DOCUMENT RESUME

ED 356 559 EA 024 822

AUTHOR	Achilles, C. M.; And Others
TITLE	The Lasting Benefits Study (LBS) in Grades 4 and 5 (1990-1991): A Legacy from Tennessee's Four-Year (K-3) Class-Size Study (1985-1989), Project STAR. Paper #7.
INSTITUTION	Tennessee State Univ., Nashville. Center of Excellence for Research in Basic Skills.
PUB DATE	14 Jan 93
NOTE	20p.; Paper presented at the Annual Meeting of the North Carolina Association for Research in Education (Greensboro, NC, January 1993).
PUB TYPE	Speeches/Conference Papers (150) -- Reports - Research/Technical (143)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Academic Achievement; Analysis of Variance; *Class Size; Elementary School Students; Elementary School Teachers; Minority Group Children; Primary Education; Public Schools; *Small Classes; Student Development; *Teacher Student Ratio
IDENTIFIERS	*Lasting Benefits Study TN; *Student Teacher Achievement Ratio Project TN; Tennessee

ABSTRACT

A 4-year longitudinal experiment conducted in Tennessee examined class-size effects on student achievement in kindergarten through grade 3. The Student Teacher Achievement Ratio (STAR) project included more than 7,000 students per year in 79 schools in 42 school systems. Class size categories were: small class (13-17 students), regular class (22-26 students), and regular class with full-time teacher aide. Students and teachers were randomly assigned to class categories. The study found that students in small classes made significantly (statistically and educationally) greater gains than other students. In addition, minority students in small classes benefitted more than minority students in other class categories. It was also determined that gains achieved in kindergarten were maintained through third grade. Analyses showed a continuing, powerful class-size effect in all locations. However, no consistent teacher-aide effect was evident in the study. The Lasting Benefits Study (LBS) had already analysed data from a sample of STAR pupils through grades 4 and 5 in an attempt to determine whether gains STAR students achieved in small classes carried through to those grades. The LBS found that students who were in STAR small classes at least in grade 3 were statistically and educationally ahead of other STAR students. Three appendices include STAR data collection instruments, primary and extended analyses designs, and analysis of variance for cognitive outcomes. (Author/JPT)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 356 559

Center of Excellence for Research in Basic Skills

Tennessee State University

Paper #7

THE LASTING BENEFITS STUDY (LBS) IN GRADES 4 AND 5 (1990-1991): A LEGACY FROM TENNESSEE'S FOUR-YEAR (K-3) CLASS-SIZE STUDY (1985-1989), PROJECT STAR*

Tennessee's Student Teacher Achievement Ratio (STAR Project (8/85-8/89), and Lasting Benefits Study (LBS: 9/89-1/93).

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it
☐ Minor changes have been made to improve reproduction quality
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

Paper prepared by:

C.M. Achilles**
B.A. Nye
J.B. Zaharias
B D. Fulton

PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
C.M. Achilles
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

Paper Presented at
North Carolina Association for Research in Education (NCARE)
Greensboro, North Carolina
January 14, 1993

* The authors acknowledge the contributions of the entire Student Teacher Achievement Ratio (STAR) Project staff, especially to E. Word, Tennessee State Department of Education, Project Director; H. Bain, J. Folger, J. Johnston, and N. Lintz who were the other members of the STAR Consortium; J. Finn, R. Hooper, and G. Bobbett, Consultants.

** C.M. Achilles, Professor, Education Administration, UNC-Greensboro, Greensboro, NC 27412-5001; member of the STAR Consortium 8/85-9/88, and consultant to LBS, 89-93; B.A. Nye, Director, Lasting Benefits Study and Center of Excellence for Research in Basic Skills, Tennessee State University, Nashville, TN 37203-3436; J. Boyd-Zaharias, and B.D. Fulton, Staff of LBS at the Center for Excellence.

EA 024 828

BEST COPY AVAILABLE

THE LASTING BENEFITS STUDY (LBS) IN GRADES 4 AND 5 (1990-1991): A LEGACY FROM TENNESSEE'S FOUR-YEAR (K-3) CLASS-SIZE STUDY (1985-1989), PROJECT STAR*

ABSTRACT

Education leaders in Tennessee commissioned a four-year (8/85-8/89) longitudinal experiment of class-size effects on pupil achievement in early primary grades (K-3). The project included over 7,000 pupils/year in 79 schools in 42 school systems. There were three conditions: Small class (13-17); Regular class (22-26) and Regular class with a full-time teacher aide. Pupils were randomly assigned to class-size conditions; teachers were randomly assigned to classes. Pupils in small classes (1:15) made significantly (statistically and educationally) greater gains than other pupils, and minority pupils in small classes benefited more than minority pupils in other class conditions. Gains initiated in kindergarten were maintained through third grade. Analyses showed a continuing, powerful class-size effect in all locations. There was no consistent teacher-aide effect evident in the analysis. This large-scale randomized experiment provided some definitive answers about class-size effects in early primary grades.

