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CLASS SIZE REDUCTION: WHAT THE LITERATURE SUGGESTS ABOUT WHAT WORKS



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CONTEXT: STUDYING THE EFFECTS OF THE ONTARIO CLASS SIZE REDUCTION POLICY



The Ontario Ministry of Education has undertaken a number of strategies to support school boards in meeting targets for achievement levels in elementary schools, as measured by provincial assessments. One of these initiatives is class size reduction with its aim to reduce the large majority of primary classrooms to twenty (20) or fewer students by 2008.

The Canadian Education Association (CEA) received funding from the Ontario Ministry of Education to conduct a study over two academic years (2006-7 and 2007-8) to understand the effects of class size reductions in Ontario schools. The study examined innovative approaches to the implementation of the policy and assessed whether the anticipated policy outcomes had been achieved. CEA contracted with Dr. Nina Bascia of the Ontario Institute for Studies in Education to act as the principal investigator and research team leader.

INTRODUCTION



Class size reduction is a policy idea that has received much interest over the past several decades, particularly in recent years, across a number of western countries.

The idea continues to be attractive to policy makers, parents and educators, making a kind of intuitive sense; it is a “feel good” idea. According to our reading there have been hundreds of attempts to reduce class size in a number of countries and jurisdictions, including Toronto and Edmonton and now, since 2004, the entire province of Ontario. Sometimes it is introduced as if it alone should make a positive difference in the quality of teaching and learning. At other times it comes with additional supports such as targeted professional development for teachers, or additional resources to support student learning.

There is a wealth of studies of the relative value of smaller classes, including a number of comprehensive reviews. Yet it is difficult to make sense of the wide range of differing conclusions about the extent to which it improves the quality of teaching and learning. While there is general consensus that it “does no harm and probably a little good,” there have been criticisms in recent years that it is not as cost-effective as other possible policy choices and, more troubling, reports in recent years that suggest that it may actually reduce the quality of learning opportunities for students who already tend to receive lower quality education. At one end of the spectrum are studies that reveal significant improvements in students' academic achievement, student engagement and teacher and parent satisfaction while others report little to no improvement and unexpected consequences that actually exacerbate the gap between learning opportunities for traditionally over- and under-achieving student populations.

In order to wrap our heads around this apparently complex phenomenon, we undertook a thorough review of the research. As a result of our review, we are left with the understanding that class size reduction is a useful initiative in combination with other factors when certain practical and instructional issues are taken into account. Arriving at this conclusion, however, required a careful weighing of the research evidence. A comprehensive picture began to emerge only after we considered the aggregate of many studies. Our reading was critical: we frequently had trouble accepting researchers' claims and conclusions because, often, so much was left unexplained or unexamined to our satisfaction. Nearly always, there was no information on what policy makers thought could be achieved by class size reduction or by what means they thought such improvements would occur. Often the research was conducted at such a distance from the action that we could not tell what was actually going on in practice. This distance sometimes led to some confusion about what class size reduction actually is and how it could be measured.

While most of the studies referred to some prior research, we saw little evidence that most researchers attempted to build upon or extend the research that had already been done by others. Often strong sentiments in favour of or against the idea of class size reduction seemed to have coloured researchers' conclusions. Often, too, researchers did not identify factors that might influence the results in the jurisdictions they were studying and therefore were unable to provide solid recommendations for implementing class size reductions elsewhere. This review of the research is our attempt to evaluate the quality of the evidence and claims researchers have made about the relative benefits and costs of class size reduction as a policy idea, in order to arrive at reasonable conclusions about its costs and benefits. While we concentrate in this review on the issue of class size reduction, we understand that the oversimplification of policy development and policy research is a more widespread phenomenon with some troubling consequences for classroom practice.

RESEARCH METHODS AND SOURCES



We started the literature review by using the University of Toronto's online search tool to check the extent of the literature in the field and its characteristics, which was very extensive. Class size reduction has come under the scrutiny of economists, educational theorists, statisticians, psychologists, sociologists, political scientists and policy analysts. The literature in the field includes critical studies that cast doubts on class size reduction as a viable policy tool capable of increasing student achievement; supporting studies that advance arguments that class size reduction is an effective policy option for increasing student academic achievement; and balanced studies that put forward alternative policies for increasing student academic performance and improving schooling. We found that the topic has evoked many concerns: about cost efficiency and effectiveness, financing, teacher salary, equity, problems of research design and methodology, the interpretation of research results, and value conflicts among educational stakeholders. Our preliminary scan of the literature revealed that class size was of international concern.

We adopted four major mixed-search approaches – electronic databases, online library catalogues, the Internet, and refereed articles – for exploring the literature in the field. In order to make the task manageable, we limited our search to works that had been published in the past twenty years.

Using the descriptor phrase “class size reduction”, we searched the following electronic databases: ERIC, Education Full-Test, ProQuest, EBSCO, Ingenta, JSTOR, and Wilson Education Abstracts. These sources netted more than 400 articles. To ensure that our search was manageable, we restricted it to peer-reviewed published works. Given the limited time we had for this work, searching through the electronic databases was the most time efficient method.

Next, we turned our attention to the University of Toronto's online library catalogues. Using the same descriptor as before, we found a small number of books on class size reduction.

We used Internet search engines (Alta Vista, Yahoo, Lycos and Google) using the descriptor words “class size reduction” and “class size policy” interchangeably. On the whole, our Internet search brought up more than 500 items. These works included conference papers, government documents, teacher union and research institution reviews of class size research, as well as journal, newspaper and magazine articles. We used the Internet search method for two reasons: First, many government and teacher union documents can be conveniently accessed on the Internet. Likewise, some research organizations post their research reports on the Internet for free public access and downloading. Second, a number of peer-reviewed journals are published in an electronic format. While some of these publications can only be accessed through paid annual subscriptions, others can be accessed electronically free of charge through the worldwide web search engines and are of equal scholarly quality as print-based journals.

Finally, we received about a dozen journal articles and conference papers from other members of the Ontario Primary Class Size Reduction Policy Project team. The journal articles were those that research team members had located in scholarly journals to which they or their academic colleagues subscribed.

Class size reduction is one of the most researched, debated, scrutinized and politicized issues in education. Numerous research studies and reviews have been published on class size reduction. A large proportion of this research was conducted by U.S. researchers and scholars, but this review also includes research conducted in

Canada, Australia, the Netherlands and the U.K. Above all, we ensured that our selected articles and other published works represented a cross-section of research and reviews on class size reduction. We ended up analyzing over eighty reports, articles and chapters for this review. While there are several other research syntheses available, we believe this is the largest and most comprehensive. Out of the large number of items we found, we selected published works that provided clear evidence, precise explanations of their purpose, and commented on the social, political, and economic contexts in which class size was researched, debated, discussed or adopted as a reform policy. Even so, as discussed in later sections of this report, we have some concerns about the quality of research methods and claims in many of the works we read.

CLASS SIZE REDUCTION AS A SUBJECT OF POLICY RESEARCH

The literature on class size reduction covers a lot of ground but can be clustered according to the questions it attempts to answer and the methods used to conduct the research. This section describes the following major research strategies in the class size reduction literature:

- the development of abstract models of cost benefits by focusing on standardized achievement test scores associated with class size reduction;
- classroom observations of teaching practice and evidence of student engagement, sometimes over a multi-year time period;
- summaries of survey results reporting on teacher or parent perceptions of class size reduction and summative reviews of past research;
- analyses of the unintended as well as intended consequences of class size reduction.

