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Class Size and Student Achievement: Research-Based Policy Alternatives

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This article is about policy related to class size and student achievement. Class size is an ongoing education policy issue that ebbs and flows over time. Class size reductions have been proposed recently in many states and enacted in a few. This article reviews the literature on class size and student achievement and suggests policy alternatives. It has four sections: First, some introductory comments are made to set subsequent comments about class size policy into a broader context; second, the research on class size and student achievement is presented; third, the policy implications of this research are developed; fourth, a short summary of policy recommendations is provided.

Since 1980, states have raised public school funding 83% in nominal and 26% in real (CPI adjusted) terms; since 1983 the increases have been 43% and 20%, respectively (Odden, 1990). The bulk of these funds were distributed in block grants through school finance equalization formulas. Some funds financed separate education reform categorical programs. At least part of the new funds could have been targeted to class size reductions, because small classes were proposed as an education reform in many states. Because class size reductions are expensive, this article identifies research-based class size reduction strategies that would likely produce substantial impacts on student performance. The paper indirectly addresses issues of how to use some current federal and state compensatory education funds differently for both class size reduction strategies and other strategies that improve student achievement.

Admittedly, this is a limited policy focus. The fact is that dramatic class size reductions are costly. For example, it would cost between $200 and $250 million just to reduce class size by one student in California (Guthrie & Kirst, 1988). Even if such a policy could be afforded, it would demand equally large results in terms of improved student performance. But as argued later in this paper, the use of research on class size and student achievement for policy is not straightforward; only targeted class size reductions coupled with other changes are likely to produce achievement gains that can justify large investments of new funds.

Two more contextual comments need to be made. The first is that local conditions for teaching and learning in urban schools (Corcoran, Walker, & White, 1988) and, more generally, in many schools (see, e.g., McLaughlin, Pfeifer, Swanson-Owens, & Yee, 1986) are not good. There are more than 30 students enrolled in many classrooms; there are insufficient books, mate-

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rials and supplies; equipment is outdated; classroom discipline and school management are inadequate; facilities are in a state of disrepair, and in California and other growing states, classrooms are in short supply. Indeed, one major benefit of many 1980s state education reforms was simply injecting new funds into the schools. In many urban districts, a major impact was to have each student in each class have a modern textbook and sufficient materials and supplies. The new money was used to fund a basic level of classroom resources that simply had not been affordable until then. To a substantial degree, then, reducing class size has become a rallying cry simply for enhancing the local context for teaching and learning. The comments in this article must be viewed in this light, that major improvements are still needed in most schools with diverse student enrollments simply to create a context minimally conducive to effective teaching and learning.

The second contextual comment relates to the types of issues researched by typical class-size studies. Nearly all studies of class size and student achievement use a measure or test of student achievement that focuses primarily on basic skills and knowledge. Because the evolving goal of most states' educational systems is achievement in complex thinking, problem solving and communication skills—that is, much more than basic skills—the existing research base on class size and student achievement probably does not address the issue of class size and student achievement in higher level thinking skills.

In summary, systemwide reductions in class size are expensive. As will be shown, strategically targeted class size reductions, coupled with other changes in school and classroom organization, are the strategies needed to produce large changes in student performance. Moreover, a wide variety of improvements are needed in many schools, including class size reductions, simply to make classrooms and schools more attractive and congenial places for learning and teaching.

Review of Literature on Class Size and Student Achievement: Meager Findings

This section summarizes the broader research base on class size and student achievement. It attempts to answer the question of whether class size reduction improves student performance, and if so, how small classes have to get and how much student achievement rises. It also addresses the issue of whether the answer differs by level of schooling (elementary vs. secondary), content area, or type of student. Finally, it summarizes research about what occurs in small classes that improves student peformance.

Measuring Class Size

Measuring class size is not straightforward. The pupil–professional (certified staff) ratio is not an accurate measure of class size because certified staff includes professionals who teach in classrooms and many who do not. The "average" pupil–teacher ratio also is not the desired measure because many teachers have nonclassroom duties. The class size measure desired is the actual number of students in a typical classroom. This measure of class size is useful because it is the measure used by most of the research on class size and achievement. It also is the measure of the real context in which teacher–student learning interactions occur. In many states today, there are still at least 30 students in most classrooms. In the Los Angeles Unified School District, for example, most elementary schools place 31 students in each classroom. Thus, in the following discussion, if small class size improves student performance, a rough comparison of the small class size in the study to a class of 30 students can be used to approximate the reduction needed.

Class Size and Student Achievement: The Research Evidence

The Glass and Smith (1978) "meta-analysis" of class size and student achievement has been the major research report around which class size policy issues have been debated during the 1980s. This section summarizes its findings as well as criticisms and reanalyses of its findings.

