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ABSTRACT

A short overview of an experimental evaluation of lower teacher-pupil ratios is presented in this report. The research under review is the Student Teacher Achievement Ratio (STAR) project. This longitudinal project was conducted in Tennessee and was designed to prove to state legislators the efficacy of smaller class sizes. For STAR, evaluation data included standardized measures of student outcomes and progress, teacher logs, observations in classrooms, student data (attendance, behavior, age, race, sex, free lunch, etc.), and data about teachers and administrators. Some of the positive results that emerged were: (1) small classes benefit all students, but minority and traditionally hard-to-teach students received approximately twice the benefit from the same investment and treatment; (2) small classes benefited teachers and parents and improved instruction; (3) students in small classes were less likely to be held back than students in large classes; (4) STAR students performed better on all measures; and (5) benefits obtained in K-3 remained with students up through at least grade 9. Other findings, such as the ineffectiveness of teacher aides, are also reported. Contains 27 references. (RJM)

SMALL-CLASS RESEARCH SUPPORTS WHAT WE ALL KNOW *

(SO, WHY AREN'T WE DOING IT?)

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Small-Class Research Supports What We All Know

(So, Why Aren't we Doing It?)

The path to establishing experimentally what common sense, teachers, parents, students, and others all know has been long, twisting and tortuous. There were some early small-scale studies and projects; the first statewide class-size effort was Project Prime Time in Indiana (Chase, Mueller & Walden, 1986). A small experimental study of class-size effects in two metro-Nashville, Tennessee schools was conducted 1983-1985 (Whittington, Bain, & Achilles, 1985; Bain, Achilles, & Witherspoon-Parks, 1988). This study (The DuPont Study) was important, as it started Tennessee policy people thinking about class-size research. These early works helped to build a solid base for a major statewide class-size experiment conducted in Tennessee, 1985-1989.

Late in its 1984 session, the Tennessee Legislature funded a four-year study of "The Effects of Small Classes" on the achievement and development of early primary youngsters as part of then-governor Lamar Alexander's "Better Schools Program." (H.B. 544). This was to be a definitive, experimental study that would provide the legislature information about class size: No "maybe" or "it-depends" answer. Perhaps to ease financial burdens if small classes should produce positive results, the legislature asked the researchers to check on the efficacy of using a full-time teacher aide or assistant in a regular class . Thus, the Tennessee study primarily known for its class-size results had two equally powerful experimental conditions. The control condition was the "regular" (R) class of one teacher to 22-26 students or an average class size of 1:25. The two experimental conditions were one teacher in a "small" (S) class of 13-17 students, with an average of 1:15, and a regular class (1:25) with a full-time instructional aide (RA). The (R) classes were set so small to assure that a student in one would not be in a class larger than the TN class-size maximum at that time.

The legislature's mandate of "cause and effect" required the four principal investigators (PIs) of Project STAR (Student Teacher Achievement Ratio) to establish an experimental design using random assignment of students and of teachers. In the parsimonious but strong "in-school" research plan, each school with one or more of the (S) classes also had one or more regular (R) class and regular-aide (RA) class. The in-school design helped control for building and district differences.

In 1997-1998 many youngsters from the STAR experiment are in grade 12. Some researchers are still following them, first in the Lasting Benefits Study (LBS) and in other related studies. In the STAR/LBS database there are

approximately 11,600 students who have been in at least one year of STAR. The cost of this research has exceeded 14 million dollars (1984-1998).

Measures of student outcomes and progress were standardized or norm-referenced tests (NRT) and criterion-referenced tests (CRT), teacher logs, observations in classrooms, student data (attendance, behavior, age, race, sex, free lunch, etc.), data about teachers and administrators. Results of the basic study were available in 1990 and they clearly favored the small-class condition (e.g., Finn & Achilles, 1990; Word, et al., 1990; Achilles, 1997).

Like many important education studies, STAR results continue to receive far less attention and use than they should. After a year-long independent review of Project STAR, Professor Frederick Mosteller (retired) of Harvard University gave the study good marks, and considered potential uses of the results.

> . . . the Tennessee class size project, a controlled experiment which is one of the most important educational investigations ever carried out and illustrates the kind and magnitude of research needed in the field of education to strengthen schools (p. 113).
>
> Because a controlled education experiment (as distinct from a sample survey) of this quality, magnitude and duration is a rarity, it is important that both educators and policy makers have access to its statistical information and understand its implications (p. 126).