The section concludes with five in-depth descriptions of large-scale class size reduction initiatives, the research published on those initiatives, and critiques of the research among educational policy analysts. These descriptions provide useful illustrations of some initiatives in practice, as well as a flavour of the research and debates in the field.

MODELING

The most common question the research on class size reduction attempts to answer is “Does class size reduction improve student learning?” The studies attempting to answer this question tend to focus on an actual jurisdiction or across several jurisdictions where class size reduction was attempted, and consider the evidence for improved student outcomes, most often some kind of standardized student test results (Blatchford & Mortimore, 1994; Edmonton/University of Alberta, 2001; Finn, *et al.*, 2001; Kruger & Whitmore, 2002; Milesi & Gamoran, 2006; Molnar & Zaharian, 1999; Scudder, 2002; Shapson, *et al.*, 1980) but also other measures such as high school graduation rates (Sharp, 2002) and pregnancy and incarceration rates (Krueger & Whitmore, 2002).

A somewhat different but related question taken up by some of the research is whether class size reduction is more cost effective in improving student learning than other policy choices such as teacher selection, teaching effectiveness and professional development (Allen & Lynd, 2000; Normore & Ilon, 2006; Odden, 1990) or vouchers (Neas, 2002) (see also Krueger & Hanushek, 2000; Peevely, *et al.*, 2005).

In some cases, the research takes into account student demographic characteristics such as race and socioeconomic circumstances in order to discern how those from traditionally academically underachieving groups compare with students with more social and economic advantages (Blatchford, *et al.*, 2002; Egelson & Harmon, 2000; Reichardt, 2001). This body of research arises out of the assumption that policy makers' primary concerns are about spending of public money, or the “bottom line”. As Blatchford and Martin (1998) note, Britain's Conservative government and its successive education ministers were “understandably nervous about the resource implications of instigating a programme of smaller classes...” (p. 119). What these studies

have in common is that they look across large numbers of cases (students, classrooms, schools and even jurisdictions) in order to determine general trends. Their assumptions about what's significant are fairly simple. The data they consider – dollars spent, test scores, graduation and incarceration rates – are quantitative (numeric) and can be plugged into mathematical equations. The intent is to come up with generalizable conclusions that would be applicable beyond the specific cases from which the actual data are drawn. What is significant about this research is that, despite the apparent lack of attention to the details of what and how students are learning in smaller class settings, they fairly consistently find that class size reduction is associated with at least modest improvements in student outcomes. As further sections of the review describe, however, many concerns have been raised about the utility of data and methods employed to arrive at these conclusions.

CLASSROOM DYNAMICS

A small but robust group of studies investigates what goes on in classrooms where class size reduction has occurred. The question these studies focus on is “To what extent and how are teachers changing how they teach and interact with students when class size is reduced?” Observing what teachers and students do, sometimes repeatedly over a several-year period, analyzing teachers' logs of classroom activity, interviewing teachers, these studies provide concrete descriptions of what actually happens in classrooms and the conditions under which it happens. They note when and where teachers are able to individualize their teaching (Burke, 1986; Korostoff, 1998; Shapson, *et al.*, 1980; Zahorik, 1999) or to manage student behaviour differently, even when students show no gains in academic achievement (Blatchford, *et al.*, 2004; Englehart, 2007); the opportunities it provides for establishing positive relationships; and how the benefits of class size reduction vary across subjects, grades and types of students (Gilstrap, 2002). From this line of research we learn that teachers' ability to teach in ways that target students' individual learning is not innate; it takes time to develop new teaching strategies. We learn that class size does seem to make a difference in the kinds of teaching strategies selected by teachers. We also discover that some teachers are more effective than others, and that the benefits vary depending on grade, subject and context.

TEACHER OPINION SURVEYS

We found several reports that summarize opinion survey results. Such reports are often specifically targeted to decision makers to provide concrete evidence on contested issues in specific jurisdictions. For example, a survey of teachers and administrators across the U.K. demonstrates the actuality of large classes that are masked when national level decision makers have access only to broad averages (Bennett, 1996). A similar survey of teachers in Ontario conducted prior to the current primary class size reduction initiative reports that their actual class sizes are higher than how they are reported at the school board level (OECTA, 1999). Parental perceptions of class size reduction also form part of the data base in some of the larger scale studies.

RESEARCH SYNTHESSES

The literature also includes several well-balanced and comprehensive research reviews that attempt to synthesize findings across jurisdictions and across system levels (state/district/school/classroom). These articles and reports raise broad questions not considered in many of the individual studies by considering class size reduc-

tion in light of a range of theoretical and practical perspectives. They suggest that it might be important to think about class size reduction in light of what it represents as a public good in terms of individual or social gains (Mitchell & Mitchell, 2003). They suggest that for class size reduction to be effective, teachers must change their practice and that professional development is a necessary additional requirement and the cost per student thus must necessarily increase (Finn, 2002; Hopkins, 1992, 1998). They remind the reader that nitty-gritty details such as busing schedules must be considered in ensuring effective class size reduction implementation. They also suggest that teacher morale is an important and not incidental reflection of, and contribution to, the success of class size reduction (Graue, *et al.*, 2006; Manitoba Teachers' Society, 2001; see also Blatchford & Mortimore, 1994).

LARGE SCALE RESEARCH AND DEVELOPMENT PROJECTS

Among the most interesting research, are evaluation studies that describe what happened when one or more jurisdictions implemented class size reduction initiatives. Studies of these class size reduction efforts usually incorporate several of the research strategies identified above – mathematical modeling focusing on costs and achievement gains, classroom observations, interviews and surveys of teacher perceptions. Beyond this, what some (but not all) of these studies add to the literature base are the identification of the logistical considerations that lie between macro-level policy decisions and classroom practice; what happens when school systems try to fund these initiatives (Odden & Archibald, 2001) and hire more teachers, when schools must find room for additional classes (Ogawa, *et al.*, 1999; Jepson & Rivkin, 2002) and teachers must learn how to work with students differently than they have in the past.

Some of these studies seem intended to portray class size reduction in a rosy glow; others, however, make the point that class size reduction is not a magic bullet, that its effects are dependent upon local circumstances. The focus is on a particular place and set of circumstances and authors do not always help readers understand how well or poorly their own jurisdiction matches the case described in the study.

We have selected five large-scale studies on class size reduction for specific discussion: the Edmonton Study, Tennessee's Student-Teacher Achievement Ratio (STAR), Wisconsin's Student-Teacher Achievement Guarantee in Education (SAGE), California's Small-class Project, and the British CSR project. This section of the literature review will describe the main features and critique each of these major research studies, including their unintended consequences.

EDMONTON AND OTHER CANADIAN CLASS SIZE STUDIES

Edmonton

In October 1999, Alberta Learning, Edmonton Public Schools, and University of Alberta Faculty of Education formed a partnership to design and implement class size reduction in several "high-needs" schools in the district. The project's purpose was to examine the impact of small class size on student growth and achievement at the Grade 1 level in high-needs schools, with a focus on those teaching practices which maximize this growth and achievement (Edmonton/University of Alberta, 2001). The initiative targeted the ten high-needs schools with the highest transience rate and the highest percentage of families in the district living in poverty.

Alberta Learning provided \$500,000 for the project and assigned the University of Alberta the responsibility to conduct the study. The project started in January 2000 with the addition of teachers and the creation of classes of 15 students or fewer at the Grade 1 level. Teachers in the project were involved in two types of

professional development: one focusing on balanced literacy and the other to share information about teaching strategies and examples of student work with University of Alberta faculty on a monthly basis.

