

# I. BACKGROUND AND PURPOSE

## A. Background

By the start of his second term, Governor Lamar Alexander had established education as a top priority. In the spring of 1984, the Tennessee State Legislature adopted comprehensive education reform called the Better Schools Program. Although the media gave most attention to the career ladder for teachers, the Tennessee Center for Excellence program provided higher education with a means to work toward improving education in Tennessee. The Tennessee State University (TSU) Center for the Teaching of Basic Skills to Economically and Educationally Disadvantaged began a modest program on the effects of small class size in one Metro Nashville school. The director of that project, Dr. Helen Bain, encouraged the legislature to adopt a reduced class size program statewide. One model for what might be done in Tennessee was a program in Indiana, Project Prime Time, which studied reduced class size in grades K-2.

In the spring of 1985, information about the Indiana and the TSU studies was shared with the Tennessee State Board of Education Chairman and staff and the members of the House and Senate Education Committees. Steve Cobb, a member of the Tennessee House of Representatives, became interested in the issue of the optimum class size in the early elementary grades. The literature, particularly the Glass Meta-Analysis (1982), suggests that class size must be reduced to about 15 to 1 to have a noticeable effect on student achievement. Glass' analysis has been criticized because the type of school and student characteristics in small classes are unrepresentative of the average public school student, and some of the "small classes" were tutoring groups (Educational Research Service, 1980). Because the research results were not conclusive and because the cost of a major reduction in class size would be very large, Representative Cobb wanted the state to conduct a well-designed study of class size before investing in a costly new program. With legislation, House Bill (HB) 544 (see Appendix A), passed in May, 1985, the Tennessee Legislature authorized and funded a major policy study to consider the effects of class size on students in primary (K-3) grades. There was an appropriation of \$3,000,000 for the first year of the four-year study.

## B. Legislation

In the last ten years there has been some reduction in the average class size in Tennessee. According to the **Tennessee Rules, Regulations, and Minimum Standards** (0520-1-3-.04, p. 28), the student/teacher ratio shall not exceed 25 students per teacher in grades K-3. The average class size in Tennessee in 1985-86 was 22.3 in kindergarten and 23.5 in grade one, not including resource teachers, librarians, and other professional personnel who are often counted in the staff/student ratios. Because reduction of class size is costly, HB 544 calls for a study of the "effects of a reduced pupil-teacher ratio on the achievement of students in public school." The legislation established demonstration centers to be operated by local boards of education throughout the state and in sites described as inner city, urban, suburban, and rural. It was specified that demonstration small classes would have no more than 17 and no fewer than 13 students, and that a variety of models could be "authorized to study and measure the relative effects of providing planning time to teachers, staff development programs..., teacher aides..., etc." (HB 544).

Section 49-3-405 of the bill explains the purposes of the legislation which include "measuring differences in **achievement** and **development** of pupils in demonstration center classes" (emphasis added). Further, the project evaluation must "encompass the goals established by the General Assembly in section 49-5-5023," Tennessee's Comprehensive Education Reform Act.

### **C. Background on Class Size**

Probably few issues in education have been studied as often as class size, yet few studies have produced satisfactory or consistent results; many have reviewed class-size reductions from 40 to 30, or 30 to 25. There have been few major, controlled class-size studies. There have been even fewer that explored the 1:15 range suggested by Glass, et al. (1978). Before HB 544 and during the study, educators reviewed and summarized the research and continued to collect evidence on the effects of class size. Project STAR personnel built upon the prior research and developed several research summaries for the legislature and for STAR (e.g., Keenan; Doncaster; Bain; Achilles and Moore). Appendix B contains summary reviews of literature and research relating to class size.