The LBS (a field study) has already analyzed data from a sample of STAR pupils through grades 4 (n=4320) and 5 (n=4649). In LBS students who were in STAR small classes at least in grade 3 are statistically ($p \leq .001$) and educationally (effect sizes about .15) ahead of students who were in STAR regular and regular-with-aide classes. This finding, in all locations and for all pupils shows that at least two full years after returning to regular (1:25) classes the former small-class pupils continue to perform better than their peers from regular and regular-with-aide classes. Although the differences maintain statistical significance ($p \leq .01$) in grade 5, the absolute differences are some less than in grade 4.

* The authors acknowledge the contributions of the entire Student Teacher Achievement Ratio (STAR) Project staff, especially to E. Word, Tennessee State Department of Education, Project Director; H. Bain, J. Folger, J. Johnston, and N. Lintz who were the other members of the STAR Consortium; J. Finn, R. Hooper, and G. Bobbett, consultants.

NOTE. A similar manuscript has been submitted to a refereed journal for publication review in 12/92. No word on disposition of the manuscript has been received except that it has been sent out for review.

THE LASTING BENEFITS STUDY (LBS) IN GRADES 4 AND 5: A LEGACY FROM TENNESSEE'S FOUR-YEAR CLASS-SIZE STUDY (1985-1989), PROJECT STAR

Introduction, Background and Perspective: The STAR Legacy

One issue that has caused considerable continuing debate is research to find a reasonable alternative to one-on-one tutoring to overcome what Bloom (1984) called the Two-Sigma Problem." A good start in schooling seems imperative if children are to succeed later. What is a reasonable class size for teaching elementary pupils? Do small (e.g., 1:15) classes work well for all children and better for some children? If pupils benefit from small classes in early grades (K-3), do those benefits continue in later schooling?

From 1985-89 researchers from four universities and State Education Agency (SEA) personnel in Tennessee (TN) cooperated on a large, longitudinal, legislatively mandated experiment of effects on pupil achievement and development in grades K-3 of small class size (1:15). Called Project STAR, the study included over 7,000 pupils in 79 schools in 42 districts.

For STAR, pupils were randomly assigned to a Small (S, or average of 15 pupils with 1 teacher - 1:15), a Regular (R, or average 1:26), or a Regular with full-time teacher Aide (RA) class and stayed in that condition (K-3). Replacement due to pupil mobility was random. There were more than 100 classes/year of each condition.

Extensive test and demographic data were collected on pupils for all years and grades of STAR; extensive demographic, context and process data were also obtained for teachers, principals, school buildings and districts, teaching practices, and other things. A listing of specific data instruments is in Appendix A.

Although the pupil was the primary unit of data collection (researchers conducted teacher interviews, etc. to support the class size analysis), the class was the unit of analysis (it was a study of class-size effects). This analysis recognized that each pupil is not an independent measure -- teacher and classmates all influence pupil learning. Outcome measures were pupil results for achievement on

ERIC

cntenon-referenced tests (CRT) and on norm-referenced tests (NRT) and for development on such things as discipline, attendance, self-concept, and the SCAMIN self-concept test.

Design Issues: STAR

Sites participated for four years, and agreed to have some visitations and extra testing, and to allow random assignment of pupils and teachers to conditions. Sites had space for the added classes and at least 57 pupils in K. This excluded small schools, but at least 57 pupils were needed for the in-school design (minimum of 1:13, 1:22, 1:22) so that any school with an S class also included R and RA class conditions. The powerful design helped ameliorate building-level variables such as leadership, curriculum, facilities, expenditures, SES. Researchers monitored testing conditions for consistency.

The state paid for additional teachers and aides. STAR personnel made only class-size changes. Districts followed their own policies, curricula, etc. No pupil in STAR received less (i.e., had a disadvantage) by being in STAR. Not every pupil took every test or had every data point, but all pupils in an analysis had all data needed for that analysis.