The academic progress of the students in the project was measured using various standardized tests: Canadian Test of Basic Skills (CTBS), Developmental Reading Assessment (DRA), and Highest Level of Achievement Test (HLAT); there were substantial gains in test scores between when the tests were first administered in January 2000 and five months later. The researchers also used semi-structured interviews to obtain information about teaching strategies, teacher satisfaction, student behaviour and parental satisfaction in the project schools. These data suggest that teachers in the project were able to individualize their teaching, develop a productive learning environment, integrate reading, writing and speaking, use hands-on activities, and support student personal skill development. Student classroom behaviour issues, including noise level, were at a minimum. Students' task engagement – measured by concentration on their work – was at a high level. Interviews with parents indicated that they were pleased that they could meet with teachers frequently and that their children could receive extra attention when they needed it. Teachers showed their satisfaction with their work and felt confident that they could identify and meet the learning needs of their students.

The Edmonton project has several interesting features. First and foremost, it implemented class size reduction along with a teacher professional development program and classroom support. These programs were needed to ensure that project teachers could make the changes necessary to realize project goals. The need for implementation of professional development programs in conjunction with class size reduction has been emphasized in the literature (Graue, *et al.*, 2005; Bohrnstedt, *et al.*, 2001; Achilles, 2003; Finn 2002; Pannozzo & Finn, 2001).

The Edmonton project's targeting of Grade 1 students in high-needs schools was consistent with a number of researchers' contentions that investments in class size reduction are most effective in the range of Kindergarten to Grade 3 because it allows children to develop the fundamental skills, dispositions, and socialization patterns necessary for successful schooling outcomes (Addonizio & Phelps, 2000; Biddle & Berliner 2002; Finn, 2002; Robinson, 1990; Milton 2006; Guillemette, 2005; Manitoba Association of School Trustees, 2001; Allen & Lynd, 2000). Hanushek (1999) and Guillemette (2005) criticize across-the-board class size reduction policies and suggest a targeted approach. Economists Krueger and Hanushek (2000) agree that greater benefits might accrue to class size reductions if resources were targeted toward minority students or those who are educationally disadvantaged or are at risk for academic failure. Recently, in their evaluation of the effects of class size reduction policy in primary schools in Ontario, People for Education (2007) criticized the current across-the-board approach to class size reduction. The organization has recommended that the Ontario Ministry of Education should allow school boards flexibility to target implementation to areas of highest need.

The Edmonton study raises several issues we believe are important to consider. First, the study suggests that there is a positive relationship between class size reduction and student academic achievement on standardized tests. This relationship, however, may be one of correlation rather than causation in the sense that class size clearly was not the only contributory factor to student academic achievement. The professional development program that teachers received may also have made valuable contributions to the students' academic growth. In this case, while some researchers and policy makers are interested in understanding the independent effects of class size reduction in order to decide whether it is worth the financial investment, other factors present (some described in the research and others perhaps not) may also influence the quality of student learning. (Hanushek, 1999; LeFevre & Rankin, 2000; Daring-Hammond, 2000). The issue of how much each of these factors independently contributes to student academic gains is highly debatable.

A second issue relates to the length of the intervention. Is it enough to reduce class size in Grade 1 alone, and hope that the benefits will last over a student's entire academic career? Grissmer (1999) analyzes the duration effect of class size reductions and concludes that there is a link between length of intervention and longevity of benefit. As well, basing his analysis on the literature, Achilles (2003) suggests a number of strategies for implementing small class size initiatives; among them the maintenance of small classes for at least three years for enduring effects. This view is also shared by Biddle & Berliner (2002), Finn, (2002), and Graue, Oen, Hatch, Rao and Fadali (2005). These authors suggest that more years spent in small classes are more likely to produce larger and sustainable benefits for students.

The Edmonton study relies heavily on teacher self-reported data (interviews and questionnaire) for assessing both teacher satisfaction and behaviour of students. Similarly, parents' self-reported data were used to examine parental satisfaction with the project. Given that teachers, teacher unions and parents may be predisposed to support class size reduction (Basham & Hepburn, 1999; Greene & Forster, 2003; Mitchell & Mitchell, 2003; Bennett, 1996; CTF, 2004; Sack, 2005), data obtained from such sources may be as much a reflection of sentiment as of actual experience.

Many questions arise from our reading of the Edmonton study. For example, how was the policy of class size reduction communicated to teachers, parents, students and administrators? Will partners be able to sustain class size reduction over time? How did the project account for new students who joined or transferred out of the project classes? Did the ten participating schools achieve similar percentage scores on the standardized tests or were there wide discrepancies? What was the nature of teacher quality prior to the implementation of the project, and did all ten schools that participated in the project have the same teacher quality?

Other Canadian Initiatives

Several other Canadian initiatives, while none as well-studied as the Edmonton initiative, are worth mentioning in that they demonstrate the persistence of class size reduction as a policy direction in this country.

A two-year experimental study of the effects of class size was conducted in metropolitan Toronto in the late 1970s (Shapson, Wright, Eason & Fitzgerald, 1980). Sixty-two Grade 4 and 5 classes across eleven schools were involved. Four class sizes (15, 23, 30 and 37) were compared with respect to teacher expectations, student achievement and student engagement on the basis of standardized student achievement test data, annual surveys of teachers and students and classroom observations. Teacher-student interactions and teaching methods were unaffected by class size. Student satisfaction did not appear affected and there were no differences attributed to student achievement scores, although students in the smallest classes had significantly higher math concepts scores than their peers in the two largest size classes. Teachers in the two smaller sized classes reported more individualized instruction, improved student behaviour and a more manageable workload. Like many other studies, in other words, the Toronto research reports mixed conclusions, likely the result of factors particular to the program's design (for example, its short time frame and absence of targeted teacher support resources).

Starting in 1988, Ontario Governments under the Liberals and then New Democrats and Progressive Conservatives instituted an incentive-based class size reduction policy for Grades 1 and 2. Benchmark targets were set to reduce class size averages at the school board level stepwise, from 28.2 in 1987 to 24.6 in 1988, 22 in 1989 and 20 in 1990. Starting in 1990, the province provided money for additional teacher salaries based on salary averages. School boards that did not achieve these targets were to "have their grants reduced proportionately" (Gidney, 1999). In the late 1990s, the Progressive Conservative Government of Ontario assumed all educational funding and instituted a number of changes in program resourcing (Ontario Ministry of Educa-

tion 1988, 1989, 1990, 1992, 1993, 1994, 1995, 1996, 1997). The province established class size “averages” of 25 for primary grades and 22 for secondary grades. The Ontario English Catholic Teachers’ Association (OECTA, 1999) conducted a membership survey to ascertain whether these targets matched the reality teachers faced. Survey results reported higher class averages, of 27 rather than 25 for Grades 3 to 8 and 23 (and 24 for core subjects such as science, English and mathematics) rather than 22 for Grades 9 to 13. The survey also reported an unintended increase in combined grade classes as the result of mandated class reductions.

In the early 2000s, the Manitoba Association of School Trustees (2001) made a submission to a provincial commission to decide whether the province should have a class size policy. The submission included a review of the research, which concluded that student learning gains are significant only when class size is reduced below 20 students. A survey of provincial trustees indicated that without mandatory class size caps, K-4 classes were kept small through additional teacher staffing and creative combined grade classes but that, should a mandatory cap be imposed, school boards’ ability to manage resources would be seriously compromised, with difficulties particularly around an adequate supply of teachers and student transportation.

