruwhiler, 2011). These findings may suggest the need for continued support and professional development opportunities (Hattie, 2005). Because teachers may not know how to take advantage of smaller classes, the literature suggests they should be given training to take advantage of the situation and should look to the practices of expert teachers to learn what works best (Englehart, 2007; Galton, 1998;).

In addition to the enhanced role of teachers, Finn and colleagues (2003) found that student behavior, despite varying definitions across research projects, was better in small classes on approximately 80% of the studies they reviewed. Overall, results suggested that students typically have decreased anti-social behaviors in smaller classrooms, become more engaged in learning, and are kept on track with lesson activities (Finn et al., 2003). This may be attributable to the sheer fact that fewer students statistically decreases the chance of disruptions in the classroom or that students may feel less invisible in a smaller group. Finn (1999) argued that it is difficult or impossible to withdraw from class participation in smaller classes and that students may feel a pressure to participate by other students. Additionally, studies have found that students in smaller classes tend to be more supportive of one another and that larger classes tend to form splinter groups that interfere with teaching and learning (Achilles, 1999; Finn et al., 2003). Kashti, Arieli, and Harel (1984) also found that in classes of 25 to 29 students, splinter groups formed with their own distinct patterns of participation and non-participation, but no definable subgroups were formed in classes of 16 students (Finn, 2015).

As a result of decreased classroom disruptions, various test scores such as math and language arts have shown improvement (Angrist et al., 1999; Blatchford et al. 2011; Chingos, 2011; Dee et al., 2011; Finn, 2002; Finn, 1999; Hattie, 2005; Hoxby, 2000; Hyunkuk, 2012; Rivkin et al., 2005). Project STAR, one of the most frequently published studies and the largest randomized experiment conducted in Tennessee in the late 1980s, found that elementary school students randomly assigned to small classes outperformed their

classmates who were assigned to regular classes on standardized tests by about 0.22 standard deviations after four years. This effect was concentrated in the first year that students participated in the program. The small class effect in the first year was 0.12 standard deviations, with an increment of 0.035 standard deviations in each of the following years (Chingos, 2013). Longitudinal studies have shown that students enrolled in reduced class-size elementary grades have experienced increased graduation rates, college enrollment, and employment status (Dee et al., 2011; Finn et al., 1991; Finn et al., 2005; Finn, 2015; Glass et al., 1978; Jepsen, 2009; Robinson, 1990; Wilde et al., 2011).

Exposure to small class size in grades K–3 appears to improve earnings and employment for black males and earnings for white males, while reducing employment and earnings among white females (Wilde et al., 2011). Several studies suggest that minority students may receive more benefit and are frequently the most impacted by reduced class size. Evidence has shown that black students benefit more than white students as supported by test scores. In Project STAR, the benefits of small classes were two to three times larger for minority students (mainly Blacks) than for Whites (Finn et al., 1999; Krueger et al., 2001). Likewise, Wisconsin's Student Achievement Guarantee in Education (SAGE) program evidenced larger benefits of small classes for black students (Melisa, 2006)

Limitations to the Research on Class Size Reduction

Debate regarding the extent that class-size impacts student achievement exists primarily due to somewhat inconsistent findings in the literature. It is likely that much of the ongoing discussion is attributable to the methodologies implemented to measure reduced class size effectiveness. Only one study, the STAR Project, used an experimental research design. Most studies have been quasi-experimental, meaning that students and teachers were not randomly assigned to smaller or larger classrooms. Limitations in much of these research projects exist because of the often informal designs (Blatchford 2011; Finn et al., 2003) and the fact that teachers and administrators were not blind to project intentions (Englehart, 2007). Additionally, researcher face challenges obtaining data on class size by school and grade over a reasonably long time period. Most states collect data on school enrollment and test scores, but not on class size (Chingos, 2013).

One of the difficulties in interpreting class-size research is that schools with different class sizes likely differ in many other, difficult-to-observe ways. For example, more affluent schools are likely to have the resources needed to support student growth (Chingos, 2011; Cho, 2012). A central challenge in assessing the true effects of smaller classes is that students with a propensity for poor achievement may be systematically assigned to smaller classes (Lazear, 2001). Similarly, the effects of a teacher's unobserved quality on the size of the teacher's assigned class could also undermine inferences about the effects of class size on student outcomes. (Dee and West, 2011) Another difficulty associated with estimating class-size effects is that various placement decisions may influence the causal relationship between class size and student performance. For example, parents may place children in schools with bigger or smaller class sizes on the basis of their performance; administrative rules may track students into different schools depending on their achievement; and individual educators may sort students within a school into differently sized classes according to their behavior or demonstrated academic potential (Wobman 2006).