The experimental aspect STAR ended when the students exited grade 3. The STAR experimental results were so powerful that a demonstration of class-size effects in difficult settings seemed to be a prudent step. The state funded Project Challenge in which 16 of the poorest counties received extra money to reduce class size. The Challenge results based on comparisons of rankings of school systems in TN, were highly positive. Tennessee legislation and policy seem clear. If districts do not work toward the mandated class size in primary grades, they risk losing state funds for education.

Using STAR's large and detailed database, researchers have conducted other studies to answer questions of importance to educators. Interest in STAR has generated other class-size studies. Table 1 shows some studies undertaken using the STAR database, or studies initiated because of STAR.

TABLE 1 ABOUT HERE

What were some major STAR findings? Here are highlights.

The basic STAR results should not surprise anyone who has taught school. They are not unlike results of similar studies.

- Small classes benefit all students(Equality factor), but minority and traditionally hard-to-teach students receive approximately twice the benefit from the same investment and treatment. (Equity factor).

- Small classes benefit students, teachers, parents; they improve instruction and provide a basis for systemic change in education (Quality factor).

- Students in small classes are far less likely to be retained in grade than are those in large classes.

- Unlike in focused projects, students in small classes achieve better on all measures, rather than just in reading, or math, or whatever the focused project is about. [1]

- Benefits obtained in K-3 remain with the students as long as we have followed them and analyzed the data (through grade 9). They are now entering grade 12.

- Retention in grade seems to be reduced in small classes.

Although there are more specifics from the many STAR related and class-size studies, these few results provide fodder for speculation and for policy. The projections and speculations may be more interesting than just reviewing the data. Two other findings seem noteworthy.

- In small classes, teachers identify student learning needs quickly, address these needs, and thus help keep students out of later special education classes.

- Besides higher test scores, students from smaller classes have far better behavior (as measured by discipline referrals), and far greater participation in school-related things (clubs, athletics, etc.) than do students who started school in larger classes.

Positive STAR results should not surprise anyone as they had been known for some time from earlier research and research reviews (Glass & Smith, 1978; Glass et al., 1982, Education Research Service or ERS, 1978,

1980; Mueller, Chase & Walden, 1988; Cahen, et al., 1983; Robinson, 1990). Cooper (1989) reviewed results of prior class-size studies and summarized findings into achievement and non-achievement gains.

SOME STAR POLICY SHOCKERS: TIME TO SPECULATE.

Of the three conditions, (S), (R), and (RA), the (S) was best in terms of student outcomes. Generally, next was the (R) class. From this and from analyses of other data combined with in-class observations, evidence suggests that a full-time aide in a K-3 classroom does not improve, and may be detrimental to, student achievement. This finding is important, because a teacher aide is commonly used for working with youngsters who don't do well. Use of teacher aides could also help account for the continuing dismal evaluations of Title I in raising student achievement.[2] Some other things are disturbing, challenging, informative, and even highly speculative when they become elements of serious class-size discussions.

1. Class size and pupil-teacher ratio (PTR) are different. Some researchers (e.g., Hanushek, Odden) argued that PTR has little or no positive impact on improving student achievement. The discussion of PTR and outcomes is constantly used in journals and policy studies to show that class size doesn't make a difference and, by extension, that money doesn't matter. A recent discussion by C. Finn (1997) points up this difference.[3] If an education policy person doesn't get it right, why should hoi polloi? The PTR which is typically computed by dividing the number of youngsters in a building by the number of professionals in that building is used erroneously as a surrogate, and a very weak surrogate, for class size (Boozer & Rouse, 1995). Analyses, however, show that class sizes are far larger than the PTR as reported in various studies. (E.g., Class-size of 1:28 and PTR of 1:18). Class size is the number of students a teacher faces and is responsible for in class day in and day out. PTR is a manufactured ratio. Table 2 shows this problem using data from two recent U. S. Government Publications (1996 and 1997).

TABLE 2 ABOUT HERE

2. Teachers can't have it both ways. If they have small classes, they need to incorporate the rest of what the research says. The teacher becomes accountable and responsible for all students. There may be a reduction in "special" help such as remedial reading, music, art, and in-class aides.

3. Although I agree that a good teacher in a small class is better than a poor teacher in either a small or a large class, STAR showed that class-size reduction brought with it increases in achievement (etc.) without "staff

development." Now, maybe there will be greater gains if there is staff development, but STAR results do not make this claim. In fact, few studies link staff development to increased student outcomes. (E.g., Orlich, et al., 1992). Perhaps staff development is an area for privatization in education.