TENNESSEE’S PROJECT STAR

Tennessee’s Student-Teacher Achievement Ratio (STAR) is one of several longitudinal studies on class size reduction conducted in the U.S. (Mosteller, 1995). The four-year study (1985-89), was intended to determine the effects of class size reduction on student academic achievement in literacy and mathematics from Kindergarten through Grade 3 (Sanogo & Gilman, 1994). A cohort of approximately 6,500 students was tracked over the four years of primary grades. Over that four-year period, they were taught by about 1,300 teachers (between 326 and 339 per year). The study took place in 76 schools in 42 districts across Tennessee. Average family income in those districts was low and a number of students received free or subsidized lunches at school. The project cost almost \$13 million a year to design and implement. Four universities – Memphis State, Tennessee State, Knoxville, and Vanderbilt – provided technical assistance in the design and implementation of the study. Several high-profile researchers and scholars were involved in the project, including Charles Achilles, Jeremy Finn, Helen Pete Bain, Frederick Mosteller, Alan Krueger, and Tennessee State representative Steve Cobb.

The STAR project was conducted in inner-city, suburban, urban and rural schools across Tennessee. Students were randomly assigned to three types of classes: small (13-17 students per teacher), regular sized classes (22-25 students per teacher) and regular sized classes with full-time teacher aides (22-25 students). The control group was the regular classes. Small classes and regular classes with full-time teacher aides were the experimental groups. Student achievement test scores were the primary evidence for judging the effectiveness of the initiative. Student development in terms of self-concept and motivation was also measured (Folger, 1989). Each year the teachers were randomly assigned to one of the three class types by project staff. New students were also assigned randomly to class type according to existing vacancies. By the fourth year of the project, almost one-third of the students had been in the same class type all four years; the other two-thirds had moved from one to another class type.

The academic performance of the project students was measured by the Stanford Achievement Test (K-3), the STAR’s Basic Skills Criterion Tests (Grades 1 and 2) and Tennessee’s Basic Skills Criterion (Grade 3). Student development was measured by the Self-Concept and Motivation Inventory (SCAMIN). A three-day in-service training was organized in thirteen schools to train teachers in order to take advantage of opportunities that small classes would provide. Fifty-seven teachers also received special training in the second grade

and 55 in the third grade; some teachers did not receive any special training. In each school, teachers were observed once during the teaching of reading and mathematics lessons to help them optimize their instructional effectiveness (Folger, 1989; Sanogo & Gilman, 1994).

With only minor exceptions, there were no apparent differences across school locations or pupil gender with respect to student achievement. A significant small-class advantage, however, was found across inner-city, urban, suburban, and rural schools and for both males and females. In each year of the study, some of the benefits of small classes were found to be greater for minority students than for non-minorities, or greater for students attending inner-city schools. No differences were found among class types on the motivational scales, yet students who had been in small classes were rated as expending more effort in the classroom, taking greater initiative with regard to learning activities, and displaying less disruptive or inattentive behaviour as compared to their peers in regular-size classes. In conclusion, Finn (1998) states: "This research leaves no doubt that small classes have an advantage over larger classes in student performance in early primary grades" (p.10).

In addition to the above results, Nye, *et al.* (1999) used STAR data to examine whether the effects of small classes fade after five years. Using hierarchical regression modeling, they found that, while the small class effect is smaller in Grade 8 than at the Grade 3 post-test, it did not fade to statistical insignificance after five years. Students who experienced more years of small classes in Kindergarten through Grade 3 had higher levels of academic achievement (adjusted for social class) five years later than students who had had fewer years of small classes. They also stated that the positive effect of small classes in K-3 may last at least until high school. Their conclusion is that "the positive effects of small classes on achievement that are large enough and of sufficient duration support policies of reduction of class sizes to result in small-sized (15 to 17 pupils) classes in the primary grades" (p.140).

The STAR project is not without its critics. Sanogo and Gilman (1994) argue that politics was the primary motivating factor behind the STAR project and not scientific inquiry. According to the authors, the state teachers' association convinced the Governor to lower class sizes in the early elementary grades from the existing maximum of 25 to 21 students per class. Folger and Breda (1989) report that a survey of project STAR teachers indicated that almost all of them believed that smaller classes were better, and two-thirds said that they would prefer a one-third smaller class to a \$2,500 a year raise. Folger and Breda suggest that teachers supported STAR to promote their own professional interests and that this may have coloured the research findings.

Another criticism of the STAR project is that it suffered from a Hawthorne effect, that the teachers and students in the experimental groups were aware of the challenge of the project and tried harder to fulfill its objective of increased student academic achievement. Similarly, it is believed that teachers and students in the control groups did not do well for the simple reason that they did not try as hard as the experimental group (Sanogo & Gilman, 1994). Graue, *et al.* (2005) contend that the news about the association of greater achievement with small classes leaked out during the project, motivating the teachers and the students in the experimental groups to do well on standardized tests. Hanushek (1999) suggests that teacher reactions and expectations may have skewed its results. Sanogo and Gilman (1994) argue that officials and teachers in participating districts believed in the efficacy of small classes and knew that positive experimental results might lead to its adoption in policy. These arguments, however, are based on logical deduction rather than empirical data. Until empirical research is done, any suggestion of Hawthorne effects is merely speculation.

Graue, *et al.* (2005) also argue that the sample in the STAR project was not typical or representative of the U.S. population in that there were few Hispanic, Native American or non-native English-speaking students. While this argument does not invalidate the study, it draws attention to the need for caution in generalizing the results to other population groups in the U.S. However, a few questions arose in connection with this crit-

icism. Would the results of the STAR project be significantly different if there were equal numbers of Hispanic and Native Americans participating in the study? What about non-native English speakers and students with learning or behaviour problems? If most of the participating students were non-native English speakers or students with learning problems, would the class size of 15-17 be sufficient for effective instruction? As Finn, *et al.* (1998) note, no research has been conducted to answer these questions. Nevertheless, they contend, in any of these cases, positive outcomes are less likely without the infusion of significant additional resources. Related to this issue is Odden's (1990) comment that class size reduction in high school for English learners makes a lot of sense because of the opportunities it would provide for this category of students to learn. One could also argue that at the early primary school levels, much more reduction of class size would be needed to instruct students who are English learners.

The randomization in project STAR has also been criticized. Random sampling is intended to provide a scientific basis for generalizing the population. Hanushek (1999) criticizes the sampling strategy used in the STAR project on four grounds: First, it is very difficult to verify the randomization procedures used in the STAR experiment. Second, even with a random assignment of teachers and students to the designed groups, entering students should have been given pre-tests to determine the differences in skills and knowledge they bring to the three class types. Third, Hanushek argues that participating schools were not randomly selected; they had to volunteer to participate, and they had to be large enough to accommodate the three class types in each grade. This research criterion automatically eliminated certain schools that were not well resourced enough to provide the three class types needed for the experiment. Fourth, Hanushek argues that the significant movements between treatment groups through the course of the experiment may have been the result of parental pressure on principals to transfer their children to smaller classes. He also contends that "if the treatment crossover – student movement from one type of class to another – were random, any estimates of the cumulative effects of class size would tend to be lessened, because the treatment and control groups are not receiving completely distinct schooling programs over time" (p. 153). This is merely a speculation, since Hanushek does not have any statistical evidence to substantiate this point of view.