A meta-analysis (Glass, McGaw, & Smith, 1981) generally takes the effect from each study and calculates the effect as a proportion of the standard deviation of the achieve-

ment measure used in the particular study. Thus, although various studies might use different achievement measures, the effect measure standardizes the impact so that analysis of effect sizes can be conducted across all studies. An overall impact of 1/2 a standard deviation means that student performance would rise from the average, or 50th percentile, to the 69th percentile, a fairly large rise. An overall impact of one standard deviation would mean average student performance would rise from the 50th to the 83rd percentile. In short, effects of 0.5 to 1.0 standard deviations can be considerable; on the other hand, effects around 0.1 or 0.2 standard deviations, while positive, have a less significant policy implication.

In the late 1970s, Glass and Smith (1978; Glass, Cahen, Smith, & Filby, 1982) conducted a meta-analysis of the research on class size and student achievement. They first conducted a massive literature review of essentially all twentieth-century research on class size and student achievement and calculated a total of 725 effects from 77 different studies. When all 77 studies in the meta-analysis are included, the data allowed for the following conclusions:

- There was a clear and strong relationship between class size and student achievement Sixty percent of all 725 effects showed achievement higher in small classes.
- Students learned more in small classes.
- Class size needed to be reduced to below 20 students, at least to 15 students, to produce important impacts on student achievement.
- Compared with a class of 30 students, students in a class of 15 students perform about 10 percentile points higher; that is, performance moved from the 50th to 60th percentile.

From these overall results, classes would have to be reduced to less than 10 students in order to produce a 1/2 standard deviation effect.

Glass and Smith (1978) noted that many of the 77 studies had neither good experimental controls nor sound research designs. When Glass and Smith removed the studies that did not have good experimental controls, only 14 studies remained, but with 109 effect measures comparing small and large classes. With just these results, the data allowed for the following conclusons:

- There was a stronger relationship between class size and student achievement.
- When classes were reduced to 15 students, achievement improved from the 50th to the 65th percentile.
- When class size was reduced to 10, achievement improved about 1/2 standard deviation, or from the 50th to the 70th percentile.

Glass and Smith (1978) analyzed the data even further by separating the above effects into two categories of length of instrument—more than 100 hours and less than 100 hours. The "more than 100 hours of instruction" category approximates the amount of instruction a student would receive for a subject or class that provided one hour of instruction during a typical school semester (90 days) or school year (180 days),[1] thus approximating the real impact of a policy that would reduce class sizes. From this subanalysis, even stronger conclusions can be drawn from their data:

- If classes are reduced to 15 students, achievement will rise by almost 1/2 standard deviation.
- If classes are reduced to about 5 students, achievement rises by nearly 1 standard deviation.

Although meta-analysis is a major breakthrough in attempting to summarize conclusions from decades of research on a particular topic, such as class size and student achievement, it has recently been criticized (Slavin, 1984) and an alternative has been proposed (Slavin, 1986). The first criticism is that meta-analysis gives equal weight to all study findings, whether they are from well or poorly designed studies. As noted above, in the Glass and Smith meta-analysis, only 14 of the original 77 studies included in the overall analysis were methodologically sound. The second criticism is that meta-analyses often combines studies that are on different topics while ostensibly addressing the same topic. For example, one of the

studies in the Glass and Smith meta-analysis that was methodologically sound and that produced large effects was on learning how to play tennis. An additional criticism of meta-analysis is its reliance on statistical interpolations.

Slavin (1989), using the actual Glass and Smith data, reanalyzed the results by using only the methodologically sound studies addressing student academic achievement, and he summarized effect findings without using statistical interpolations. The data Slavin discussed are shown in Table 1, with the effect sizes (as a proportion of a standard deviation) given by the actual size of the small class. These results shed new light on the Glass and Smith conclusions for this reduced sample of studies. First, the data base does not include a continuous range of small classes. There are a few classes around 20, a few classes around 15, and the rest either are 1–1 or small group tutoring. There are no classes with between 3 and 14 students. Thus, the Glass and Smith (1978) results for classes of less than 20 are essentially based on statistical interpolations of the findings in the 14 studies analyzed. Although these results are statistically accurate, these data do not include actual examples of the impact of classes with, for example, 5 or 10 students on student achievement.

More important, for both the small classes with about 20 and those with about 15 students, the effects are very small. The average effect is 0.08 and 0.04 standard deviations, respectively. If the one negative effect for the class with 17 students is excluded, the average effect increases to just 0.10 standard deviation. These are hardly large effects. These results show that if class sizes were reduced by half, from 30 to 15 (which would cost billions of dollars nationwide), the effect would be to increase student performance by just 1/10 of a standard deviation. Few would claim that to be an effective policy change, let alone a cost-effective policy change.