The general Multivariate (MULTIVARIANCE: Finn & Bock, 1985) design included four locations and the class type (S, R, RA) for either achievement measures or non-cognitive measures. The primary analyses addressed the questions required in the legislation for each of the four years. Additional analyses are underway. (Details appear in technical reports: Nye et al., 1991, 1992.) The model for analyses is in Appendix B. The primary STAR analysis consisted of multivariate tests of mean differences between and among the groups being analyzed. The Lasting Benefits Study (or LBS) follows this design to the degree possible. Table 1 provides a summary of the STAR and LBS relationships.

Table 1 about here

The analysis employed a general linear model approach for unequal-n design. The design has unequal n' and some empty cells and requires multiple error terms to test all the fixed effects. Test statistics were the univariate F-ratio for each measure and Wilks' likelihood ratio for multivariate sets. There were two planned contrasts tested among three class types:

- S class mean vs all R and RA class means (S vs. "Other),
- R class mean vs. RA class mean.

Summary Results

The consistency -- even monotony -- of the STAR findings is significant. Pupils in S did statistically significantly better (usually at $p \leq .001$) than pupils in R and/or RA at every grade level (K-3). The class size effect was found equally in all locations (e.g., urban, rural) and favored the S condition in four grade levels. Some findings appeared in single grades, or in two of the four years. Appendix C contains major achievement results (K-3). Measures of development (e.g., self concept, attendance, discipline) showed no difference between S and R/RA in K-3.

Some simple analyses demonstrated powerful effects. A strong positive class-size benefit for minority pupils appears in the percent of pupils passing the CRT (BSF) in grade 1. (This result was confirmed in multivariate analyses that showed differences in Grade 1 by race but disappeared in later grades -- Appendix C.) Over 17% more minority pupils pass the BSF if the pupils are in S rather than in R (or RA). Note the results in Table 2.

Table 2 about here

The statistical significance question seems to be resolved in class-size issues. STAR results also addressed the "educational" significance question. Often "educational" significance derives from "effect sizes." Effect size shows how much the difference is relative to a standard deviation. With the CRT the educational effect might be estimated as the percent passing. Effect sizes favoring S in STAR range from .08 (in K) to .40 (in grade 3) for minority pupils. Generally the positive STAR effect sizes for pupils in S are in the .20 to .27 range. This effect size was obtained with no change except class size. (Consider what might be possible with class size as the base from which to build education improvement.)

The LBS Continues the STAR Legacy

Weikart (1989) pointed out the lasting benefits of early intervention. What about lasting benefits of small classes? What happens when STAR pupils who benefited from S in K-3 return in grades 4 and later to "regular" classes? The LBS analyses use pupil test scores and behavioral indicators of school efforts In 1989 Tennessee changed from the CAT to the Tennessee Comprehensive Assessment Program (TCAP). The LBS uses TCAP data. The fourth-grade analysis included 4230 pupils. (They were identified by class type in at least grade 3.) Of those 1412 were S, 1250 were R and 1568 were RA. Grade 5 analyses included 4946 pupils distributed approximately the same.

Scaled-score means for the three STAR class types (S, R, RA) were compared using MANOVA for unequal n's (MULTIVARIANCE; Finn & Bock, 1985). Following the STAR analysis design, three achievement subsets were compared separately for the LBS. Two subsets included scores from both the NRT and CRT components of TCAP. Set 1 included Total Reading and Total Language (NRT scores) and the number of domains mastered in Language Arts (CRT). Set 2 consisted of Total Math and Total Science (NRT scores), and the number of domains mastered in Mathematics (CRT). Set 3 included Study Skills (NRT) and Social Science (NRT) scores. (See Finn et al., 1989/1992.)

LBS Summary Results

To date (9/92) the LBS analysis has yielded clear and consistent results. Grade 4 and grade 5 students previously in a small-size STAR class demonstrated that they had statistically significant (at least $p \leq .01$) advantages over pupils previously in R and RA on every set of measurements. The greatest achievement advantages in grade 4 were for inner-city and suburban classes (Table 3). No RA v R contrast was significant either year, showing the consistency (beginning in STAR, grade 1) of no gain by using teacher aides to improve pupil academic performance in primary grades. By grade 5 the location analysis was discontinued as some pupils had entered middle-school configurations.