4. Class size reduction need NOT be expensive if done creatively. Although this may come as a surprise to some people, serious reading and contemplation of the research will suggest various paths to savings that can help offset other costs. Some of the savings include:

   1) Fewer teacher assistants in classrooms,

   2) Far less need for special and expensive projects. Not removing students from classrooms slows the frenetic pace of many school days, "unfragments" the day, and lets each teacher plan coherent lessons for a "community" of regular students.

   3) Early identification of special needs and timely intervention may mean that youngsters don't spend endless years in an expensive special education spiral,

   4) Far less retention occurs in small classes than in larger classes. "What did you do in school today? "I failed Kindergarten." Retention in grade is an expensive inanity.

   5) Less time and money will be spent on discipline and vandalism.

   6) An equity element (greater benefit to typically marginalized students) is built into this equality treatment (all pupils receive the same treatment), and education outcomes improve (quality).

   7) Parental involvement increases in small classes.

   8) Space and crowding take on new importance and meaning. Space for schooling very young pupils does not have to be a new school, or the usual "classroom." Think space. Consider negative results of studies of BIG schools and positive results of neighborhood schools. Note changes in federal policy on huge public housing projects. Many are being destroyed. (Pruitt-Igoe, etc.)

   9) Research (e.g., Tinbergen, 1952; Calhoun, 1962; Hall, 1966, 1976) has shown the power of crowding to change behavior in negative ways. In small classes crowding is reduced. Does gang behavior start in crowded early primary settings?

We have determined no negative effects of small (1:15 - 1:18) classes in K-3. In fact, Bloom's studies of Mastery Learning demonstrated the efficacy of one-to-one tutoring (Bloom, 1984 a & b). Bloom posed the "2-sigma problem" for educators -- to find some group instructional process that was realistically cost-efficient and that would approach the effectiveness of tutoring.

Where Did the Idea of "Reducing" Class Sizes Come From?

Starting from what was a "convenience" number [the number of youths to be served divided by available salaries or by the available teachers as a way to estimate the number of instructional units], class sizes have grown incrementally as a student or two were added every year or so. When classes reach a certain size, the teacher may then get a teacher aide. There are large classes that grew like "Topsey" from benign neglect and fiscal exigency. These class-sizes need attention.[4]

The class-size problem is not unlike the crisis in school facilities -- about 120 billion dollars needed just to get things up to snuff and to meet building-code requirements -- made clear in Kozol's Savage Inequalities and illuminated in the Public TV production "Children in America's Schools" narrated by Bill Moyers. Combine the facilities problems and the need for instructing young children in reasonably-sized groups, and this long-term neglect of American education is escalating rapidly as an unfunded liability to the need for an "Education Marshall Plan," or a bailout similar to those provided to businesses in the private economic sector, and to governments. [5] As this education debt comes due, policy people seem to be in a big hurry to "privatize," or in other ways try to avoid the obligation to provide an education that will be the base for a lasting democracy. [6]

Potential for Systemic Change and Policy Adjustments

By building the education system upon a strong, research-based foundation, educators can have a start on the "systemic" change that folks clamor for. For example, administrators might use technology to connect "satellite" neighborhood K-2 units to the home-base school and to Central Services (the former Central Office).[7] Ideas formerly advanced in "differentiated staffing" concepts may re-emerge as class sizes will vary based upon the purposes and planned outcomes of the classes. As shown by STAR and related studies, changes in transportation, facilities, methods, special education, parent involvement, assessment (etc.) will follow the move to appropriately sized classes that are closely tied to education goals.

STAR results add to the knowledge base on the value of kindergarten (e.g., Achilles, Nye, & Bain, 1993-94) and demonstrate the need to separate discussions of class size and of PTR [see Boozer & Rouse, (1995) who found

that PTR change did not improve education outcomes, but that class-size reductions did]. STAR results seriously question federal policies as typically implemented in remedial efforts such as Title I. In fact, most "projects" to help students rely on small classes(e.g., Reading Recovery, Success for All). Folks often point out that these projects have larger "effects" (usually determined by effect size or ES) than does a small class. The STAR research determined the ES of small classes, that is, the size of a small-class effect. What happens to the "value" -- cost/outcome -- of some projects if the small-class effect is subtracted from the reported ES of the project? This might be fertile ground for some future policy-related research.