It seems that the impacts of small classes in the Glass and Smith (1978) study were driven by small group and one-to-one tutoring, which admittedly produce large effects. If these effects had been eliminated from their analysis of the 14 studies, class size reduction even down to 15 or 20 would have shown essentially little or no impact.

The data in Table 1, though, document extraordinary impacts of small group and one-to-one tutoring, that is, very dramatic class size reductions. For these interventions, which are mainly in elementary schools, the effect is more than 0.5 standard deviations and rises above 1.0 standard deviation for more than one study. These kinds of impacts are significant.

The Glass and Smith work is not the only study that documents large effects of one-to-one tutoring at the elementary level. Indeed, in an analysis of effective pull-out

TABLE 1
Student achievement effects (SAE) of class size reductions by size of class

Size of smaller class							
1[a]		3		14–17[b]		20–23[c]	
SAE	Class size	SAE	Class size	SAE	Class size	SAE	Class size
0.65	1–32	1.22	3–25	0.17	14–30	0.15	20–28
0.78	1–30			0.17	15–30	0.04	23–30
1.52	1–25			0.08	16–37	0.00	23–37
0.72	1–14			0.04	16–30		
0.30	1–8			0.05	16–23		
0.22	1–3			−0.29	17–35		

Note. The numbers under "Class size" show first the size of the small class and then the size of the large class. The student achievement effect, given as a proportion of a standard deviation, is the achievement difference between the two classes. Source: Slavin, 1989, and Glass, Cahen, Smith, and Filby, 1982.
[a] Mean = 0.69. [b] Mean = 0.04. [c] Mean = 0.08.

programs for students at risk (i.e., poor and minority), Madden and Slavin (1987) found several one-to-one and small group (maximum of 3 students) tutoring programs that had effects in the same range, that is, above 0.5 and sometimes exceeding 1.0 standard deviations. It seems, somewhat unsurprisingly, that classes need to be reduced dramatically to a size that allows for individual tutoring (1 to 3 students) before a significant impact on achievement is produced. Further, in most of the studies identified by Madden and Slavin, students were tutored for 20 to 30 minutes a day, which means one individual (teacher or trained paraprofessional) could teach 15 students (one-to-one tutoring) or 45 students (tutoring in a group of 3) during a week in which students are tutored once every day over a six-hour time period. Such tutoring likely will produce large achievement gains for students.

In short, research on class size and student achievement supports dramatic—and only dramatic—class size reductions. Put differently, research on class size and student achievement primarily supports individual or very small group tutoring at the elementary level. Only when classes are reduced to 1–3 students—that is, a tutoring situation—do important achievement gains result. Further, this research is bolstered by the complementary Madden and Slavin (1987) research on effective programs for poor and minority students, who comprise the bulk of elementary students enrolled in urban schools.

The Robinson and Wittebols (Education Research Service, 1978) Study

Shortly after the Glass and Smith meta-analysis was published, the Education Research Service (ERS) conducted a literature review of class size and student achievement research (1978). That analysis was followed by a more detailed review (Robinson & Wittebols, 1986) that organized studies by several different topical areas such as level of schooling (Grades K–3, 4–8, and 9–12), content areas, and type of student.

The latter study found that class size impacts differed. They concluded that the evidence was strongest for showing that class size reductions to 22 or fewer students improved student performance in Grades K–3, was less stong for Grades 4–8, and pretty much nonexistent for Grades 9–12. They did not make firm conclusions about impacts across content areas because most studies measured just reading and mathematics achievement. Nevertheless, when analyzed, the impact of smaller classes was strongest for reading achievement and mathematics achievement, with the evidence a bit less strong for mathematics. As for student characteristics, almost all of the few studies that assessed this issue found higher achievement for low income and minority students in smaller classes.

Unfortunately, methodological soundness was not a strong criterion for including or excluding studies in the Robinson and Wittebols report. Their study can be criticized for including research with methodological shortcomings, a practice that raises questions about their conclusions. Second, Robinson and Wittebols did not give a quantitative measure of the degree of change on student achievement made by smaller classes. This study, at best, can be used as a secondary source for determining research-based class size reduction policies. Thus, the Robinson and Wittebols conclusion that smaller classes (i.e., classes with 22 or fewer students) were effective in improving student performance in Grades K–3, in reading and mathematics, and especially for low income and minority students,[2] bolsters (though softly) the conclusion reached in the previous section.