Table 3 about here

The LBS students who had attended small STAR classes had a statistically significant advantage over LBS students who had attended R and RA STAR classes. The positive effects from early involvement in a small-size class still remained pervasive two full years after students returned to regular-size classes. Small-class students outperformed R and RA class students on every achievement measure in all locations as shown by scaled score differences (Table 4). The trend, also begun in STAR, of pupils from R outperforming pupils from RA classes is still evident in both grades 4 and 5. (Note that no R/RA comparison reached statistical significance, but the trend has remained constant on all measures from grade 1 through grade 5.)

Table 4 about here

The differences in performances of pupils previously in S, R and RA in at least grade 3 and now in regular (e.g., 1:25) classes in grades 4 and 5 can also be shown in effect sizes (Table 5). Note the consistent (but small) positive advantage of former S pupils over former R pupils and the consistent positive advantage of former R pupils over former RA pupils on all measures (except the CRT for grade 5) in both grades 4 and 5. This supports the statistical significance finding and helps formulate the difference into gains relative to a standard deviation. In grades 4 and 5 the former S pupils exceed the former R and RA pupils from .11 to .22 of a standard deviation. The R/RA contrast shows effect sizes ranging from -.02 to -.09 (Finn et al., 1989/1992; Nye et al., 1991, 1992).

Table 5 about here

A Report on Pupil Participation

Finn (1989) noted that increased student participation in school reflected a decreasing tendency for student alienation and dropout in later years. Opportunities for student participation (e.g., clubs, service projects, government, music, athletics) can be established by teachers and administrators. Participation also includes a pupil's involvement in classroom activity (e.g., responding, asking questions, doing projects). Small classes should increase that involvement.

Finn et al. assessed a grade four subset of STAR pupils by asking their teachers to rate them on the 25-item Pupil Participation Questionnaire on a five-point range from (1) "never" to (5) "always." Teachers rated pupils on three behavioral scales (Finn et al., 1989/1992, p. 78): . . .Nonparticipatory

Behavior (e.g., "Annoys or interferes with peers' work"), Minimally Adequate Effort (e.g., "Pays attention in class"), and Initiative Taking (e.g., "Does more than just the assigned work").

Teachers (n=258) rated pupils (n=2,207) in their classes who had participated in STAR (S, R, RA) conditions for three years (grades 1-3). Using the LBS MANOVA design, scores on the three participation scales -- Effort, Initiative and Nonparticipatory Behavior -- were simultaneous criterion variables (p. 79). Statistically significant differences were found on participation variables: [Location ($p \leq .05$); Class type ($p \leq .0001$); Loc x Type ($p \leq .05$)] (p. 79). According to Finn et al. (1989/1992), "Pupils who had attended small classes were rated as having superior modes of participation in grade four in comparison to their peers" (p. 81). The participation effect sizes (.11 to .14) were similar to effect sizes found in LBS achievement analyses (.11 to .22) No RA/R contrast was significant. This LBS analysis links the desired participation behavior to higher pupil academic achievement on measures used in LBS. Building upon the STAR database, LBS research is showing that early small-class involvement (e.g., 1:15) has continuing benefits (note also Weikart, 1989). This counters some criticism of the cost of reduced class size, since benefits continue years after the class-size reduction.

Discussion

The STAR data provide the basis for a longitudinal study of the "Lasting Benefits" to a pupil of being in a small-class setting during early primary grades (K-3). Some discussion and conclusions seem appropriate. The power of the design and therefore the strength of the results and the confidence that one has in the findings/conclusions diminish as one moves from the experiment of STAR to the LBS field study. However, LBS results build on the strong STAR database, taking advantage of the longitudinal and randomized study. The STAR and LBS results help in determining ways that achievement can be improved in schools.

Class-size reduction, as a treatment or intervention, is really an one-time event. That is, the treatment is when the student first experiences the reduction from regular (e.g., 1:26) to small (1:15); the ensuing years are a continuation, but not a separate treatment. Nevertheless, benefits once gained seem to last for several years if the pupil stays in 1:15 (STAR) or goes to regular (LBS) classes.

The LBS results (grades 4 and 5) show the continuing benefits of a pupil's participation in the small class in early primary. Post hoc analyses of important elements of schooling other than achievement (e.g., participation) suggest a small-class influence here, too. Continuing analyses through LBS may be able to add to information provided by other longitudinal studies (e.g., Weikart, 1989) of important social benefits of early interventions. Zigler (1992) claims major social benefits (e.g., reduced crime and delinquency) and strong academic benefits for Head Start. (Unfortunately, policy makers continue to reduce Headstart funding.)