Randomization is not the only issue Hanushek has found with project STAR. He is critical of the fact that a large number of students in the experiment did not take the tests in each year. He finds that four of the schools in the experiment dropped out of the experiment, but the reasons for their withdrawal are not reported. Furthermore, he argues that the results of the study depend fundamentally on the choice of teachers, and that the way teachers are assigned to different treatment groups influences the outcome of the study. Finally, he contends that since there are many uncertainties around project STAR, its findings cannot be used exclusively as a rational basis for formulating policies on class size reduction. He notes that in medical trials, more than one experiment is needed to justify the efficacy of any treatment modality.

In fact, researchers in the field are widely divided on further experiments on class size reduction. Graue, *et al.* (2005), who interviewed researchers in the field, report that some favour other types of class size experiments. David Grissmer (1999), on the other hand, is concerned with why class size reduction promotes student academic growth. He acknowledges the limitations of theories of experimentation and offers the following insight:

While more experimentation seems essential to making progress in educational research, experiments can never be depended on to solve all complex and contextual effects. Educational research will probably never follow health research where trials are needed for every new intervention before implementation (p. 239).

According to Graue, *et al.* (2005), by pursuing “why” and “how” questions in education research, we will be able to develop a theory of action: why and how do things work the way they do? Joan McRobbie, another researcher in the field who Graue, *et al.* (2005) interviewed, agrees with Grissmer. She suggests that what we need is much more synthetic and derivative understanding of the existing literature on class size reduction with the purpose of guiding policies.

WISCONSIN’S SAGE

Wisconsin’s Student Achievement Guarantee in Education (SAGE) is another major class size reduction research study conducted in the United States. The project focused on students who were regarded as disadvantaged, such as low-income and minority students, implementing class size reductions from Kindergarten through Grade 3. It was designed as a five-year pilot project that began in the 1996-97 school year. School districts that had one school with at least 50% of children living below the poverty level were eligible to apply for participation in SAGE. Within those districts, any school with 30% or more below the poverty level was allowed to become a SAGE school. Eligible school districts were allowed only one SAGE school except the Milwaukee School District, which was allowed up to 10 SAGE schools. Thirty schools in 21 districts began the program in K-1. Grade 2 was added for these schools in 1997-98 and Grade 3 in 1998-99. There were 17 comparison schools with similar student characteristics to SAGE schools. However, while SAGE schools and comparison schools had similar proportion of minority students in 1996-97, SAGE schools had a smaller proportion of African-American students and a greater proportion of Native American students in 1997-98.

According to Molnar, Smith, Zahorik, Palmer, Halbach and Ehrle (1999), the SAGE program required that participating schools implement the following four interventions: (a) reduce pupil-teacher ratio within a classroom to 15 students per teacher, (b) establish “lighted school-houses” open from early in the morning until late in the evening, (c) develop “rigorous” curricula, and (d) create a system of staff development and professional accountability. The SAGE study focused on the effects of class size reduction on student academic achievement in reading, language arts, and mathematics at Grades 1 through 3 and the effects of class size on teaching that may account for any program effects on student academic achievement (Zahorik, *et al.*, 2003). Student achievement was measured using the Comprehensive Test of Basic Skills (CTBS) at each grade level.

The SAGE project was evaluated every year by a team of researchers from the University of Wisconsin-Milwaukee. The study reported that students in the program at the three grade levels achieved significantly higher scores than students in the comparison schools in mathematics, reading and language arts (Molnar, *et al.*, 1998). It was estimated that while the SAGE effect varied by subject matter, it represented one third to one half of one school year’s growth when compared to the academic averages. It was also reported that the SAGE program helped to narrow the Black-White achievement gap in Grade 1 as much as 38% and that it prevented it from widening in Grades 2 and 3. It was also reported that SAGE teachers individualized their instruction, developed deeper and greater knowledge of their students, and offered hands-on activities to their students. SAGE included six different classroom configurations, including “regular” classes with 15 students, shared space classrooms with two teachers and 30 students, floating teachers coming into classrooms with 30 students for some subjects, split day classrooms with 15 students and two teachers, and three-teacher team classrooms with 45 students.

The SAGE project raises many questions. The evaluators of SAGE did not say anything about the possible impact of different classroom organization formats on teaching or student achievement. Further, the use of different classroom configurations raises the issue of what class size really means. Class size has been one of

the concepts in the literature that causes confusion because it is usually conflated with pupil-teacher ratio (PTR). If we go by Achilles' (2002) definition of class size, a classroom consisting of 30 students and a floating teacher that is joined by another teacher for reading, language arts and mathematics has a class size of 30, not 15. Consequently, SAGE class size was not 15 but ranged from 15 to 45. European researchers have challenged Achilles' definition of class size by introducing the concept of Pupil-Adult Ratio (PAR) (Annevelink, 2004). PAR includes all adults who work with a student or who contribute to a student's academic well-being, such as speech therapists, reading recovery teachers, special education teachers, bilingual teachers and others.

The attention to leadership issues in the research on class size reduction is almost nonexistent. The sole exception is a study by Burch and Theoharis (2005), who interviewed nine principals of SAGE schools and found that the principals' influence proved central in three areas: the use of classroom space, serving the needs of diverse learners, and teacher capacity building. According to the authors, while some of the principals focused on solving the space problem, others maintained the status-quo with the result that a variety of classroom configurations were created in SAGE schools. Some principals maintained separate classrooms for special education students, whereas others saw it as an opportunity to integrate those students into reduced size classes and achieve an inclusive school. Finally, Burch and Theoharis report that some principals interpreted the professional development components of SAGE to be peripheral to the program, while others regarded it as crucial to its effectiveness. What are the effects of these different leadership practices on student achievement or classroom processes? Unfortunately, we have no research to answer such questions.

The three SAGE evaluations – 1996-97, 1997-98, and 1998-2000 – disclose little information about teacher characteristics. Twenty-eight teachers were interviewed to find out how they altered their teaching in small classes but very little was said about those teachers. Characteristics such as length of professional experience, race/ethnicity, educational attainment, and the length of time teaching a specific grade are missing in the SAGE reports. This information is crucial for generalizability, specifically with respect to sample-to-population extrapolation, analytic generalization, and case-to-case transfer (See Firestone, 1993). It is important to take teacher quality into account in making sense of the SAGE reports. Finally, the SAGE evaluation of teachers' classroom behaviours relies exclusively on data from teacher questionnaires and interviews. Independent classroom observations and student interviews might shed more light on the authenticity of changes in the classrooms that teachers have reported.

CALIFORNIA'S CLASS SIZE PROJECT

In 1996-97, the state of California provided \$971 million in incentive funding for school districts to voluntarily reduce K-3 classes to 20 students per class. By 2002-03, funding for this program had grown to \$1.7 billion, making it one of the most costly programs in the state and the biggest class size reduction program in the United States. California's Class Size Reduction (CSR) was enacted in response to a ten-year decline in achievement scores. For example, the state's National Assessment of Education Progress (NAEP) test scores for reading in 1994 were lower than most other states. California's schools had overcrowded classrooms, unqualified teachers, and poor academic performance especially for minority students and non-native English language learners (Korostoff, 1998). With a massive budget surplus, a booming economy and the news of the impressive claims of project STAR, the government of California decided to implement CSR as a state wide education reform (Graue, *et al.*, 2005). The specific objective of the class size reduction initiative was to improve early literacy but participation was voluntary and professional development compulsory (McRobbie, 1998).

Many researchers have criticized California's CSR, including the evaluation capstone report, completed in 2002. It reported that most school districts faced budget shortfalls as a result of class size reductions; many took dollars from other programs to support its implementation, especially in the areas of facility maintenance and administrative services. About one third of the state's districts also reduced resources for teacher professional development, and computer and library programs (Bohrnstedt & Stecher, 2002). A question that arises is: is it worth it to sacrifice these programs for smaller classes?