Two recent longitudinal studies of state policies designed to reduce classes in the early elementary grades shed additional light on class-size reduction strategies. Indiana's project PRIME TIME reduced class sizes in kindergarten through third grade. When the program was implemented, the legislature appropriated funds to study the effects of this expensive strategy. McGiverin, Gilman, and Tillitski (1989) summarized several of the studies that were conducted. They concluded that children in small classes (19.1

students on average) performed better than children in large classes (26.4 students on average). The effect was 0.34 standard deviation over a 2-year time period. The positive news was that performance gains were documented over a longitudinal time period. The longitudinal period is important because often first-year gains erode in the second year. But the effect size, although positive, nevertheless was small—1/6 (0.17) of a standard deviation each year, only about 1/3 of a standard deviation over the 2 years. The policy question is whether this student achievement effect could be produced with other interventions at lower cost or whether larger effects could be produced with other interventions at the same cost. As is indicated below, the answer is yes to both questions. A student achievement increase of only 1/3 a standard deviation over a 2-year period is probably not worth the large cost of class size reduction.

Tennessee's Project STAR is a similar program of class size reduction in the early elementary grades. As enlightenedly, the legislature also funded a large research effort to document its effects. There now is about 4 years of research on this program, in which students have been placed in smaller classes from kindergarten through Grade 3. Although initial findings were optimistic (Bain & Achilles, 1986)—that is, achievement increased for the students in the small classes—recent results (Folger, 1990) for third grade students who have been in small classes since kindergarten show almost no achievement differential. These are disappointing findings, but they are based on solid longitudinal research for which students were randomly assigned to small and large classes. Unfortunately, both of these studies show that new, costly, state policies that reduce class size to under 20 students do not produce very large gains in student performance, a finding that further undercuts the efficacy of class size reductions.

Class Size and Teacher Classroom Behavior

Research is rather consistent in showing that smaller classes have a positive impact on teachers' classroom attitude and behavior. Smith and Glass (1980) conducted a meta-analysis of research on class size and classroom practices (Glass et al., 1982) shortly after their study of class size and student achievement. They found even stronger relationships between smaller classes and teacher attitudes, morale and satisfaction, student attitudes and interests, and changed classroom practices. In smaller classes, teachers felt better and showed greater use of individualization in instruction, more varied pedagogy, and increased interactions with students. The authors concluded that teachers felt better and worked better in smaller classes.

In a follow-through study of intensive case studies of teacher behavior in small classes, Filby, Cahen, McCutheon, and Kyle (1980) drew the following conclusions about how small classes changed teacher actions:

- Teachers were more able to complete their direct lessons in reading and mathematics, teachers felt that they were more able to develop their lessons in depth, and teachers were able to move through the curriculum more quickly and to provide more curriculum enrichment activities.
- Teachers were better able to manage their classes. Classes functioned more smoothly, less time was spent on discipline, and student absences were proportionately lower.
- Students received more individualized attention, including more encouraging, counseling, and monitoring.
- Students were more attentive to their classwork. Students had to wait less time to receive help or have their papers checked, and they had more opportunities to participate in group lessons.

A more recent study of 63 fifth-grade teachers (Bourke, 1986), in which class size and achievement, as well as teacher behaviors, were studied over a school term found the following:

- Individualization of instruction was not related to class size but that whole group instruction and grouping within classroom was. In smaller classes, there was more whole-group instruction, and student achievement was higher. In larger

classes, teachers tended to form groups and students had lower achievement. Grouping seemed to fragment lessons and forced the teacher to use time allocated for instruction to repeat the same instructional activities for each group, thus reducing overall instructional time for each individual student.

- Larger classes required more time for management. Students' questions to teachers about clarifying issues and teachers' time spent in nonacademic procedures were higher in large classes and decreased the time available for instruction.
- Teachers' questioning behavior was better in small classes—teachers tended to ask more probing questions and to provide more "wait time" after asking questions, both behaviors shown by other research to be linked to higher achievement. As teachers spent less time in managing small classes, they had more time to ask probing questions and to "wait" for answers after asking questions. Just the opposite was true in large classes.
- After the number and length of homework assignments were combined into one variable, the study found that students in small classes had more homework.

In short, it seems that smaller classes at least provide several opportuntiies for teachers to engage in instructional strategies shown by research to be related to higher student performance. These findings are nevertheless somewhat perplexing, given the small impact on student learning from the research on class size and student achievement. In combining these two different kinds of studies, one conclusion might be that although smaller classes provide opportunities to alter instructional practices, either the opportunity is not always exploited or the new instructional activities in which the teacher engages are not those that improve student learning. Although research clearly documents better teacher morale and attitude in smaller classes and changed classroom practice, the systemic link among class size, pedagogical practice, and significant student achievement increase does not seem to exist, except for one-to-one and small group tutoring.