### **D. Organization to Conduct the Study**

The Tennessee State Department of Education organized to conduct the legislated study of reduced student/teacher ratio and adopted the name STAR, an acronym for Student/ Teacher Achievement Ratio. The Department employed Elizabeth Word, an experienced elementary principal, as project director and asked personnel from four universities (Memphis State University, Tennessee State University, the University of Tennessee at Knoxville, and Vanderbilt University) to develop the study design, plan the research, analyze the data, and prepare periodic reports of progress for the State Board of Education and the legislature. The State Department of Education retained management and budget control of the project, and the universities had both an advisory and an operational role. Responsibilities for direct contact with the 79 STAR schools (1985-86) were divided among the universities. Personnel from each university supplied assigned schools with information, collected data, and observed testing and other activities. The project director contacted all schools directly concerning administrative and fiscal matters and some research issues.

Thus, the organization to conduct the study consisted of a consortium of persons from the Tennessee State Department of Education, STAR staff, the four universities, and a representative each from the State Board of Education and the State Superintendents' Association. The term "consortium" refers to the total group that guided project activities.

The project was implemented rapidly through a cooperative effort of the consortium. Since the legislation passed in May and schools started in August, key policy, design and operational decisions had to be made very quickly.

The State paid salary costs for the extra teachers required to reduce class size and the project teacher aides and provided modest contracts to each of the four universities in the consortium. Major costs, about 2.5 of the 3 million dollars per year, were for additional teachers and aides in the project. During the third year of the study it was decided to have a follow-up year to collect information about the persistence of STAR achievement gains and to complete the data analysis. Funding for an additional year was requested and the legislature approved \$389,500 for this purpose. Annual budgets for the five years are shown in Table I-1. During the first year, major immediate concerns were the development of a design for the overall project, procedures for assignment of students, details necessary for data collection, general operating procedures, etc.

**TABLE I-1****Project STAR Expenditures 1985 Through 1990**

	<b>1985-86</b>	<b>1986-87</b>	<b>1987-88</b>	<b>1988-89</b>	<b>1989-90</b>
Appropriation	\$3,000,000	\$3,005,000	\$3,009,200	\$3,213,446	\$ 389,500
Personnel and Benefits	71,500	110,142	120,765	88,948	91,400
Travel	2,600	6,266	6,850	4,885	2,093
Printing	200	444	644	59	1,000
Communication and Shipping	1,900	4,926	4,645	2,093	5,600
Maintenance	600	65	572	215	-0-
Professional Services	146,200	268,733	608,249	443,463	280,000
Supplies	3,300	3,505	5,740	5,116	4,700
Rentals and Insurance	4,100	1,606	2,126	1,046	4,800
Teacher and Aide Salaries	2,181,400	2,578,904	2,229,468	2,690,107	-0-
<b>Total Expenditures</b>	<b>\$2,411,800</b>	<b>\$2,974,591</b>	<b>\$2,979,059</b>	<b>\$3,235,932</b>	<b>\$ 389,500</b>

**E. Questions to be Answered by the Demonstration and Study****1. Information from the Legislation**

The legislation initiating Project STAR **specified** some basic questions and issues which the project should answer. The primary question came from the legislation's purpose, "...to study the effects of a reduced pupil-teacher ratio on the achievement of students in public school...." The project was "to make a longitudinal study of the relative effects of reduced pupil-teacher ratio on the achievement of pupils." The legislation specified that the small class size in the demonstration would be between 13 and 17 students for students in kindergarten in 1985-86; for these same students in the first grades (1986-87); for these same students in the second grade (1987-88); and in 1988-89 for these same students in the third grade.

The legislation required that participating schools represent different geographic regions and different kinds of communities (i.e., rural, urban, suburban, and inner city) and **suggested** that the study should also assess "relative effects" of reduced pupil-teacher ratio in varying school environments. The legislation permitted study of such things as teacher planning time, staff development for teachers, the use of teacher aides, the use of teachers with different levels of experience, and the differential effects of small classes on students from various socioeconomic backgrounds.

