

NCPEA POLICY BRIEF

*CLASS-SIZE POLICY: THE STAR EXPERIMENT AND
RELATED CLASS-SIZE STUDIES*

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Class-Size Policy: The STAR Experiment and Related Class-Size Studies

Executive Summary

This brief summarizes findings on class size from over 25 years of work on the Tennessee Student Teacher Achievement Ratio (STAR) randomized, longitudinal experiment, and other Class-Size Reduction (CSR) studies throughout the United States, Australia, Hong Kong, Sweden, Great Britain, and elsewhere. The brief concludes with recommendations.

The STAR research shows that small classes (15-17 pupils) in kindergarten through third grade (K-3) provide short- and long-term benefits for students, teachers, and society at large. Although all students benefit; poor, minority, and male students reap extra benefits in terms of improved test outcomes, school engagement, and reduced grade retention and dropout rates.

Differing formulas for counting students and teachers are a major impediment to understanding and using small classes correctly: a pupil-teacher ratio (PTR) is a division problem, class size is an addition problem. The two are not the same, and thus PTR data cannot be used as a substitute for actual class-size data.

Background

The Tennessee Student Teacher Achievement Ratio (STAR) was a large-scale, randomized, longitudinal experiment conducted between 1985 and 1989 based on early childhood education theory. The STAR experiment was high-intensity, affecting children for the entire school day every day of the school year, for up to four consecutive years. STAR impacted the learning setting directly, influencing all student-teacher interactions taking place in that setting.

Beginning in kindergarten, pupils were randomly assigned to ‘Small’ classes (about 15-17 students), ‘Regular’ classes (about 22-25 students), and ‘Regular with a full-time Aide’ classes (about 22-25 students) in 79 schools. STAR enrollments were near 7,000 every year. Each STAR school had at least one of each class type (small, regular, and regular with aide) in the robust and parsimonious within-school design.¹ The class arrangement was maintained throughout the day, all school year long. There was no intervention other than class size and a full-time teacher aide provided to assist classes. The large sample size and random assignment overcame threats to validity.

Cognitive outcomes were measured by norm-referenced tests and criterion-referenced tests aligned to state standards. Non-cognitive outcomes were also assessed. Between 1990 and 1996 STAR students were assessed on state tests in grades 4-8 in the Lasting Benefits Study (LBS). In the Enduring Effects Phase (1996-2011, and continuing) STAR principal investigators and others studied class size using the STAR database of 11,601 students with full test data.

¹ See a summary of the research design on page 6.

Short-Term Effects of Small Classes in the Early Grades

The STAR data and analyses showed immediate impacts of small classes on student behavior and achievement. These impacts include:

- improved test outcomes
- improved school engagement
- reduced grade retention
- greater benefits for poor, minority, and male students

Long-Term Effects of Small Classes in the Early Grades

The STAR Experiment has shown that attending small classes in early grades (K-3) is accompanied by long-term advantages including:

- **Taking College Entrance Examinations.** Students who attended small classes in K-3 were more likely to take the SAT and ACT exams, compared to randomly assigned peers who had attended full-size classes in K-3.² The benefit for Black students was substantially greater than for White students, thus reducing the Black-White gap in college entrance test taking by 54%.
- **Graduating from High School.** The effects on graduation rates were larger with each additional year of small-class participation for students in STAR.³ 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, three years of small classes increased the odds of graduating by approximately 67%, and four years in small classes more than doubled the odds. Graduation rates for low-income students with three or more years of small-class participation were at least as high as those of higher-income students, closing the income gap in graduation rates completely.⁴
- **Taking Advanced Course Work in High School.** Small-class participation had a significant positive impact on the amount of foreign language courses taken, and the highest levels taken in foreign languages and mathematics. The effect sizes were small but noteworthy. The greatest course-taking benefits accrued to students who spent three or more years in small classes in grades K-3. Both poor and affluent students were affected similarly.⁵

² Krueger, & Whitmore, 2001.

³ Finn, Gerber, & Boyd-Zaharias, 2005.

⁴ The effects on graduation rates were not fully explained by the improvements in academic performance. Other dynamics were occurring as well.

⁵ Finn, *op. cit.*, 2005.

Research and Analysis Continues

Reanalysis of STAR data and long-term outcomes of other small-class efforts such as the Perry Preschool⁶ work have gained momentum. Class-Size Reduction (CSR) done as small classes in grades K-3 or Pre-K-3 was among five “interventions that demonstrated improvement in high school graduation rates.”⁷ In addition, CSR is estimated to provide long-term savings. “From a societal perspective (incorporating earnings and health outcomes), class-size reductions would generate a net cost savings of approximately \$168,000 and a net gain of 1.7 quality-adjusted life years for each high school graduate produced by small classes. When targeted to low-income students, the estimated savings would increase to \$196,000 per additional graduate.”⁸ The purposeful joining of research on class size, econometric studies, and medical research should activate the long-standing, but seldom correctly used class-size research.