This conclusion also characterizes the findings from recent analyses of teaching behaviors in small classes that were part of the many studies of the Tennessee STAR class-size reduction program (Evertson, Folger, Breda, & Randolph 1990). In this study, a subsample of teachers in small, regular, and regular classes with teacher aides was provided training in instructional strategies, classroom management skills, and higher-order-thinking/question-asking strategies. Although the researchers found a few small differences in mathematics teaching strategies at the second-grade level, there were few statistically significant differences in Grade 3 in either reading or mathematics instructional practices. Put differently, third-grade teachers taught much the same way in small or large classes, regardless of whether they had been given special staff development. In their discussion of these results, the authors noted that the reason for the lack of differences could be in the curriculum program used. All teachers used a fairly prescriptive, fragmented, skills-oriented approach in reading classes; there was little emphasis on comprehension, writing, or reading literature. The emphasis was on teaching and learning reading skills. The authors concluded that if that is the type of learning pursued, class size might not make much of a difference.

The authors cautioned, however, that if teaching becomes more learner centered, with multiple projects, emphases on writing, reading comprehension, thinking, and student engagement, smaller classes likely will be needed. As mentioned at the beginning of this article, the implication is that although current research on class size and student achievement—in basic skills—does not support the efficacy of small classes, it should not be used to suggest policy implications when the learning goals shift, as they are shifting, to higher level thinking skills.

Affordable Policy Strategies for Reducing Class Sizes and Increasing Student Performance

This section draws policy implications from the above research findings on class

size and student achievement and has four parts. Part One discusses strategies for elementary school class size reductions, and Part Two presents strategies for secondary school class size reductions. The third part suggests a few more dramatic class size reduction possibilities. The section ends with comments on how extra classroom space can be found if class size reduction strategies are implemented.

Elementary Class Size Reduction Strategies

What, then, are policy strategies that could be developed on the basis of research on class size and student achievement? Are there alternative ways to reduce class size than just by adding more teachers to the current educational system? As just argued, the research that exists, admitting its limitations, suggests that the most promising avenues for pursuing class size reduction policies appear to be in the early, primary grades, where the focus is on the basic skill areas of reading and mathematics (though not just basic skills in those areas), and for low income and minority students.

The first research-based policy strategy for class size reduction is to dramatically reduce class size to allow for individual or small group (two to three students) tutoring for a minimum of 20 to 30 minutes each day. This strategy, obviously, cannot be used for all students, but it should be *targeted only to students achieving below grade level in elementary schools.* Research suggests that tutoring for students achieving below grade level in Grade K–3 is likely to produce powerful improvements in student performance. Although one-to-one or small group tutoring is expensive, the high expense is nevertheless accompanied by large increases in student achievement. Ohio adopted this approach in its Reading Recovery Program, which is based on early-grade tutoring programs that produced large student achievement gains in New Zealand.

Research evidence does not support remedial programs in groups that are larger than three (Slavin, 1989), even though the average group size in most pull-out compensatory education programs is eight students (Birman, Orland, Jung, Anson, & Garcia, 1987). If the goal is to use new funds to reduce class size for the purpose of improving student performance, then one-to-one or small group (maximum of three students) tutoring for some portion of the school day for students in the early elementary grades seems to be the most powerful strategy. Tutoring, arguably, also could be a priority use for current compensatory education funds. Such tutoring should be carefully coordinated with the regular school curriculum program; the tutoring goal should be to help the student to master the regular curriculum program.

A tutoring strategy, though, needs to be imbedded into a broader set of school strategies in order to capitalize on the gains tutoring can produce and in order to have students experience a set of other educational experiences when they are not being tutored; this strategy also should be research based, with high potential for improving student achievement. There are several such broader strategies for elementary students, one of which has an important class size dimension to it.

The first concerns the issue of how students should be grouped for instruction. The issue is whether students should be grouped with students of like ability and achievement (homogeneous grouping) or with students of different abilities and achievement (heterogeneous grouping). There is a research base, though not complete, on which decisions on this issue can be based. In reviewing methodologically sound studies, Slavin (1987) concluded that cross-grade ability grouping contributed to improved student learning for reading and that within-class ability grouping (two groups) was most strongly related to student achievement gains in mathematics. This was the strategy used in Joplin, Missouri, and is often called the Joplin Plan. For all other activities, students were placed in within-class and grade heterogeneous groupings. These strategies were more powerful than either simple homogeneous or heterogeneous grouping within grades, where low-ability students clearly learned less in both cases. In short, a mixture

of ability and mixed grouping seems to help improve student achievement, but it is the type of ability and mixed grouping that matters.