## **2. Questions Required by the Legislation**

- a. What are the effects of a reduced pupil-teacher ratio (13-17 to 1) on the **achievement** (normed and criterion tests) and **development** (self-concept, attendance, etc.) of students in public elementary school, grades K-3? Systematic comparisons are made of test performance among students in small classes, in regular classes, and in regular classes with a full-time teacher aide.
- b. Is there a cumulative effect of being in a small class over an extended time as compared with a one-year effect for students in a small class for one year?
- c. Does a training program designed to help teachers take maximum advantage of small classes or to use aides effectively improve student performance as compared with teachers who have no special preparation for their altered conditions? Do differences in teacher behavior attributable to staff development increase student learning?

## **3. Questions Suggested by the Legislation or by Previous Research**

- a. In which grade is the biggest effect for students in a small class evident?
- b. What are the effects on student performance of a full-time aide in a regular class as compared with a regular class without an aide, or a regular class with a part-time aide? How does the performance of students with an aide (where the adult/pupil ratio is lower than in a small class) compare with student performance in small classes? Do certain patterns of use of aides have more effect than others? For example, does use of an aide in direct instruction have more effect than if the aide is used primarily in administration and clerical duties?
- c. What are the various cost factors associated with class size reduction and the use of teacher aides?
- d. Do teachers modify their teaching when they have small classes or when they have aides? If so, how do they change?
- e. Is there a differential effect of small classes or classes with an aide on students from varying Socioeconomic Status (SES) backgrounds?
- f. What teacher characteristics are associated with classes that have high achievement?
- g. What other factors are associated with high-achieving classes?
- h. What are the residual effects of small classes after the end of the project? (This would require follow-up that is not currently planned or funded.)

In July and August, 1985, there were several meetings in which the Commissioner of Education, staff members from the State Department of Education, the Executive Director of the State Board of Education, Representative Steve Cobb, and Senator Douglas Henry discussed the project design and the priorities for data collection. Based on this information, the design in the next section was developed, and a report was made to the State Board of Education at its October, 1985, meeting. During the year, consortium members and members of an external project advisory committee continued to refine the research design, questions and processes.

## F. Sample Selection

The project timeline (legislation in May, director appointed in July, schools opened in August) required the consortium to decide upon a design and get students placed quickly. The first task, even while the design was being developed, was to identify school districts and schools to participate in the study. The ideal would have been that all school districts would opt to participate and that all choices (select districts to participate from among all districts in the state, then select schools, teachers, students, etc.) be made randomly.

### 1. Selection of Project Schools

The legislation specified that the project should include "inner city, suburban, urban, and rural schools" to assess the effects of class size in different school locations. No existing designation of schools used the categories specified above, so the consortium developed designations using various criteria.

**Inner-city** and **suburban** schools were all located in metropolitan areas. Schools that had more than half of their students on free or reduced cost lunch (indicative of a low-income family background) were tentatively defined as **inner city**. Schools in the outlying areas of metropolitan cities were classified as **suburban**.

In non-metropolitan areas, schools were classified as **urban** or **rural** depending on the location of the school. If located in a town of over 2,500 and serving primarily an urban population (the census definition of urban), the school was classified as **urban**. All other schools were classified as **rural**. All classifications were checked with local school officials to see if they agreed with the designation of their school. The application of these rules led to the classification of schools shown in Table I-2.

In kindergarten there were 17 inner-city schools and 16 suburban schools drawn from four metropolitan areas: Knoxville, Nashville, Memphis, and Chattanooga. Fifteen of the 17 inner-city schools were located in Memphis. There were 8 urban schools that serve non-metropolitan cities and large towns (for example, Manchester and Maryville). There were 38 rural schools.

Schools were spread across the state, not clustered in one section. The Commissioner of Education invited all Tennessee school systems to participate and sent guidelines for participation to each local system. These guidelines indicated that the state would cover additional costs for project teachers and teacher aides, but that local systems would furnish any additional classroom space needed. The project schools would not receive any special considerations other than class size--the students would use the regular district or school curriculum, supplies, texts, etc. There should be no major changes in process, organization, etc, other than class sizes. Schools should plan to remain in the project for four years; the project would start in kindergarten in 1985-86 and follow students successively through grades one, two and three.