Graue, *et al.* (2005) report that the CSR program led to a high demand for additional space for new classrooms. This led to the conversion of special education rooms, libraries, auditoriums, and childcare spaces into classrooms, with the hardest hit schools being those serving children living in poverty and non-native English language learners. Further, the rapid speed with which the CSR was implemented made it necessary for a 38% increase in the teaching force (Stecher & Bohrnstedt, 2000; Graue, *et al.*, 2005). School districts competed among themselves and with other sectors of the booming economy for teachers. It was reported that some qualified teachers in schools serving children living in poverty transferred to more affluent schools, leaving these schools without teachers (Jepsen & Rivkin, 2002). The high demand for teachers also affected teacher training; at least one program had to modify its requirement for supervised clinical field work. Student teachers who had not completed their formal practicum field experience were allowed to accept full-time teaching positions and use such teaching experience as a substitute for their official field experience (Turley & Nakai, 1998).

Perhaps the most devastating consequence is that most of the unqualified teachers hired on an emergency basis ended up teaching in schools that serve racial minorities and non-native English language learners. Schools serving students living in poverty and minority students saw a more than 16% drop in the number of qualified teachers (Jepsen & Rivkin, 2002). Because so many of the teachers were inexperienced and lacked credentials, there was a great need for in-service professional development. McRobbie, Finn and Harman (1998) report that no districts had spending estimates available, suggesting that neither new nor old teachers were given significant professional development opportunities. Graue, *et al.* (2005) and Bohrnstedt and Stecher (2002) assert that the failure of California CSR can be traced to its failure to combine it with professional development for teachers.

Despite these problems, some researchers contend that California CSR had some positive effects. Graue, *et al.*, (2005) report that minimal gains were made in the form of increased test scores after the second and third year, more time for teaching, less time spent on discipline and more parent-teacher interactions (see also Halloway, 2002). For example, third graders enrolled in reduced size classes performed better on Standard Achievement Test (SAT-9) than did students in regular classes, and this gain persisted after the students moved to larger fourth grade classes. The gains in achievement were uniform for all students, regardless of socio-economic background, fluency in English, or ethnicity/race (Stecher, *et al.*, 2001). The evaluators of California CSR acknowledge the increase in test scores but did not link it to the CSR, contending that factors other than small size classes were responsible for increases in academic attainment (Bohrnstedt & Stecher, 2002).

Parents of children attending smaller classes rated all aspects of educational quality higher than did parents of children enrolled in non-reduced classes. Parents of children enrolled in reduced size classes also reported having more contact with teachers and expressed higher satisfaction with schools. Teachers expressed enthusiasm and satisfaction with teaching 20 students rather than 30 (Korostoff, 1998). This enthusiasm may well be one of the important factors that make class size reduction effective in increasing student achievement (The California Education Policy Seminar & The California State University Institute for Educational Reform, 1996).

Korostoff (1998) interviewed ten teachers from four California schools. This was supplemented by classroom observations in ten first and second grade classrooms with teachers with various levels of experience. She also interviewed 200 students from those ten schools. First year interviews showed that teachers did not change their teaching practices and indicated that they were not aware that any particular teaching practices were more suitable for smaller classes. In the second year, observations showed that teachers interacted more frequently with students individually. Teachers were also able to cover the curriculum contents more rapidly, meet all groups of students all day, and provide them opportunities to connect individually. Yet Stecher and Bohrnstedt (2001) found that instructional practices in Grade 3 were consistent across classrooms, regardless of class size and that teachers did not individualize or spend a reasonable amount of time working with individual students.

BRITISH CLASS SIZE REDUCTION STUDY

In the 1990s, the British government argued that student academic achievement hinged on teacher quality rather than class size (Bennett, 1996; Graue, *et al.*, 2005). This led to an intense debate in Britain about the effects of class size on student academic attainment. Though there are other research studies in Britain on class size (Bennett, 1996, Hall & Nuttall, 1999), this section of the literature review focuses mostly on research conducted by the Institute of Education, University of London, between 2000 and 2003, under the leadership of Peter Blatchford. The research had two principal objectives: investigating the effects of class size on pupil attainment for students ages 4 to 7 (Junior Kindergarten, Senior Kindergarten, Grade 1, and Grade 2) and understanding the relationship between class size and classroom processes and their effects on pupil achievement (Blatchford, *et al.*, 2003).

The researchers followed a cohort of pupils who entered Reception classes (4-5 year olds) in English schools starting in 1996-97 for three years. A second cohort of 4,244 pupils was followed for the same number of years one year later; that is, through Reception (4-5 year olds), Year 1 (5-6 year olds) and Year 2 (6-7 year olds). Schools were selected at random and reflected the diversity in the general population such as social background, ethnicity/race, and geographical location of schools in terms of urban, suburban, and rural areas. A variety of information was collected, including child, school and teacher characteristics, academic attainment (measured using Avon Reception Entry Assessment), class grouping practices, teacher estimates of time allowed for teaching, systematic observation of classrooms, and teacher experiences of class size; case studies of selected small and large classes, and Pupil Behaviour Ratings (PBR). The following discoveries were uncovered:

1. It was found that, for grouping purposes, the larger the class size the greater the number of groupings and the size of each group. Qualitative data indicate that large groups render instruction less effective and that large classes are detrimental to effective learning.
2. The relationship between class size and teaching can be conceptualized in the following ways: in smaller classes there is more teacher time with pupils and there is more individualization of instruction, more pupil interactions, and easier classroom management and control. This is consistent with findings from other studies.
3. Much depends on the teacher's interest in and ability to take full advantage of opportunities small class sizes provide. Again, this accords with other class size research.

4. Pupil Behaviour Ratings (PBR) shows that in small classes students do not necessarily receive more attention from teachers; rather, students are active initiators of contact with the teacher.
5. It was also found that children in small classes concentrate on tasks more than those in large classes.
6. It is reported that as class size was reduced from 30 to 20, pupil attainment in literacy increased by almost 0.35 standard deviations for low achievers, 0.2 standard deviations for middle achievers, and 0.15 standard deviations for high achievers. In mathematics, a reduction in class size from 30 to 20 pupils resulted in an increase in attainment of almost 0.25. Again, this finding is consistent with findings in the other class size reduction research.
7. Pupils who remained in small classes in Year 1 were able to maintain their literacy achievement in Year 2. With regard to mathematics, however, it was found that pupils in large classes made more progress during Year 1 than those in small classes but the achievement gains in literacy that were maintained in Year 1 were lost during Year 2. Year 1 and Year 2 literacy and mathematics achievement was not associated with class size. No optimum class size was found; it appeared that teachers' preference for a specific class size is based on their own experience. This contradicts project STAR and SAGE research in which the optimum class size was established at 13-17 and 15, respectively. It also challenges Bennett's (1996) research in the U.K. in which teachers and parents unanimously agreed that optimal class size should be 22.
8. The research indicates that there is no evidence that additional staff in classrooms, particularly teacher assistants, contribute to student academic achievement. This finding tallies with that of Finn, *et al.* (2000), who used project STAR data to show that teacher aides are non-contributors to student academic growth from an educational perspective.

The British CSR project included some attention to teacher quality, which other researchers have found to contribute to student academic growth (Hopkins, 1997; Ogawa, *et al.*, 1999; Darling-Hammond, 2000; Jepsen & Rivkin, 2002; LeFevre & Rankin, 2000). According to the researchers, there was no evidence that any teacher characteristics such as age, level of experience, educational attainment, or the length of time in the current school or teaching a particular grade had any influence on student achievement in any discipline during Years 4 to 6 (Blatchford, *et al.*, 2004).