In a recent study, Madden, Slavin, Karweit, and Livermon (1989) tested the effects of such practices, combined with individual and small group tutoring, in a school in Baltimore with students that are all minority and mostly poor. Students were placed in mixed-ability classes for most of the school day. All Grade 1–3 students achieving below grade level received individual tutoring for 20 minutes each day from a trained, certified reading specialist; first graders had priority for tutoring time. The costs were funded mainly with compensatory education funds. For reading instruction—that is for 90 minutes a day—students were reorganized into ability grouped, cross-grade classes of just 15 students. All teachers taught reading during that time period, including the tutors. The small class size "maximized" the degree of homogeneity in reading classes and allowed whole-group instruction during reading. Whole group instruction, in turn, helped to increase the amount of time students were exposed to reading instruction. The study so far has produced large impacts on student reading achievement.

This strategy combines individual tutoring with additional, but targeted, class size reduction just for reading instruction. And it does not cost any more than the tutors. With tutors already funded, it is an extra class-size reduction strategy that costs no more but simply uses tutors in a different role for 90 minutes. For the other portion of the day, tutors can tutor 11 students individually for 20 minutes each. Thus, the second research based strategy is to combine individual tutoring with class size reduction to 15 for just language arts/reading instruction (in which students are placed in ability groups across grades) in kindergarten through Grade 3, in schools with large concentrations of educationally and economically disadvantaged students. Canady (1989; Canady & Hotchkiss, 1984) has suggested several similar parallel scheduling approaches, many of which produced student achievement gains, particularly for students in the bottom quartile.

There are three major variations of this class-size reduction strategy for only reading, although at this point I am not aware of research supporting any one specifically. The first is to stagger student attendance during the day, so that half the students start school an hour early at the beginning of the day, and the other half stay at school for an hour later at the end of the day. Class size for reading instruction during those special hours, then, can be reduced by half, with only a modest increase in cost.

A second variation is to hire an additional reading teacher for the school and to add that teacher to regular classrooms for reading instruction only. Reading instruction would be staggered by grade in hourly intervals. During each grade's reading instruction time, the reading teacher would teach reading for that grade. Students in that grade could be regrouped from two mixed classes of 30 into three ability-grouped classes of 20 and receive whole-group instruction from each of three teachers.

A third variation is a form of differentiated grouping. Students in several grades could be regrouped at a certain time, with some groups (substantially?) larger than 30 and the reading group substantially less than 30, say, down to 15. This, basically, is a no-cost alternative. Physical education, social studies, or other activities could occur for the larger groups. The idea is to have groups of a variety of sizes in order to create small, cross-grade ability groups just for reading instruction.

All three of these variations reduce class size for reading instruction only. All could be supplemented with individual tutoring for students still achieving below grade level. The general idea is to provide intensive intervention in the early grades to maximize the possibility of having all students enter the third grade while achieving on grade level in mathematics and reading.

Note that this strategy does not limit reading and mathematics goals to just basic skills. Indeed, although class size reductions for teaching basic skills in reading and math-

ematics may not be warranted, smaller classes are likely needed when the emphasis is on teaching for understanding, engaging students in problem solving, and developing thinking skills (Evertson et al., 1990).

If improving student performance is the goal—indeed, if delivering all elementary students to the third grade with solid reading and mathematics skills were the specific goal—there are additional research-based strategies, including curriculum change and broader modifications in school and classroom organization, that could complement and reinforce these targeted, elementary school class-size reduction strategies (Madden et al., 1989; Slavin, 1989; Slavin, Karweit, & Madden, 1989). Further, these strategies individually and collectively have been shown to be especially successful for low-income, ethnic, and language minority students, which increasingly characterize the "average" student. The "Success for All School" in Baltimore is implementing all of these interventions, and in the first year produced impressive student achievement gains (Madden et al., 1989).

The broader strategies would include the following:

1. Early childhood education for three- and four-year-olds. Nearly all studies have shown that such programs have long-term impacts, and even when future benefits are discounted to present values, they have significant net benefit–cost ratios (Barnett, 1985; Grubb, 1989). Early childhood education programs for children from poverty backgrounds improve student performance in the basic skills in high school, decrease student failure rates and below grade level performance, decrease discipline problems, and improve rates of high school graduation (Karweit, 1987).

2. Extended day kindergarten. Kindergarten was a full-day program until World War II, when a shortage of teachers shortened it to a half day. Research syntheses suggest that students from poverty backgrounds who receive a full-day kindergarten program perform from 0.5 to over 1.0 standard deviations better on basic skill activities in the early elementary grades (Puleo, 1988; Slavin et al., 1989) than those who do not. Both expanded early childhood education and extended day kindergarten for poor students would need additional funding.