Since LBS shows continuing benefits in pupil achievement after small-class involvement, can small-class involvement for only one or two years (rather than STAR's four years) provide a sound base to help pupils get started well in school? STAR results were strongest in K and 1, suggesting that these should, at a minimum, be the years of the small-class intervention. The early primary heterogeneous classes provided by the STAR random assignment and STAR's seeming ability to help minority pupils close the achievement gap are promising areas for LBS analyses. Although consistent in all STAR conditions (S, R, RA), pupil assignment in STAR (random) was different from regular pupil assignment practices. Did pupil random assignment positively influence STAR results in all or in some STAR conditions? Additional analyses of the STAR database may help unravel this interesting question.

Results of STAR (the experiment) provide clear evidence of ways to improve schooling in early primary grades. Given the added needs of children entering schools in the 1990's (e.g., Hamburg, 1992; Hodgkinson, 1991) the use of small classes may become imperative for later school success. We have found a way to improve schooling; do we have the will? The STAR experiment results have held up in field research and in policy conditions (e.g., LBS, Challenge) and are continuing to show added, continuous benefits How much evidence do leaders need before they apply these strong findings to help improve schooling? (See Zigler, 1992, also.)

Education excellence must start somewhere. Given the problems experienced by many new entrants to schooling and the increasing family dislocations (Hamburg, 1992; Hodgkinson, 1991), drastic class-size reductions in early grades seem to offer the best hope yet advanced. Small classes provide a new "floor" from which educators can work. This is a positive indicator of a restructuring process that will help pupils. (Interestingly, small classes probably don't harm teachers, either. Might small classes be one way to help with new teacher induction into the profession? Might smaller classes help new teachers really learn to teach? Might the first year or two of teaching in a small class help retain in teaching some people who leave due to frustrations engendered by being put into teaching situations that are not the most desirable?)

Should these and similar studies be seen simply as studies in class-size reduction? Perhaps they are better cast as trying to find the right class sizes to help solve Bloom's (1984) "two-sigma" problem -- trying to match the size of the instructional unit to the job to be done. The results clearly suggest one way to move from assembly-line, industrial-age schooling to case-load, information-age learning activities.

Ways to accommodate this social "paradigm shift" are at the heart of the movement to restructure (redesign, reinvent) education. Class-size reduction is a restructuring process. So, while others still are seeking some "magic bullets" to aid in education restructuring, this research offers strong recommendations that at a minimum restructuring should start with small groups of youngsters in at least K-1 or K-2, heterogeneously grouped (STAR assignment was random), with a teacher (and no instructional aide) as the instructional unit.

The Future

Using the STAR/LBS database, researchers at the Center of Excellence for Research in the Basic Skills plan several new and continuing studies. The LBS analyses will continue as long as is feasible. Tennessee has initiated Project Challenge, a 1:15 event (K-3) in 17 of the state's 138 school systems. Researchers will monitor these efforts.

Using the STAR/LBS database, researchers plan a variety of new studies. Some of these include:

- Homogeneous v. heterogeneous pupil assignments,
- Retention-in-grade questions and issues,
- Teacher behavior differences in different (S, R, RA) classroom environments,
- Class-size and achievement gap reduction between white and non-white STAR pupils (and the lasting benefits of this),

- Discipline/participation measures (grade 7).
- Class-size/school size interactions.
- ?

When completed, this series of studies should tell educators much more about the issues of class size and pupil achievement and development than have the numerous, but considerably smaller and less experimental, prior studies. The various studies and compilations of class-size studies are found in such citations as: Cahen et al., 1983; ERS, 1978 and 1980; Folger, 1989/92; Glass & smith, 1978; Glass et al., 1982; Mitchell et al., 1989; Mueller et al., 1980; Slavin, 1989 and 1990; Tomlinson, 1988 and 1990; etc. The full STAR report appears in Ward et al., (1990) and the STAR and various LBS technical reports (e.g., Nye et al., 1991 and 1992) are available from the Center of Excellence, Tennessee State University.

Orlich (1991) called STAR ". . .the most significant educational research done in the US during the past 25 years" (p. 632). The LBS is extending STAR results as a basis for future education policy. Educators need to apply results of definitive research ["This research leaves no doubt that small classes have an advantage over large classes in reading and mathematics in the early primary grades" (Finn & Achilles, 1990, p. 573)] in making school organization decisions.

References

Bloom, B. (1984, May). The search for methods of group instruction as effective as one-to-one tutoring. Educational Leadership, 4-17.