TABLE I-2

**Project STAR Schools by School Type  
Kindergarten Through Grade 3 (1985-1989)**

	Kindergarten	Grade 1	Grade 2	Grade 3
Inner City	17	15	15	15
Suburban	16	15	15	15
Rural	38	38	38	38
Urban	8	8	7	7
<b>Total</b>	<b>79</b>	<b>76</b>	<b>75</b>	<b>75</b>

All participating teachers had to be certified for the grade level they were teaching. Schools had to agree to the random assignment of teachers and students to the different class conditions. Initially, 180 schools in about 50 of the state's 141 school systems expressed interest in participating. Only about 100 schools had enough students in kindergarten (a minimum of 57) to meet the size criterion for participation. The size criterion was necessary because the project utilized a "within-school" design. The final selection of schools was based on (a) including at least one school from each district that had volunteered and (b) including enough schools from all four school types and all three regions of the state to permit comparisons between school types, as specified in the legislation. After discussion and negotiation, 79 schools in 42 systems became participants in the first year. The goal was to have approximately 100 small, 100 regular, and 100 regular with aide classes. This objective was met. In the 1985-86 year, the project had 128 small classes (approximately 1,900 students), 101 regular classes, (approximately 2,300 students), and 99 regular classes with teacher aides (approximately 2,200 students).

**2. Selection of Comparison Schools**

In addition to the project schools, information was needed about the performance of a comparable group of students whose teachers were carrying out the regular school program in average-size classes. Sometimes an experiment in a school will affect all students and all teachers. The use of a comparison group helped researchers to identify such effects. The superintendent of each system having project schools was asked if non-STAR elementary schools would administer the same tests used in STAR schools to provide comparison scores. Seventeen systems identified 39 possible comparison schools. Twenty-two schools with 51 regular classes and approximately 1,100 students became a comparison group. The 22 comparison schools, drawn from 17 STAR school systems, administered the same tests that the project schools administered. Comparison schools allowed STAR researchers to check on the possibility that project schools were influenced by the Hawthorne Effect.

**G. Project Schools and Statewide Averages**

Since selection of STAR districts was not random, it was important to see how the STAR districts compared to the averages for non-STAR systems on some key variables. The average system size of STAR schools was larger than the size for non-STAR groups since Memphis, Nashville and Knoxville--the largest systems in the state--participated. Project STAR schools were larger than the state average since small schools were excluded by the nature of design.

Researchers collected information on the project schools' expenditures per pupil, pupil/teacher ratios, teacher education levels, and student test achievement and compared these with statewide averages to check the representativeness of the STAR sample. Project STAR systems were similar to the statewide system average on most variables (Table I-3) except system size.

The 1985-86 data show that regular kindergarten classes in STAR schools were slightly, less than one student, larger than the statewide class size in kindergarten. Resource measures, including teacher salaries, per-pupil expenditures, and teacher preparation were available at the system level but not at the individual school level. Project STAR systems include Metro Nashville and Memphis which spend substantially more than the state average per pupil and pay their teachers higher salaries than the state average. The STAR system per-pupil expenditures were about 6 percent higher than the state average, and teacher salaries were about 3 percent higher. (See Table I-3.)

**TABLE I-3**  
**Teacher Salaries, Per-Pupil Expenditures,**  
**and Teacher-Pupil Ratios**  
**State Average and Project STAR School Systems Average**

Item	STAR Average	State Average
Per-Pupil Expenditure (1986-87)	\$ 2,724	\$ 2,561
Average Teacher Salary	\$ 23,168	\$ 22,627
Average System Size	8,462	4,202
Teacher-Pupil Ratio Kindergarten (1985-86)	22.7*	22.3
Percent of Teachers with Master's Degree or Higher (System Figures)	42	40

\*Based on regular-sized STAR classes

Note: Project STAR systems are weighted by the number of students or teachers from each system who are participating in the project.