3. Continuous progress programs in reading and mathematics (Slavin & Madden, 1989). Performance of at-risk students improves by at least 0.5 standard deviations when these students are periodically regrouped, with cross-grade ability grouping in reading in Grades 1–3 and within-grade ability grouping in mathematics but with heterogeneous class groupings for all other subjects (Slavin, 1987) also improve performance of at-risk students by at least 0.5 standard deviations.

4. Curriculum programs with the goal of developing students' complex thinking skills, that is, with the goal of having students become active learners. These include an integrated language arts approach with an emphasis on reading comprehension, a process approach to writing, a natural language approach to children with limited English proficiency, and a problem solving/manipulative-based approach to mathematics.[3]

5. Cooperative learning across all of the above curriculum topics and including team-based individualization in a cooperative learning environment. Slavin (1989) has shown that cooperative learning, especially in the upper elementary grades, has a broad range of large impacts (over 0.5 standard deviations) on student academic performance, student attitudes towards other students, and skills in working with groups. Furthermore, cooperative learning "works" for improving student achievement both for low-income and minority students and for language minority students (Kagan, 1989).

6. Peer or volunteer tutoring. Several peer and volunteer tutoring programs in schools with high concentrations of poor and ethnic and language minorities have been shown by controlled research studies to produce significant (0.5 to 1.0 standard deviations) gains in achievement of students tutored (Slavin & Madden, 1989). Other research typically shows that tutors also improve these students' academic performance. Peer

tutoring is also a highly cost-effective program (Levin, Leitner, & Meister, 1987).

7. Computer-assisted instruction. A number of computer-assisted-instruction programs, most of which have emphasized basic skill acquisition, have produced 0.5 or more standard deviations of achievement gains, including the type developed by the Curriculum Computer Corporation for the Los Angeles Unified School District (Slavin & Madden, 1987).

In short, there are several strategies that schools, districts, and the state can deploy that have a research base showing that they are likely to produce significant gains in elementary students' achievement. Research has shown these strategies to be not only individually effective (Slavin et al., 1989) but also effective when all are implemented in one school (Madden et al., 1989). Further, and most important for this article, these strategies include two major class size reduction components: one-to-one or small group (maximum of 3 students) tutoring and cross-grade, ability groups of 15 students for reading instruction only. If new dollars for schools were targeted to these specific class-size reduction strategies and combined with these other intervention strategies, a significant impact on elementary student performance likely would result. The point is that class size reduction should be part of a larger, comprehensive set of strategies, with class size reduction used sparingly and strategically.

The last strategy is an amibtious staff development program to help ensure that the above pedagogical behaviors and changes, as well as school and classroom organization, get fully implemented. Many of the above activities are not common in most classrooms today. Further, one major dilemma of class size and student achievement research (developed above) is that although small classes produce changes in teachers' classroom behaviors, those changes tend not to get translated into student learning gains. Thus a major, ambitious staff development strategy would help ensure that the appropriate changes in teacher behavior that should result from class size reduction, as well as from the other suggested interventions, will in fact occur. Such an ambitious staff development strategy can be developed from a relatively broad knowledge base. There is considerable knowledge about effective staff development (Joyce & Showers, 1988), as well as schoolwide change and improvement (Fullan, 1985; Huberman & Miles, 1984). Staff development should focus on implementing new mathematics and language arts curriculum frameworks with their myriad attendant changes in teacher pedagogy, including content-specific higher level of thinking skills, writing across curriculum content areas, cooperative learning, grouping and regrouping in elementary school, peer tutoring, classroom management, and perhaps general emphases on thinking and problem-solving skills. A comprehensive staff development program which focuses on training staff development trainers could easily cost $25 per pupil annually and the payoff likely would be high.

Secondary School Class-Size Reduction Strategies

The research base for secondary class size reductions is thin, at best. The typical proposals for class size reduction at this level currently have logistical rationales that have surface appeal but as yet do not have research support. The first is a strategy that has been proposed but not yet adopted in California, though it has been adopted in a number of other states, first in Florida. This strategy reduces high school English classes to a maximum of 20 students on the condition that one writing assignment is made every week, corrected, and returned to students. This policy recognizes that it is difficult for the typical English teacher to make writing assignments and correct them for five or six classes of 30 students. Although research does not exist to document the short- or long-term validity of this strategy, it has an intuitive appeal: Students will probably improve their writing if they write more and receive feedback on their writing. In addition, writing is a higher level skill, so this policy also reinforces new emphasis on

higher level cognitive skills. This strategy would cost about $15 to $20 million.