Cahen, L.S., Filby, N., McCutcheon, G., & Kyle, D.W. (1983). Class size and instruction. New York: Longman.

Education: Long-term benefits of preschool. (1990, March-April). The Futurist Magazine, 24(2), 49.

Education Research Service or ERS. (1978). Class size: A summary of research. Arlington, VA: Author.

Education Research Service or ERS. (1980). Class size research: A critique of recent meta-analysis. Arlington, VA: Author.

Finn, J.D. (1989, Summer). Withdrawing from school. Review of Educational Research, 59(5), 117-142.

Finn, J.D., & Achilles, C.M. (1990, Fall). Answers and questions about class size: A statewide experiment. American Educational Research Journal, 27(3), 557-577.

Finn, J.D., Achilles, C.M., Bain, H.P., Folger, J., Johnston, J., Lintz, M.N., & Word, E. (1990). Three years in a small class. Teaching and Teacher Education, 6(2), 127-136.

Finn, J.D., & Bock, R.D. (1985). MULTIVARIANCE VII user's guide. Mooresville, IN: Scientific Software, Inc.

Finn, J.D., & Cox, D. (1992, Spring). Participation and withdrawal among fourth-grade pupils. American Educational Research Journal, 29(1), 141-162.

Finn, J., Zaharias, J., Fulton, D., & Nye, B. (1989, Fall). Carry-over effects of small classes. Peabody Journal of Education, 67(1), 75-84. (Published in 1992).

Folger, J. (Ed.). (1989, Fall). Project STAR and class size policy. Peabody Journal of Education, 67(1). (Published in 1992.)

Glass, G.V., & 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.

Glass, G.V., Cahen, L.S., Smith, M.L., & Filby, N.N. (1982). School class size. Research and policy. Beverly Hills: Sage Publications.

Hamburg, D.A. (1992). Today's children. New York: Time Books, Random House.

Hodgkinson, H. (1991, Sept). Reform vs reality. Phi Delta Kappan, 73(1), 8-16.

Mitchell, D.E., Beach, S.A., & Badarak, G. (1989, Fall). Modeling the relationship between achievement and class size: A re-analysis of the Tennessee Project STAR data. Peabody Journal of Education, 67(1), 34-74. (Published in 1992).

Mitchell, D.E., Carson, C., & Badarak, G. (1989, May). How changing class size affects classrooms and students. University of California, Riverside: California Educational Research Cooperative.

Mueller, D.J., Chase, C.I., & Walden, J.O. (1988). Effects of reduced class sizes in primary classes. Educational Leadership, 45, 48-50.

Nye, B., Zaharias, J., Fulton, D., Achilles, C.M., & Hooper, R. (1991 and 1992). The lasting benefits study: Technical reports (grades 4 and 5). Nashville, TN: Tennessee State University Center for Excellence.

Orlich, D.C. (1991, April). Brown v. board of education: Time for a reassessment. Phi Delta Kappan, 72(8), 631-632.

Ramey, M. (1992, April). Classroom characteristics related to ethnic achievement gap reduction. Paper at AERA, San Francisco. (Ramey is at Seattle Public Schools.)

Robinson, G.E. (1990, May). Synthesis of research on the effects of class size. Educational Leadership, 47(7), 80-90.

Robinson, G.E., & Wittebols, J.H. (1986). Class size research: A related cluster analysis for decision making. Arlington, VA: Educational Research Service, Inc.

Shapson, S.M., Wright, E.N., Eason, G., & Fitzgerald, J. (1980). An experimental study of the effects of class size. American Educational Research Journal, 17, 141-152.

Slavin, R.E. (1989). Achievement effects of substantial reductions in class size. In R.E. Slavin (Ed.), School and classroom organization (pp. 247-257). Hillsdale, NJ: Lawrence Erlbaum Associates.

Slavin, R.E. (1990, Fall). Class size and student achievement: In small better? Contemporary Education, LXII(1), 6-12.

Tomlinson, T.M. (1988). Class size and public policy: Politics and Panaceas. Washington, DC: US Department of Education, Office of Educational Research and Improvement.

Tomlinson, T.M. (1990, Fall). Class size and public policy: The plot thickens. Contemporary Education, LXII(1), 17-23.

Weikart, D.P. (1989, June). Quality preschool programs: A long-term social investment. Occasional paper Number 5. Ford Foundation Project on Social Welfare and the American Future. New York: The Ford Foundation. (28 pp.).