Differing Definitions that Affect Conclusions: Class Size vs. Pupil-Teacher Ratio

Since the early 1900s class-size studies in the United States and elsewhere have shown positive benefits for students and teachers. Yet class size in the early grades is still debated and is not a predominant national policy. The debate is fueled in part by confusion over how students and teachers are counted.

Between 1980 and 2012 researchers have conducted many class size, Class-Size Reduction (CSR), and Pupil-Teacher Ratio (PTR) efforts (often misnamed as “class-size studies”) in the U.S. and abroad. Two remarkable consistencies are apparent: a) PTR analyses show little effect, and b) class-size analyses show considerable positive effects on short- and long-term student outcomes. On average, the difference between these two calculations in American elementary schools is about 10 students.

Pupil Teacher Ratio (PTR) is “the number of students in a school or district compared to the number of teaching professionals.”⁹ Often all educators are part of the computation, including counselors and administrators. PTR is a formula and process for equitable allocation of resources important to administrators, policy persons, and others.

Class Size is “the number of students for whom a teacher is primarily responsible during a school year.”¹⁰ Class size is an organizing tool for providing instructional and education services to clients.

Average Class Size is the sum of all students regularly in each teacher’s class divided by the actual number of regular teachers in those specific classes. If four second grade classrooms have 14, 16, 18, 18 (n=65) students, the average, (not actual) second grade class size is 16.25 (or 16).

⁶ For information about the HighScope Perry Preschool project, visit <http://www.highscope.org/>.

⁷ Levin, Belfield, Muennig, & Rouse, 2007, p. 4.

⁸ Muennig, & Woolf, 2007, p. 2020.

⁹ McRobbie, Finn, & Harman, 1998, p. 4.

¹⁰ Lewit, & Baker, 1997, p. 113.

Class-Size Reduction (CSR) involves the processes to achieve class sizes smaller than the ones presently in place, such as changing the class size from 25 to 16.

Surveys and databases usually generate PTR's. Valid and reliable ways to get class-size data are 1) to count students in a class and/or 2) to establish class sizes and monitor them as in the Tennessee STAR Experiment.

Contribution of Small Classes to the Total Education Equation

The small-class benefits for K-3 obtained in the STAR Experiment are supported by research and theories about learning, teaching, and contexts. This detailed table can further be condensed for easy recall of the key points: Early Intervention, High Intensity (every day, all day long), and Duration (three or more continuous years in cohort). Table 1 summarizes the major elements that small classes bring to the total education equation for developing a strong foundation for a lifetime of continuous learning.

Table 1: Why Small Classes ‘Work’: Major Elements Small Classes Bring to the Total Education Equation

I. LEARNING

- A. Task Induction: Learn “to do” School
- B. Participation and Engagement
- C. Time On Task Increases
- D. Mastery of Basics Skills
- E. Appropriate Use of Homework
- F. Developmentally Appropriate Activities
- G. Early Intervention
- H. Duration
- I. Opportunity to Learn (OTL)¹¹

II. TEACHING

- A. Teach to Mastery
- B. Immediate Reinforcement.
- C. Early Diagnosis and Remediation of Learning Difficulties
- D. Individual Accommodations (I.E.P.)
- E. Effective Teaching Methods
- F. Portfolios, Running Records, etc.
- G. Portfolios, Running Records, etc.
- H. Opportunity to Teach (OTT)

III. CLASSROOM/CONTEXTS

- A. Classroom Environment (e.g., air quality, space, crowding, noise)
- B. Variable Room Arrangements (e.g., learning centers, groups)
- C. Inclusion, Special Needs
- D. Classroom Management – Few Discipline Problems¹²
- E. Mixed Ability Groupings

IV. OTHER BENEFITS

- A. Parent Involvement
- B. Reduced Grade Retention/Dropout
- C. Increased Teacher/Student Morale and Energy
- D. Teacher Accountability and Responsibility
- E. No “Pull Outs,” Intensity (all day, each day)
- F. Psychological Sense of Community (PSOC)

¹¹ Correct numbers of students provide the Opportunity to Teach (OTT) and students the Opportunity to Learn (OTL). OTT and OTL are reciprocal.

¹² Finn, Pannozzo, & Achilles, 2003.

Recommendations

For school improvement, policies should rely on class size, not Pupil-Teacher Ratio (PTR) calculations. The difference between the PTR and actual class size in U.S. elementary schools is about 10 students. This provides flexibility. If a school has a PTR of 12:1, that suggests enough staff to work toward class sizes of 15 or so for kindergarten through third grade, and still have personnel for special assignments.