Keeping these limitations in mind, a sampling of research studies pertaining to class size reduction are presented below.

Student Performance

- Project Prime Time, Indiana's 1985 reduction of class size initiative, experienced significant improvements in 50% of the districts in first grade reading scores, 30% in first grade math, 20% in second grade reading, and 20% in second grade math. Researchers contested that the results were attributable to increased individual attention to students, teacher morale, and student achievement within the smaller classrooms (Englehart et al., 2007).
- Project STAR is likely the most cited study in the class-size reduction literature. Krueger's (1999) original analysis of the Tennessee STAR experiment found that elementary school students randomly assigned to small classes outperformed their classmates who were assigned to regular classes on standardized tests by about 0.22 standard deviations after four years.
- Dee and West's (2011) quasi-experimental analysis of nationally representative data on eighth graders indicated that reductions in class size are associated with improvements in the available measures of non-cognitive skills related to psychological, but not behavioral, engagement with school. They also found modest overall positive effects on non-cognitive skills related to school engagement. Students in smaller classes were less likely to say that they do not look forward to the subject, do not see it as useful, or are afraid to ask questions. Teachers of smaller classes said their students were less likely to be inattentive, but not more or less likely to be disruptive.
- Hyunkuk, C., et al. (2012) found positive effects of smaller classes, albeit of a smaller magnitude than the Project STAR effects. Specifically, their estimates suggested that a reduction of class size by 10 students' increases test scores in grades 3 and 5 by 0.04 to 0.05 standard deviations.
- A study on class size in Israel (Angrist et al. 1999) consistently showed a negative association between larger classes and student achievement. These effects were largest for the math and reading scores of fifth graders, with smaller effects for the reading scores of fourth graders. Results for the math scores of fourth graders were not significant, though pooled estimates for fourth and fifth graders were significant and precise on both tests.
- Rivkin, Hanushek, and Kain (2005) found positive effects of smaller class sizes on reading and mathematics in fourth grade, a smaller but still statistically significant effect in fifth grade, and little or no effects in later grades.
- Finn (2002) identified several associated impacts including improved teacher morale in small classes; teachers spend more time on direct instruction and less on classroom management when classes are smaller; there are fewer disruptions in small classes and fewer discipline problems; students' engagement in learning is increased; in-grade retentions are reduced; dropout rates may be reduced; greater numbers of students who attend small classes in the early grades elect to take SAT or ACT tests in high school - that is, aspirations to attend college are increased, especially among African American students (Finn, 2002).
- Chingos (2012) examined the impact of Florida's statewide class size reduction policy and found that the effect on middle school reading scores was negative and statistically insignificant, but precisely estimated enough to rule out small positive effects. The math

results were closer to zero and not precise enough to rule out small positive effects.

- Englehart (2007) indicated that data seem to indicate that size factors have some influence on educational

outcomes; however this influence is mediated by other factors (such as SES) and there are many social/political/geographic factors which determine the boundaries of school districts, the size of schools, and, of course class size.

Future Oriented Impacts

- Project STAR improved cognition and high school graduation rates. These benefits were primarily realized among low-income and minority students and exposure to small class size increased employment and earnings for black males. Exposure to small classes also led to an increase in earnings for white males while reducing employment and earnings among white females (Wilde et al. 2011).
- Dynarski et al. (2011) analyzed the Project STAR data and found that students assigned to a small class were about three percentage points more likely to attend college. The effect is largest among black students (5.8 percentage points) and students eligible for free lunch (4.4 points), but is not statistically significant from zero among white students and those students not eligible for the free lunch program. Dynarski et al. (2011) also found that smaller classes increased the likelihood of earning a college degree by 1.6 percentage points and shifted students toward high-earning fields such as STEM (science, technology, engineering, and mathematics), business, and economics.
- Chetty et al. (2011) merged STAR data with US tax records for 1996 to 2006 obtained from the Internal Revenue Service. There were no significant differences in favor of those who had attended small classes, but both studies noted that college attendance may have confounded the results. The years studied included typical college ages and students who attended small classes were more likely than others to be in college.
- Finn et al. (2005) examined graduation and dropout rates of the STAR students. The effects on graduation rates were larger with each additional year of small-class participation. For all students combined, the effects of attending small classes for four years increased the odds of graduation by about 80%. For students from low-income homes, 3 years of small classes increased the odds of graduating by approximately 67%, and 4 years more than doubled the odds. The graduation rates for low-income students with 3 or more years in a small class were at least as high as those of higher-income students, closing the income gap in high school graduation entirely.