Word, E., Johnston, J., Bain, H., Fulton, B., Zaharias, J., Lintz, N., Achilles, C.M., Folger, J., & Breda, C. (1990). Student/teacher achievement ratio (STAR): Tennessee's K-3 class size study. Final report and final report summary. Nashville, TN: Tennessee State Department of Education.

Zigler, E. (1992, June 27). Head Start falls behind. New York Times, p. 15.

Table 1. Relationships of STAR and LBS Showing Years, Grades, Measurements, etc; 1985-1992.

Study	Years	Grades	Measurement	Instruments
STAR*-	1985-89	K-3 1 grade/yr	Each year & longitudinal	SAT/BSF & questionnaires
LBS*	1990-92	4-6	Each year	
			Cognitive	TCAP
			Particip. Grade 4	Questionnaire

*Pupils progressed through the grades and were tested each year.

Table 2. Average Percent of Pupils Passing BSF Reading: Grade 1, STAR.

Status	Grade	Class Type: Small	Class Type: Reg.	Difference (S-R) or (S) Advantage
Minority	1	65.4%	48%	17.4
Non-Minority	1	69.5%	62.3%	7.2
Difference	--	4.1%	14.3%	--

ERIC

Table 3. LBS Results, Grade 4 (1989-90) and Grade 5 (1990-91) on TCAP. Summary of Class Effects Analysis Using Mean Scores of Sets.

	Set 1 Verbal		Set 2 Math/Sci		Set 3 Soc Sci/Study	
Grade:	4	5	4	5	4	5
Loc. (urban, etc.)	p≤.001	N/A	p≤.001	N/A	p≤.001	N/A
Type (S,R,RA)	p≤.001	p≤.01	p≤.001	p≤.01	p≤.001	p≤.01
Loc X Type	NS (Results found in all locations equally)	N/A	NS	N/A	NS	N/A

Loc. differences on all sets favoring S in the location, but major difference is due mostly to lower-performing inner-city pupils. Type differences favor S. R vs RA contrasts NS. Loc X Type class-type differences are the same in all locations.

Table 4. LBS: Grades 4 and 5. TCAP. Scaled Score Differences and the Differences in Mean Number of Domains Mastered between S and R Class Students and between RA and R Class Students. Means are tabled in Appendix B of the Technical Report (Nye et al., 1991, 1992).

Measures	1989-90 (4th)		1990-91 (5th)	
NRT*	S vs R	RA v R	S vs R	RA v R
Total Reading	5.61	-2.23	10.53	.10
Total Language	4.99	-.73	8.21	-1.03
Total Math	4.87	-2.29	8.08	-.34
Science	5.69	-1.47	8.99	-2.66
Social Sciences	6.13	-.20	8.14	-1.31
Study Skills	10.10	-2.15	10.62	-.85
CRT (Domains Mastered)*				
Language Arts:	.25	-.18	.84	.07
Mathematics:	.35	-.09	.68	.16

*S consistently better than R; RA consistently less good than R (-).

Table 5. LBS: Grades 4 and 5, 1989-90; 90-91. TCAP. Estimates of S and RA Effect Sizes.

Measures	1989-90 (4th)		1990-91 (5th)	
NRT*	S v R	RA v R	S v R	RA v R
Total Reading	.13	-.05	.22	.00
Total Language	.13	-.02	.18	-.02
Total Math	.12	-.06	.18	-.01
Science	.12	-.03	.17	-.05
Social Science	.11	-.04	.17	-.03
Study Skills	.14	-.03	.18	-.01
CRT (Percent differences)*				
Language Arts	.11	-.09	.34	.03
Mathematics	.16	-.04	.28	.07

*S consistently better than R; RA consistently lower than R excepton CRT, grade 5.

Appendix A

DATA COLLECTION INSTRUMENTS: STAR, 1985-1989

1 Profiles: Data collected include:

System: Enrollment, total expenditures per student, location, etc.

School: Type, size, type of community served, special programs, etc.

Principal: Age, sex, race, education, experience, etc..

Teacher. Age, sex, race, education, certification, experience, career ladder level, attendance, etc.

Aide: Age, sex, race, education, experience as an aide.

Project Student: Age, sex, race, SES, special education programs.

Comparison Student: Age, sex, race, and SES.

2. Stanford Early School Achievement Test (SESAT II) and other forms of SAT to measure pupil achievement in math and reading/language arts, based on national norms.