Some Thoughts to Stir Debate

Why isn't STAR more widely known and its results more actively used? The STAR researchers would like to know the answer to that. If the study had been done at a famous institution, would its results be readily accepted and used in education today? Is it because the study is about young children who don't vote? (Adults changed health habits after the Framingham Heart Study). Do STAR results make so much sense that they aren't challenging enough to use?

Some educators don't believe the results. Maybe they are victims of America's "substandard" education system (as evaluated by business or media or politicians) and they lack skills to read or do math. Other educators don't want to believe results that suggest that they'll need to change. Are the results too simple? (I wish that I had invented the paperclip!) Some educators just "Follow the Flock" and jump on each passing bandwagon, often proposed by someone outside of education. Other folks think that "something" might be better for youngsters, although they don't advance any research or data to show the benefits of this other something. On it goes.

Education is BIG business. Some people think that there are profits to be made from education, and so it is that entrepreneurs move into education to sell projects and Band Aids to patch up each minor bruise. If they work, these quick-fix projects almost always rely upon class-size effects. Do their advocates explain what really is behind positive results they may get? What benefit would remain if the small-class effect is removed?

More than 20 states (1998) are now moving ahead with small-class initiatives. Some states move much more boldly than others. California is an example of a state moving boldly, as is Tennessee. Michigan is responding with a crawl to action. Iowa may have a bill soon. Nevada is trying two teachers for 35-40 kids in one room. In Alabama the change is the result of State Board of Education action. Outside the USA, the Netherlands seem to be doing it right. There, the new national design is the "Reverse Pyramide"

where the younger and smaller the student, the smaller the class. Slavin (1997-98) noted that in the Netherlands, "a funding formula provides 25 percent more funding for each lower-class Dutch child in a school and 90 percent more funding for each minority child" (p. 7). This makes consummate sense. In England the 5-7 year olds will soon benefit from smaller classes. STAR researchers have communicated on class-size matters with educators outside of the U. S., e.g.,: England, Australia, Canada, and Sweden.

Implementing class-size change to offer young students a good start in school offers great opportunities for "systemic" change. With reasonably-sized primary classes educators can now move ahead boldly with ideas built upon a solid knowledge base. This one effort will provide Quality, Equality, and Equity (Achilles, Finn & Bain, 1997-98). Think about possible options: Satellite spaces for K-1 classes; Technology to manage the activities; Reduced student failures; Long-term positive benefits; Imagination; Creativity.

Results of the STAR experiment and of related class-size studies are widely available in journal articles, conference papers, ERIC, book chapters, and in other ways. The results seem unequivocal. With Professor Mosteller, I hope that policy makers and educators will pay attention to research results that are this positive, this longitudinal, and this consistent over time. These research results "square" with common sense. STARtling, isn't it? Let's start. Now.

Table 2. Comparisons of Average Class Size and of Pupil-Teacher Ratio (PTR) from U. S. Department of Education Documents.

1. PTR (Based on enrollment by organizational level). *

School Level	1983-84	Estimate 1994-95	Projected 2005-06
Elementary	19.9	18.8	17.8
Secondary	16.4	14.7	14.4

2. Class Size, 1993-94 (From "Schools and Staffing Survey"). **

School Type		School Size	
	AVE	up to 150	150 or more
Public	23.2	15.4	24.5
Private	19.6	—	—

* NCES 96-660, p. 2

** NCES 97-371, p. 4

Table 1. Samples of Studies Derived from and Building upon STAR, Classed as "Subsidiary" (directly from STAR), "Ancillary" (building on STAR database) and "Related" (usually involving STAR researchers).

CATEGORY, TITLE & PURPOSE *	DATE(S)	AUTHOR(S) OR PUBLICATION DATE
STAR (Many sources)	1985-1989	Word, et al., 1991 Finn & Achilles, 1990
Subsidiary Studies		
• Lasting Benefits Study	1989-Present	Nye et al., 1991-1996
• Project Challenge (TN)	1989-Present	Nye et al., 1991-1996
• Participation in Grades 4, 8	1990, 1996	Finn, 1989, 1993; Voelkl, 1995 Finn, et al., 1989, 1990 Finn and Cox, 1992
• Follow-up of STAR students	1996-1998	HEROS (1997)
Ancillary Studies (Use or extend STAR. Some dissertations.)		
• Retention in Grade	1994	Harvey, 1994
• Achievement Gap	1993-1995	Bingham, 1993
• Value of K in Classes of Varying Sizes (test scores)	1985-1989	Achilles, Nye, Bain
• School-Size and Class Size Issues	1985-1989	Nye, K., 1995
• Random v. Non-Random Pupil Assignment and Achievement	1985-1989	Zaharias, et al., 1995
• Class Size and Discipline in Grades 3,5,7	1989, 1991, 1996, etc.	Several studies. Hibbs (1996).
• Outstanding Teacher Analysis (top 10% of STAR teachers)	1985-1989	Bain et al., 1992
Related Studies		
• Success Starts Small: Grade 1 in Chapter 1 (1:14, 1:23) Schools	1993-1995	Achilles et al., 1995
• Burke Co., NC Study	1992-1998	Achilles et al., 1994
• Education Production Functions	1996-1997	Krueger, A. B. (1997)