Students Who Benefit Most

- Project STAR participants improved cognition and high school graduation rates. These benefits were primarily realized among low-income and minority students (Wilde, 2011; Chingos, 2013).

Wilde et al. (2011) tracked STAR participants into the future and found that particularly black males, benefited from exposure to small class size with respect to annual employment and

earnings. This is largely consistent with earlier studies, which found that Project STAR disproportionately impacted the percentage of black students who graduated from high school and who took college-entrance exams. It is also consistent with adult earnings data from other early intervention programs targeted toward black children (Wilde et al., 2011).

- Robinson (1990) conducted a meta-analysis to synthesize several research projects focused on the effects of class size. He ascertained that on average, students who were economically disadvantaged or from some ethnic minorities performed better academically in smaller classes.
- Results of the Wisconsin's Student Achievement Guarantee in Education (SAGE) project showed positive effects of the smaller classes. For all schools, attending a SAGE school was a significant predictor of student achievement. African-American SAGE students had a higher mean test score than African-American non-SAGE students, and they scored significantly higher on every subtest. African-American SAGE students had greater achievement gains relative to those made by white SAGE students, thereby reducing the existing achievement gap. In contrast, African-American comparison school students achieved lesser gains relative to their white counterparts. The achievement gap, then, widened in comparison schools (Englehart, 2007).
- Dee and West's (2011) analysis of eight-grade students showed a positive effect on test scores in urban schools, with a 10-student decrease in class size associated with an increase in test scores of 0.12 standard deviations. The estimate for black students was similar in magnitude, but estimated with less precision and consequently statistically insignificant from zero (Chingos, 2013).
- Studies by Angrist and Lavy (1999), Hoxby (2000), and Rivkin, Hanushek, and Kain (2005) looked at variation in class size in order to learn more about the effects of class size on achievement (in Israel, Connecticut, and Texas, respectively). Except for Hoxby (2000), the studies found that smaller classes significantly increase achievement in the early grades (Grade 5 and below) and the effects tended to be larger for lower-income students (Jepsen, 2009).
- One of Blatchford's (2011) main study implications was that the lower attaining pupils in particular can benefit from small classes at secondary level. This suggests that small classes can be a valuable educational initiative right through school, but lower attaining pupils at secondary level could particularly benefit from small classes. If placed in large classes, the evidence is that they will be more prone to go off task and teachers will have to use up more time bringing them back on task (Blatchford, 2011).

Associated Mechanisms

- Biddle and Berliner (2002) offered a two-part framework to explain why smaller classes are more effective. The teacher is the focus of the first, expressing that small classes allow teachers to interact with students on more of a one-to-one basis and to better support students. The second part focused on the classroom environment. Smaller class size classrooms witness fewer behavioral

problems and greater student engagement. These in turn result in better student social and learning behavior (Englehart, 2007) Additionally, Finn, Pannozzo, and Achilles (2003) offered a similar argument. They suggested that teachers' interpersonal styles were influenced by class size and asserted that teachers get to know their students better in small classes (Finn et al. 2003).

- The existence of disruptions induces beneficial class size effects therefore increasing potential for students to be off-track (Finn et al. 2003). Supporting this argument Rice (1999) and Blatchford et al. (2002) find that more time is devoted to instruction if the class is smaller (Mueller, 2013). Student behavior may also provide a context for the effect of class size on student achievement. Research consistently shows that teachers in smaller classes spend less time maintaining order (Milesi, 2006). One reason why student behavior is relevant to academic achievement is that, given a fixed amount of class time, a reduction in non-instructional time may result in an increase in time spent in instruction, thus benefiting student learning. Another reason is that students' behavior reflects their engagement in the classroom (Milesi, 2006).
- In an extensive review of studies of class size and student engagement, Finn, Pannozzo, and Achilles (2003) found that students in small classes are more engaged in learning behavior and display less disruptive behavior compared to students in large classes (Milesi, 2006).
- When morale is up and the class seems more manageable, teachers can be more

tolerant of moderate amounts of misbehavior. In turn, students see the classroom as a warm and accepting place (Bourke, 1986).