3. Self-Concept and Motivation Inventory (SCAMIN) to measure elements of academic self-concept and academic motivation.

4. Basic Skills Mastery (BSF). A curriculum-based criterion-referenced test to measure mastery of objectives in grades 1, 2, and 3.

5. Grouping Questionnaire to study how teachers regularly divide students into groups for instruction.

6. Parent/Teacher Interaction Questionnaire to determine the amount of time teachers spend interacting with parents during a school year.

7. Teacher/Problem Checklist (Cruickshank) to measure teacher perceived problems related to class size and pupil/teacher ratio.

8. Teacher Log provides a self-reported use of school time (also Aide log).

9 Aide Questionnaire to obtain basic information regarding aides' supervision, job description and training.

10 Exit Interviews to obtain teacher perceptions pertinent to the project.

APPENDIX B

Primary and Extended Analyses Designs: STAR (1985-1989); LBS 1990-1992.

Sample Design:

4 Locations (Urban, rural, etc.)	(Fixed Effect)
Schools nested in Locations	(Random Effect)
Class types (S,R,RA) crossed with locations and school types	(Fixed Effect)
2 Training categories*	(Fixed)

Source Table

Source of Variation:	Error Term:
Location (L)	Schools
Training* (TR)	Schools
Type (T)	School x type
LxT	School x type
LxTR	School
TxTR	School x type
LxTxTR	School x type

		Degrees of freedom (df)	
		Ach. Meas.	Noncog. Meas.
Schools	e.g. (1986)	75	69
School x Type	e.g. (1987)	149	137
Classes within School-Types (etc.)		Etc.	

Primary Model: Measures

Achievement (Ach):	SESAT, SAT, BSF	Matched
Noncognitive (Noncog):	SCAMIN, Attendance, Behavior, etc.	t-tests

---

Extended Model: Measures:

Sex (or Race, or SES)	Ave. Diff Scores on Ach.	Multivariate
Sex (or Race, or SES) Training*	Ave. Diff. Scores on Noncog.	Models

---

Two planned contrasts: S class mean vs means of all R and RA; S vs (R + RA ÷ 2)
RA class mean vs R class mean.

Each effect tested holding constant earlier effects in order of elimination. TR and T each tested as last main effect; LxTR and LxT each tested as last two-way interaction.

Analysis of BSF done with "log-odds index."

*For grades 2 and 3, a random subset of schools was chosen to study the effects, if any, of teacher training (TR) on pupil outcomes. The training used had no significant effect.

ERIC

APPENDIX C

Analysis of Variance for Cognitive Outcomes, STAR, Grades K-3. Sig. Levels $p \leq .05$ or Greater are Tabled.

Effect/[a]	Grade	Reading: Multi-variate [b]	Reading: SAT[c] Read	Reading: BSF Read	Mathematics: Multi-variate [b]	Mathematics: SAT Math	Mathematics: BSF Math
Location (L)	K		.02			.05	
	1	.01	.06		.05		
	2	.001	.001	.001		.001	.001
	3	.001	.001	.001	.001	.001	.001
Race(R)	1	.001	.001	.001	.001	.001	.001
	2	.001	.001	.001	.001	.001	.001
Type(T)	K		.001			.02	
	1	.001	.001	.001	.001	.001	.05
	2	.001	.001	.05	.001	.001	.05
	3	.001	.001	.001	.001	.001	.001
SES	K		.001			.02	
Loc X Race	1	.05		.05			
Loc X Type	K-3	All N/S. The class-size effect is found equally in all locations -- Inner City, Suburban, Urban and Rural schools. (Tabled as important.)					
Race X Type	1	.05	.05	.01			
LxRxT	1			.05			.01
LxTRxT	2	.05	.01	.05	.05	.05	.01

NOTE: Only statistically significant ($\leq .05$)results are shown. [a] The nonorthagonal design required tests in several orders (Finn and Bock, 1985). Results were obtained as follows: each main effect was tested eliminating both other main effects; loc x race tested eliminating main effects and loc x type; loc x type tested eliminating main effects and loc x race; race x type tested eliminating main effects and other two-way interactions, and loc x race x type tested eliminating all else (Finn and Achilles, 1990). [b] Obtained from F-approximation from Wilks' likelihood ratio. Essentially, no statistically significant differences were obtained on the self-concept and/or motivation (SCAMIN) measures.

This table, the table in Appendix B and tables in the text have appeared in other articles, reports and papers that discuss STAR results.