Another way to reduce class size in high schools is to follow the model of the Ted Sizer Coalition of Essential Schools (see Sizer, 1984, 1989). High schools in this coalition take the funds that a district allocates to a high school for professional staff—teachers, department chairs, counselors, psychologists, deans, and other certificated staff, save for librarians and a few administrators—and use them to hire classroom teachers. The goal is to have each group of teachers work with only 80 students. The goal is to reduce teacher–student contacts, or more specfically, to reduce the number of individual students for which the teacher is responsible for academic as well as nonacademic concerns. Teachers are expected to teach subjects in an integrated-discipline way, with a humanities (language arts/history) and mathematics/science emphasis, and to provide appropriate counseling and supportive services. The trade-off for the broader responsibilities is a smaller student–teacher ratio, about 20 to 1, and thus a more personalized—smaller—environment. This strategy essentially reallocates current resources. This strategy could be stimulated with incentives, such as a requirement for receiving a state's school improvement program funds. Although there is no research documenting the effectiveness of the restructuring approach, the strategy is based on analysis of the dysfunctions of current high school structures and is being tried by several high schools across the country.

A final comment is that there is general consensus that most effective secondary programs specifically developed for students at risk of dropping out of high school are characterized by small size, small class size, small program size, and small school size (e.g., Cuban, 1989).

Conclusions

Systemwide class-size reduction would have little effect on student performance and even if it did, would cost too much money. When current research is analyzed critically, it shows student achievement impacts of only about 0.1 standard deviations for class size reductions from 30 to 20 or even down to 15 students. Much research, moreover, is not particularly relevant to many districts because students are more diverse and complex than students in the typical class-size study and because new state educational goals increasingly are focused on student achievement in higher level thinking skills and not just basic skills and knowledge. Moreover, a wide variety of improvements still are needed in many urban districts and states generally, including class-size reductions, simply to make classrooms and schools more attractive and congenial places for learning and teaching. Although research shows that smaller classes improve teacher morale and produce changes in teacher classroom behavior, the dilemma is that it does not show the links to student performance. Research supports only targeted class-size reduction strategies.

The first research-based policy strategy for class size reduction is to dramatically reduce class size to allow for individual or small group (two to three students) tutoring. This strategy obviously cannot be used for all students but should be targeted only to students achieving below grade level in elementary schools. Research suggests that tutoring for students achieving below grade level in Grades K–3 is likely to produce powerful improvements in student performance. This strategy can improve elementary student achievement, especially students from low-income backgrounds, by more than 1 standard deviation. The impact of this strategy is multiplied with the second strategy. *The second research-based strategy is to combine individual tutoring with class size reduction to 15 for just language arts/reading instruction* (in which students are placed in ability groups across grades) in kindergarten through Grades 3, in schools with large concentrations of educationally and economically disadvantaged students. For this strategy to work, the language arts program should include a continuous progress reading program, use an integrated approach to reading, emphasize reading comprehension,

and incorporate a process approach to writing.

The impact of these two class-size reduction strategies on student achievement can be bolstered if they are further combined with cooperative learning, peer and volunteer tutoring, new forms of computer-assisted instruction, and a rich curriculum emphasizing thinking skills. Each of these additional strategies can improve student performance by 0.5–1.0 standard deviations.

Implementing all of these strategies requires *an ambitious staff development program* to help ensure that the above pedagogical behaviors and changes, along with school and classroom organization, get fully implemented. Staff development should focus on the reading and writing programs, as well as on a manipulative-based, problem-solving approach to mathematics, cooperative learning, and the organization and management of peer and volunteer tutoring programs. Funding these strategies requires a modest amount of new funds and reallocation of current federal and state compensatory education funds toward these purposes. The impact of all of these strategies can be further bolstered with early childhood programs for 3- and 4-year-olds and extended day kindergarten for 5-year-olds, especially those 3- to 5-year-old children from poor backgrounds; these would need additional and larger funding increases.

At the secondary level, the class size reduction proposals are threefold: (a) to reduce high school English classes to 20 students and to require that one writing assignment be assigned, corrected, and returned each week; (b) to move to a restructured school organization such as that proposed by the Ted Sizer Coalition for Essential Schools, which reduces teacher–student contact to approximately 80 students per day; and (c) to have small program and class size for any program specifically designed for secondary students at risk of dropping out of school.

Notes

[1] Only about 80% of time in these days is typically allocated for instruction (Karweit, 1989).

[2] The report does not systematically indicate the degree of improvement. The report primarily groups studies into those with positive and negative impacts on student achievement.

[3] There is an extensive research base on each of these curriculum changes. Several states, including California, and several national professional organizations, including the National Council of Teachers of Mathematics, the National Council of Teachers of English, and the National Council of Teachers of Science, have developed new curriculum frameworks that reflect most of this research. This intervention can be read to mean implementing this type of new curriculum.

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