How can we use small classes most effectively in cost-efficient ways? Instituting a class-size initiative does not mean hiring teachers and doing business as usual. To maximize the benefits of class-size reduction efforts, teachers and staff must alter instructional practices as well. A class-size initiative should incorporate what long-term class-size research has determined are important steps for obtaining successful schooling outcomes:

1. EARLY INTERVENTION. Start when the pupil enters “schooling” in kindergarten or pre-kindergarten.
2. SUFFICIENT DURATION. For enduring effects, maintain the small-class environment for at least three—preferably four—years.
3. INTENSE TREATMENT. Ensure the pupil spends all day, every day in the small class. Avoid “pull-out” projects or team teaching. Small classes facilitate intense treatment, fostering a psychological sense of community, close student-teacher relations, and coherence. Although teacher aides may assist in the building, there is scant evidence that they influence student outcomes positively.
4. MIXED ABILITY GROUPINGS. Randomly assign students and teachers to a class to facilitate peer tutoring, problem-solving groups, student-to-student cooperation, and active participation and engagement. (Draw straws or use a computer generated program).
5. EMPLOY A COHORT MODEL for several years so students develop a sense of community.
6. EVALUATE process and outcomes carefully, and share results. Appropriately sized classes in elementary grades will take policy and perhaps even legislative change.

Summary

The benefits of small classes have potential for cost savings, social benefits, and long-term pupil gains. Fewer school dropouts and lower retention-in-grade (especially for minority and male students) have immediate and long-term cost implications, such as increased numbers of college-bound students. To calculate class sizes correctly use the appropriate class size formula. Small classes in the early grades are most effective as part of a comprehensive instructional plan that reflects research-based principles of teaching and learning.

Table 2: Rigorous Design of STAR¹³

<p>1. All Tennessee schools with K-3 classes were invited to participate. This ensured a diverse sample and ruled out the possibility that class-size effects could have resulted from having “chosen” certain schools.</p> <p>2. Each school included in the study had to have a large enough student body to form at least one of each of the three class types—small (about 15-17), regular (about 22-25), and regular with a full-time teacher aide about (22-25)—in order to accommodate the within-school design. The within-school design controlled for differences among schools (e.g., resources, leadership, facilities). Class-size effects could not be attributed to these factors.</p> <p>3. 79 schools in 42 systems met the within-school design requirement, and the STAR sample was nearly 7,000 students per grade level. The large sample lent credibility to the results and allowed for reduced sample size due to inevitable student mobility.</p> <p>4. Schools from inner-city, rural, urban, and suburban locations were included. This feature guaranteed that the sample would include children from various ethnic backgrounds and income levels.</p> <p>5. Students and teachers were randomly assigned to their class type. The randomization made certain that differences in the students’ test scores could be confidently attributed to class-size. It would not be possible to assert that the “smart” children were placed within a particular class type, or that the best teachers were given a particular class size.</p>	<p>6. Investigators followed the standard procedures for confidentiality and human subjects’ research. Only principal investigators and their staff had access to individual student information. Results were always reported at an aggregate level so that no individual child’s demographic or test-score data could be discerned.</p> <p>7. No children were to receive fewer services than normal because of the experiment. This, too, was required by the legislature, but it was an easy condition to fulfill: Without STAR, all of these children would have been in class sizes ranging from 22-25 (or larger). Therefore, the study did not “harm” any children.</p> <p>8. Student achievement was tracked by standardized tests, which were carefully monitored. During testing, monitors ensured that test instructions were followed and that teachers did not coach or help students taking the tests.</p> <p>9. An outside consultant was contracted to perform all primary statistical analyses. Jeremy Finn, State University of New York, Buffalo, served as the primary statistician. An expert in the field, he had not been involved with the study or the principal investigators before the Tennessee Department of Education contacted him. This additional safeguard guaranteed impartial results.</p>
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¹³ Boyd-Zaharias (1999), p. 2.

The Author

Charles M. Achilles is retired. Formerly, Dr. Achilles served on the faculty at Seton Hall University, Eastern Michigan University, the University of North Carolina, Greensboro, and the University of Tennessee, Knoxville. Dr. Achilles has conducted research on Tennessee's STAR experiment and class size for over 25 years. He was a principal investigator for the STAR experiment from 1985-1989 and conducted follow up research and analysis on the STAR findings. A major strand of his work includes determining how the use of research results can improve schooling.

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External Reviewers

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Website Resources

Class Size Matters: www.classsizematters.org

Institute of Education Class Size Research Project: <http://www.classsizeresearch.org.uk/>

National Education Association (NEA): www.nea.org/home/13120.htm

SERVE Educational Laboratory: <http://www.serve.org/publicationslisting.aspx>