- Student interaction also may help explain the effects of small class-sizes. Students in smaller classes tend to be more supportive of one another (Achilles, 1999; Finn et al., 2003). Larger classes tend to form splinter groups that interfere with teaching and learning. Kashti, Arieli, and Harel (1984) found that in classes of 25 to 29 students, splinter groups formed with their own distinct patterns of participation and non-participation, but no definable subgroups were formed in classes of 16 students (Finn, 2005).
- Several studies demonstrated that reducing class size reduces antisocial behavior. Students in small classes were less likely than students in large classes to fool around, engage in inappropriate behavior, or disrupt the work of other students, and they had fewer referrals for discipline problems (Finn et al. 2003).
- Observational studies (Blatchford et al., 1998; Bourke, 1986) have demonstrated that smaller classes increase teacher-pupil interaction and the amount of homework assigned and graded. Halbach's (2001) study on class size revealed that smaller classes are perceived to produce fewer discipline problems, provide more time for instruction, and increase the amount and depth of course coverage.
- Smaller classes (Datar, 2008) have also been shown to allow more academic individualization and better classroom management, have much less in discipline, promote student engagement and participation, and increase parent interest more relative to larger classes.

- Finn et al. (2003) argued that the effects of class size on pupils' classroom engagement are more important than those on teaching.(Blatchford 2011)
- Blatchford (2011) found a tendency for pupils to be more on task and less disruptive behaviors as class sizes decreased, and conversely less time spent on tasks as class sizes increased.

Future Directions for Research on Class Size Reduction

Future research is needed to further understand the dynamics of why class-size affects student academic performance. Additionally, studies are needed to better understand how it impacts student behavior and attendance rates as these were rarely present in the literature. Although it seems clear that smaller class sizes benefit some students in some settings, researchers have yet to determine all of the factors that influence this success. Bruhweiler (2011) suggested that to improve the knowledge regarding the conditions of class size effects, various factors influencing and mediating these effects need to be considered and empirically tested in a formal model. Such factors may include individual-level such as student family dynamics and school-level such as culture and climate as these may impact the ability of reduced class size classrooms to be effective.

On a Local Note

Reduced class size for elementary grades is a component of Buffalo Public Schools New Education Bargain. The goal of this component includes reducing class-sizes for PK through 3rd grade levels. Target numbers associated with this goal are provided in the Table 1. As of the completion of the first quarter in school year 2016-2017, the Chief Academic Officer reported a significant decrease in class size for grades Pre K through first. Table 2 depicts the current average class sizes.

Table 1: Aspirations of New Education Bargain for Reduced Class Size

Configuration	Good Standing	Focus	Priority
PK	18	18	18
GR K (2015-16)	25	20	20
GR 1 (2016-17)	25	20	20
GR 2 (2017-18)	25	20	20
GR 3 (2018-19)	25	20	20

Table 2: Reduced Class Size for Buffalo Public Schools as of October, 2016

Configuration	Good Standing	Focus	Priority
PK	17	17	16
GR K	21	18	17

GR 1	22	19	19
------	----	----	----

*These numbers may fluctuate as new students and the District and other students transfer out.

The Office of Shared Accountability has developed research questions to begin measuring the effectiveness of these reductions. Data will be collected and analyzed to understand how reduced class size impacted student academic performance, student and teacher attendance, and student behaviors.

References

- Achilles, C. M. (1999). *Let's put kids first, finally: Getting class size right*. Thousand Oaks, CA: Corwin Press.
- Angrist, J.D. and Lavy, V. (1999). Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement. *The Quarterly Journal of Economics*, 114 (2) 533-575.
- Biddle, B. J., and Berliner, D.C. (2002). Small class size and its effects. *Educational Leadership*, 59, 12–23.
- Biggs, J. (1998). Learning from the Confucian heritage: So size doesn't matter? *International Journal of Educational Research*, 29, 723–738.
- Blatchford, P. and Martin C., (1998).The effects of class size on classroom processes: It's a bit like a treadmill—working hard and getting nowhere fast. *British Journal of Educational Studies*, 46(2), 118–137.
- Blatchford, P. (2003). A systematic observational study of teachers' and pupils' behaviour in large and small classes. *Learning and Instruction* 13, 569–595.
- Blatchford, P., Moriarty, V., Edmonds, S., Martin, C. (2002). Relationships between class size and teaching: a multimethod analysis of English infant schools. *American Educational Research Journal* 39 (1), 101–132.
- Blatchford, P., Bassett P, and Brown, P. (2011). Examining the effect of class size on classroom engagement and teacher pupil interaction: Differences in relation to pupil prior attainment and primary vs. secondary schools. *Learning and Instruction*, (21) 715-730.
- Bourke, S. (1986). How smaller is better: Some relationships between class size, teaching practices and student achievement. *American Educational Research Journal*, 23, 558–571.
- Bruhweiler, C. and Blatchford, P. (2011). Effects of class size and adaptive teaching competency on classroom processes and academic outcome. *Learning and Instruction*, (21) 95-108.
- Chetty R, Friedman J, Hilger N, (2011). How does your kindergarten classroom affect your earnings? Evidence from project STAR. *Quarterly Journal of Economics*, 126, 1593–1660.
- Chingos, M. M. (2011). *The false promise of class-size reduction*. Washington, DC: Center for American Progress.
- Chingos, M.M. (2013). Class Size and Student Outcomes: Research and Policy Implications. *Journal of Policy Analysis and Management*, 32 (2) 411-438.