DISCUSSION 1: IMPLICATIONS FOR PRACTICE



As we have made clear, the literature on class size reduction is wide and encompasses a variety of issues. A framework or organizer is needed to understand the implications for effective class size reduction design and implementation guidelines embedded in the literature. This section reports on the recommendations of practitioners and policy analysts for designing and implementing class size reduction initiatives, derived from the class size reduction projects discussed in the previous section. These recommendations include defining policy goals clearly, targeting particular students, implementing sequentially but intensively, emphasizing teachers' work beyond formal teaching, supporting teachers' professional development, and ensuring sustainable funding and other additional resources.

PRECISE STATEMENT OF POLICY GOALS

Designing and implementing a class size reduction initiative requires a clear specification of the objectives to be achieved. It will help to determine the kinds of professional development and support needed by teachers and principals for effective implementation of class size reduction at the school level, and it will help any effort to evaluate the effectiveness of the policy. From the literature, class size reduction initiatives are used to achieve a variety of goals:

- improving student academic growth as measured by achievement test scores;
- improving teaching and learning conditions or processes in the classroom;
- improving student engagement in learning as evidenced by classroom behaviour, attitude, and effort;
- improving students' life chances over the long run as measured by pregnancy and recidivism rates, and inculcation of certain civic and democratic values;
- enhancing the academic preparedness and achievement profiles of marginalized groups such as immigrant children, racialized minorities, and those who are educationally disadvantaged.

Some of these goals are explicitly stated in the literature, while others are implicitly derived from class size initiatives. The first two goals dominate the literature. Much of the research on class size reduction has focused exclusively on academic achievement and neglected other desirable educational goals such as students' social and emotional development (Manitoba, 2001).

DESIGN ELEMENTS

Class size reduction can be conceptualized as both treatment and prevention. Graue, *et al.* (2005) suggest that timing, intensity, and duration underlie prevention and treatment. These elements can be used to guide the design and implementation process. In the case of timing of class size reduction, the question is: when does class size reduction have the most effect? Researchers agree that it is most effective at the primary grades (K-3). The STAR study reported that the maximum effects of class size reduction are in Kindergarten and Grade 1 (Folger, 1998). For intensity the question is: how small does a class have to be in order to optimize the

advantage? It seems that advantages would be obtained when class size is reduced to at least 20 students (Manitoba Teachers' Society, n.d), but much larger gain is attainable when reduction is below 20 students (Addonizio & Phelps, 2000; Biddle & Berliner, 2002; Finn, 2002). Reductions to below 20 such as 13, 15, 16 or 17 bring teaching closer to one-on-one tutoring. Finally, researchers (i.e., Grissmer, 1999; Nye, *et al.*, 1999; Biddle & Berliner, 2002, Finn, 2002) agree that the length of the intervention is linked with sustainability of benefits. Nye, *et al.* (1999) find that the lasting benefits or effects of reduced class-size are dependent on how long students had been exposed to it. But the research suggests the degree of the reduction is dependent on the goal of the policy, student characteristics, and the availability of good teachers.

TARGETING

Many (but not all) researchers and policymakers are concerned with the cost of class size reduction and argue that it should be administered judiciously, to those who need it the most. Researchers in the U.S. argue that class size reduction benefits at-risk students, minority students, students living in poverty, and students who are educationally disadvantaged the most (Finn, 2002). Krueger and Whitmore's (2002) analysis of STAR data concluded that class size reduction benefits African American students more than white students. They contend that the statistical effects of being in small classes in Grades K-3 was about 0.26 for African Americans and 0.13 for Whites; and that being assigned to small classes would result in a reduction of Black-White achievement test scores by as much as 38% in Grades K-3. The same conclusion was reached in relation to Wisconsin's SAGE program (Molnar, *et al.*, 1999). Maasoumi, *et al.* (2005) used a statistical model to arrive at the same conclusion that class size shrinkage benefits low performing students. Achilles (2000) concurs, adding that class size reduction has an equity dimension since those at risk of academic failure get more from small classes. Hanushek and Krueger (2000) - the most vociferous economists in the class size debate in the U.S. - agree that greater benefits might be available if class size reductions are targeted toward minority students and those who are educational underperformers. A targeted approach to class size reduction could take a variety of forms. Folger (1989) has suggested that targeted class size reduction may be implemented in core subjects such as math or language arts for early primary grades. Alternatively, they could be implemented specifically for low-achievers who need special assistance to improve their academic achievement. In Canada, however, targeting is not a straightforward matter. While the Manitoba Association of School Trustees (2001) and People for Education (2007) have argued against universal class size reduction, their point seems not so much that students who have not had many academic disadvantages do not deserve attention as it is that large-scale mandates reduce the flexibility of schools and school boards to manage resources effectively. A cultural reluctance to draw overt attention to distinctions among students and the belief that universal application of class size reduction is more politically acceptable may also be in play.

GRADUALISM AND INTENSITY

Achilles (2003) suggests that when class size is reduced at the Kindergarten or pre-Kindergarten level, a grade should be added every year through Grade 3. He adds that sufficient duration of class size – small class for at least three years or preferably four years – has more enduring effects. This was one of the problems that plagued the California CSR project. California rapidly implemented CSR in all schools at one time. Schools began class size reductions only a few months after the legislation was passed, and by the next year, almost all first grade and second grade classes in the state had been reduced to 20 students. By 1999-2000, almost all

K-3 classes had been reduced (Jepsen & Rivkin, 2002). Gradual implementation of class size reduction enables schools to manage implementation problems as they arise. When it starts at the Kindergarten level, schools have ample opportunity to evaluate and make adjustments before it is extended to Grade 1. Achilles (2003) also states that, for the purpose of intense treatment, students should spend all day every day in small classes and that pull-out programs should be avoided.

TEACHING STRATEGIES AND BEHAVIOUR

Class size does not influence student achievement directly: it is what teachers and students do in smaller classes that matters (Folger, 1989; Molnar, *et al.*, 1999; Zahorik, 1999; Graue, *et al.*, 2005). As Folger (1989) states, “the most important lesson may be that just changing class size without changing what is taught or how it is taught will probably have modest results, because the various factors all influence achievement.” (p.126).

In Shapson, *et al.*'s (1980) study of different class sizes (16, 23, 30 and 37) in Toronto, teachers did not change their teaching strategies in small classes, did not individualize lessons or monitor student progress closely. In that study, students in small classes did not achieve better academic outcomes in language arts, social studies or science than their counterparts in large classes, except in the concept area of mathematics. According to Zahorik, *et al.* (2003), critics argue that class size reduction does not have any impact on student achievement because it does not bring about fundamentally corresponding changes in teaching.

Class size reduction is an opportunity for teachers to reorganize classroom processes to achieve specific goals. The literature on class size reduction does not offer specific teaching strategies appropriate for small sized classes, nor does it promote any teaching procedures for teaching specific subject or subject contents in reduced size classes (see McRobbie, *et al.*, 1998). On the contrary, the literature reports broad teaching strategies and teacher behaviours that have been observed or reported by teachers in small classes. One may say that these teaching strategies are not unique, but small size classes facilitate their effective practice that ultimately leads to greater student achievement.