* This list is not complete. It provides samples of the types of studies done. Not all authors appear in the references in the exact way listed here. This table appears in several STAR reports in substantially this same form. For a list of all references, see Achilles (1996), and the STAR Bibliography, and the STAR Bibliography (Nye et al., 1998).

After a year-long independent review of Project STAR, Professor Frederick Mosteller (retired) of Harvard University gave the study good marks:

> This article briefly summarizes the Tennessee class size project, a controlled experiment which is one of the most important educational investigations ever carried out and illustrates the kind and magnitude of research needed in the field of education to strengthen schools (p. 113).

Concerning the potential uses of this study, Professor Mosteller had this to say:

> Because a controlled education experiment (as distinct from a sample survey) of this quality, magnitude and duration is a rarity, it is important that both educators and policy makers have access to its statistical information and understand its implications (p. 126).

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ENDNOTES

[1] For example, in Success For All, (SFA), students are given extra time and work in reading and they score better in reading. In STAR, students in (S) achieved their higher reading scores in about 15 minutes per day less time than students in the (R) classes (Evertson & Folger, 1989, p. 7) and in grade 4 (S) students from STAR outperformed (R) students on all subjects tested, not just in reading or math.

[2] Evaluations of Indiana's Prime Time were mixed on class size and student achievement. The STAR finding about teacher-aide effects may be helpful in understanding the Prime Time outcomes. In Prime Time, one way to achieve small-class status was to change the "PTR" by employing an aide in the large class. (Chase, Mueller, Walden, 1986). Evaluations of the Federal Title I effort continue to show this massive, primarily pull-out, often teacher-aide loaded remedial approach to "helping" students does not get highly acclaimed results.

[3] Even a former high-ranking official of the Department of Education confuses PTR and class-size. Finn (1997) seems to use the terms as synonyms (incorrectly) to advance his privatize/high-tech "solutions" for education. By this incorrect use of the terms, Finn can support his agenda to solve "problems" that won't exist if he uses the terms correctly.

> A policy decision to employ more teachers (such as by reducing pupil-teacher ratios which have fallen from 27-to-1 to 17-to-1 over the past 40 years) is obviously different from a decision to hold class size constant but pay teachers more – or invest more in technology. (pp. 48, 36; Emphasis added).

[4] Folks sometimes speak of "class size reduction" as if there is some research-based class size that the move to smaller classes is changing. To the contrary, I could find no creditable study that large classes should be the norm: STAR can be seen as a scientific attempt to answer Bloom's (1984 a,b) 2-sigma problem. People who know of good research showing that large classes should be the norm should contact the author.

[5] It does seem strange that whenever it gets into trouble, the "private sector" pressures government to bail it out. (E.g., the Chrysler bail-out, or such things as tobacco allotments, "protective" tariffs that only protect the corporations, corporate welfare such as the great airwaves giveaway or tax breaks). When the BIG 3 auto makers lost market share in the Fall of 1997, the three "competitors" together went to DC to seek help. Then, as Asian economies began to falter, the private sector enjoyed "summits" so the governments could find ways to bail out the private sector. Private, indeed. We should privatize schools like this.

[6] Some things are such a foundation of democracy that the government is required to see that they are provided to all citizens. Jefferson said that "If a nation wishes to be ignorant and free, it seeks what never has been and never will be." Education was once considered a national security issue (remember the NDEA?). It may be time for a re-assessment of citizens' priorities.

[7] This idea was demonstrated to me in two school systems. Most recently and dramatically the idea was implemented by E. Dosdall, superintendent in Edmonton Public Schools. Floyd Buchanan demonstrated the idea in the Clovis (CA) schools in the mid- 1980's.

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