A comparison of test scores for grade-two students in project schools, the comparison schools, and the statewide average (see Table I-4) indicated that project schools had scores lower than the state average and the average of the comparison schools. These differences reflect the higher proportion of inner-city schools in STAR; students in inner-city schools scored 10 to 12 points lower on the average than students in suburban schools. Differences in scores among urban, rural, and suburban schools were smaller. The comparison schools did not include any inner-city schools. STAR schools in the same systems with comparison schools scored slightly (not significantly) higher than the comparison schools.

**TABLE I-4**

**Reading and Math Scaled Scores, Stanford Achievement Test  
Project STAR, Grade 2 (Spring 1986)  
Selected Comparisons**

	Math	Reading
State Average for 2nd Grade	572	582
All Project STAR Schools	566	578
Comparison Schools	577	587
STAR Schools (Same Systems as Comparison Schools)	579	590

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### **H. Data Collection Plan and Data Base**

A major first-year task was to plan and implement a comprehensive data collection plan for the first and subsequent years. The design and data formats allowed researchers to follow individual students for four years. Subjects were assigned individual identification numbers. Data were collected for students, teachers, principals, teacher aides, schools, and systems (see section II-E). Each child in the appropriate grade in comparison schools received an identification number and information was collected about race, sex, age, free or reduced lunch (one indicator of socioeconomic status), and test scores.

In seeking information about why a small class might affect student learning, researchers collected data about how teachers teach, about student-teacher interactions, etc. Data were also collected on factors that might affect the results: the number and distribution of special education children, pull-out programs, and adults other than the teacher who participate in the instructional program. Appendix C contains a list of instruments and copies of the data collection forms as well as descriptions of the standardized tests.

### **I. General Operating Guidelines**

Two general guidelines helped project personnel with operational decisions.

1. Participation in STAR would not cause any child to receive fewer services than if the child/school did not participate. (Participation in STAR would not put any child "at risk" in any way.)
2. STAR would not dictate changes (e.g., curriculum, materials, schedule) to the school; STAR efforts would work within the regular school framework (with the exceptions of student and teacher assignment, ability grouping across classes, testing, etc.) as much as possible. STAR would minimize disruptions to the school's regular routine. Schools would maintain the random assignments, and basic instruction would be carried out primarily in the classes to which students were assigned.



## **J. Teacher Orientation**

Orientation sessions were conducted for teachers at 20 schools entering the project in kindergarten. The orientation idea was later refined and used for all principals and all teachers entering the project. The person conducting the orientation described the project, its purposes and processes, and answered questions. The orientation process for new teachers entering the project at each grade level was also expanded after the first year and made more comprehensive.

## **K. The Advisory Committee and External Assistance**

Two nationally recognized experts on class-size research and measurement served as an external review and advisory committee. They were Dr. Doris Ryan of the Ontario Institute for Studies in Education and later at St. Johns University, New Brunswick, who has extensive experience in the conduct of class-size studies, and Dr. Roy Forbes of East Carolina University (and later at the University of North Carolina, Greensboro) and former director of the National Assessment of Educational Progress. Several researchers from Memphis State University, Tennessee State University, the University of Tennessee, Knoxville and Vanderbilt University reviewed the project's design and the work plans and suggested ways to improve the design. As a result of their suggestions, the comparison schools were added to the design. The consultants reacted favorably to the within-school design and the study plans. Dr. Jeremy Finn, a nationally acclaimed educational statistician from the State University of New York at Buffalo, assumed responsibility for primary analyses of class-size effects for each year of the project.

## **L. Scope of Project STAR**

The STAR data base is extremely large and there have been and will continue to be many opportunities for different and expanded analyses using all or different portions of the data. The analyses could employ different methods or statistics and even different basic designs (e.g., using student level vs. class level data). The heart of the STAR Final Report is built around class-level data as analyzed by the external consultant, Dr. Jeremy Finn.

Numerous papers have been developed and presented at national, regional, and state meetings and conferences. Some articles based on STAR data and concepts have been disseminated. These and other detailed papers and reports are available from Tennessee's Assistant Commissioner of Curriculum and Instruction, Project STAR, Tennessee State Department of Education, Cordell Hull Building, Nashville, Tennessee 37243-0379.