- Datar, A. and Mason, B. (2008). Do reductions in class size “crowdout” parental investment in education? *Economics Education Review*, 712-723.
- Dee, T.S. and West, M.R. (2011). The non-cognitive returns to class size. *Educational Evaluation and Policy Analysis*, 33 (1) 23-46.
- Dynarski, S., Hyman, J., and Whitmore Schanzenbach, D. (2013). Experimental Evidence on the Effect of Childhood Investments on Postsecondary Attainment and Degree Completion. *Journal of Policy Analysis and Management*, 32 (4) 692-717.
- Englehart, J.M. (2007). The Centrality of Context in Learning from Further Class Size Research. *Educational Psychology Review*, (19) 455-467.
- Finn, J.D. and Achilles, C.M. (1999). Tennessee’s Class Size Study: Finding, Implications, Misconceptions. *Educational Evaluation and Policy Analysis*, (21) 2, 97-109.
- Finn, J.D. and Pannozzo, G.M. (2004). Classroom Organization and Student Behavior in Kindergarten. *The Journal of Educational Research*, 98 (2) 79-91.
- Finn, J.D., Gerber, S.B., and Boyd-Zaharias, J. (2005). Small Classes in the Early Grades, Academic Achievement, and Graduating From High School. *Journal of Educational Psychology*, 97 (2) 214–223.
- Finn, J. (2002). Small Classes in American Schools: Research, Practice, and Politics. *The Phi Delta Kappan*, 83 (7) 551-560
- Finn, J. D., Pannozzo, G. M., & Achilles, C. M. (2003). The “why’s” of class size: Student behavior in small classes. *Review of Educational Research*, 73, 321–368.
- Glass, G.V., and Smith, M.L. (1978). *Meta-analysis of Research on the Relationship of Class Size and Achievement*. San Francisco: Far West Laboratory for Educational Research and Development.
- Halbach, A., Ehrle, K., Zahorik, J., & Molnar, A. (2001). Class size reduction: From promise to practice. *Educational Leadership*, 58(6), 32–35 (March).
- Hattie, J. (2005). The paradox of reducing class size and improving learning outcomes. *International Journal of Educational Research*, (43) 387-425.
- Hoxby, C.M. (2000). "The Effects of Class Size on Student Achievement: New Evidence from Population Variation." *Quarterly Journal of Economics*, 115(4): 1239-86
- Hyunkuk, C., Glewwe, P., and 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) 77-95.
- Jepsen, C. and Rivkin, S. (2009). Class size reduction and student achievement: The potential tradeoff between teacher quality and class size. *Journal of Human Resources*, (44) 223-250.
- Krueger, A. B. (1999). Experimental estimates of education production functions. *Quarterly Journal of Economics*, 115, 497-532.

- Milesi, C. and Gamoran, A. (2006). Effects of Class Size and Instruction on Kindergarten Achievement. *Educational Evaluation and Policy Analysis*, 28 (4) 287-313.
- Mueller, S. (2013). Teacher experience and the class size effect – experimental evidence. *Journal of Public Economics*, (98) 44-52.
- Rice, J., (1999). The impact of class size on instructional strategies and the use of time in high school. *Educational Evaluation and Policy Analysis*, 21 (2), 215–229.
- Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, 73, 417-458.
- Robinson, G.E. (1990). Synthesis of research on effects of class size. *Educational Leadership*, 47(7), 80–90.
- Ross, R. (1999). "How Class-Size Reduction Harms Kids in Poor Neighborhoods. *Education Week*, May 26.
- Sims, D. (2008). A strategic response to class size reduction: combination classes and student achievement in California. *Journal of Policy Analysis and Management*, 27 (3) 457-478.
- Wilde, E.T., Finn, J., Johnson, G. and Muennig, P (2011). The Effect of Class Size in Grades K–3 on Adult Earnings, Employment, and Disability Status: Evidence from a Multi-center Randomized Controlled Trial. *Journal of Health Care for the Poor and Underserved*, 22 (4) 1424-1435.
- Xmann, L.W. and West, M. (2006) Class-size effects in school systems around the world: Evidence from between-grade variation in TIMSS. *European Economic Review*, 50 695–736.