Blatchford, *et al.* (2001) used both qualitative and quantitative research approaches to study the connection between class size and within class grouping. One of their findings was that class size affects the size and number of groups, student learning experiences and social relationships in the classroom, which in turn appear to affect student achievement. Another finding is that small groupings and group size facilitate frequent and closer student-to-student and teacher-to-student interactions. From their findings, the researchers argue that small sized classes offer the advantage of having a small number of groups and a group size which is most effective for instruction. They state that those conditions allow teachers to individualize instruction, engage in frequent assessment of student progress, and address individual learning problems. Burke's (1986) research on the relationship between instructional practices and small classes in metropolitan Melbourne, Australia, found that teachers' questioning behaviour was better in small classes than large classes, since the small number of students in the class allowed teachers to ask more probing questions and to provide more “wait time” for students to respond. Burke also reports that teachers in small classes assigned more homework to their students and had time to mark homework assignments and their progress. He reports that teachers of small classes spent little time on classroom management and spent more time on instruction and interaction with students. Small classes also allowed the teachers to group students for the purpose of individualization of instruction and interactions.

Achilles (2003) has also suggested two other broad strategies for teaching in small classes. One has to do with developing a sense of community and close student-to-teacher relations. As Blatchford, *et al.* (2001) have stressed, close student-teacher relations allow teachers to identify students' learning needs and to develop appropriate plans for addressing them. Further, Zahorik, *et al.* (2003) found in the SAGE program that class size reduction enabled the teachers to develop greater knowledge of their students' interests, habits, perspectives, strengths, and other characteristics that are essential to instructional programming, instructional delivery modalities and assessment practices. They also found that there was increased individualization in smaller classes and that it allowed teachers to structure, manage, and pace instructional and learning activities to dovetail with individual learning needs and styles. Finally, they found that the teachers in smaller classes used a greater deal of hands-on activities. Teaching was not characterized so much by student-centered learning, but there was a marked use of math manipulatives, interest centres, cooperative groups, and project-type activities that would be more difficult to put in practice in large classes. According to the authors, the teachers were able to decide to use hands-on activities because of their confidence in their ability to control the flow of events and because the quantity of materials and resources required for such activities are fewer.

PROFESSIONAL DEVELOPMENT AND SUPPORT

As we have indicated, class size reduction should not be construed as a magic solution that can automatically and directly boost student academic performance, but rather as one ingredient for increasing student achievement. Professional development and support for teachers is needed for both new and veteran teachers to acquire the knowledge and skills needed for effective instruction in small classes. As Ehrenberg, *et al.* (2001) put it:

Overall, the weight of the evidence tilts strongly toward a conclusion that reducing class size, by itself, does not typically affect the instructional activities that occur in classrooms... The finding that teaching practices do not vary with class size is consistent with recent work on school restructuring. Observers report that teaching methods are highly resistant to changes in school structure. This does not mean teachers cannot change practice along with class size reductions, but it may take time, and may require opportunities for teachers to learn about other approaches to teaching (p. 18).

In the Edmonton project (2001), two kinds of professional development strategies were provided for teachers. In the other class size projects such as STAR and SAGE, minimal professional development was provided to the participating teachers. One of the shortcomings of the California CSR is that no professional development was provided to the teachers and the result was that most teachers did not know how to teach reduced size classes effectively (Stecher, *et al.*, 2001). Pannozzo and Finn (2001) suggest that both new and veteran teachers need professional development to help them take advantage of the opportunities class size reduction provides. They argue that while veteran teachers may have a lot of professional experience under their belts, they may profit from courses in the basic principles of individualized instruction, assessment of student progress and addressing individual student learning problems with techniques not possible in a class of 30 students. Pannozzo and Finn (2001) also suggest that principals could provide leadership in the professional support of teachers, both new and old, by observing, evaluating and providing feedback to them so that they are viewed as partners in the classroom processes.

SUSTAINABLE FUNDING

A common criticism of class size reduction is that it requires significant resources to hire additional teachers, build or rent new facilities, provide heat and electricity, and ensure adequate custodial and clerical services (McRobbie, *et al.*, 1998). In most cases of class size reduction, the state or province provides program funding; this may be supplemented by federal funding as it has been in the U.S. However, state or provincial funding may dry up as economic conditions change or as tax revenues decrease. For example, after a decade of implementing class size reduction in California, while only 9 out of the 800 school districts had elected to abandon the CSR program, budget constraints forced at least one school district to reduce the number of grades it could run at reduced size (Sack, 2005). A sustainable source of funding for class size reduction is very important for the success of the program.

The literature covers instances of school districts that have successfully implemented class size reduction without additional funding from the state or province. One case is Burke County, a poor rural district in North Carolina, which reduced class size to 17 students (Egelson & Harman, 2000). Financial flexibility allowed the district to reallocate its financial resources by using state dollars for full-time teacher assistants and state funds it received as a low-wealth county to fund regular teaching positions (McRobbie, *et al.*, 1998). This allowed it to fund its class size reduction program without any additional infusion of funds from either the state or federal government.

Odden and Archibald (2001) studied Kenosha Public School District in Wisconsin to find out how it was able to finance its class size reduction without additional funding from outside sources. Using its existing flexible financial arrangement, it financed its own class size reduction program from two major sources: it switched from half-day Kindergarten to full-day, thus allowing it to receive a per student expenditure of \$7,000, and it experienced an enormous growth in student enrolment, which also increased revenue. Because its marginal costs of class size reductions (i.e. hiring additional teachers and other operation costs) were lower than its marginal revenue, it was possible for Kenosha to sustain its class size reduction program.

Two creative scheduling strategies are discernible in the literature. One is parallel block scheduling, by which half of a class is taught subjects such as reading and math in small groups, while the other half attend specialty classes such as music, art, or computer lab. Another approach requires that all teachers in a school, including specialists, teach 15 students in core academic areas – reading, language arts, and math – for three hours. For the remaining hours, subjects are taught in regular class sizes of approximately 25 students while specialists provide services and consultation (McRobbie, *et al.*, 1998). Alternatively, small size classes could be offered for core subjects such as math, science, and language arts while other non-core subjects are taught in large classes (see Folger, 1989; Odden, 1990).

OTHER RESOURCES

Other resources are needed to implement class size reduction successfully. An adequate supply of good teachers is one of the critical resources needed for an effective class size reduction implementation. Merely reducing class size cannot compensate for poor teaching; this is why Hanushek (1999) has argued that the outcome of STAR class size reduction initiative depends significantly on the choice of teachers. Teacher quality or effectiveness, rather than class size, has been cited as the most critical factor in student achievement (Hopkins, 1998b; Ogawa, *et al.*, 1999; LeFevre & Rankin, 2000; Jepsen & Rivkin, 2002). A key question is: what criteria can best be used to determine good teachers? Proxies such as state or provincial certification, academic transcripts, participation in professional development courses, or graduate work in education are not sufficient

indicators of good teachers. Stack (2005) reports that a lack of good teachers is one of the cardinal issues that continue to plague the California class size reduction initiative.

Sufficient classroom space, textbooks, and materials are needed for effective implementation of class size reduction projects. In the case of STAR, the participating schools had no problems finding classroom space to reduce class sizes (McRobbie, *et al.*, 1998). California, however, did not factor classroom space availability into its class size initiative, with the results that some schools were using inappropriate spaces such as libraries, gyms, and cafeterias for classes (Stecher, *et al.*, 2001). Teacher access to an adequate supply of resources is equally important for effective implementation of class size reduction. In project STAR, McRobbie, *et al.* (1998) report that both small and large classes had access to materials they needed, along with the services of specialists, such as school psychologists, librarian, special education and bilingual teachers.

DISCUSSION 2: IMPLICATIONS FOR RESEARCH



Our own careful and comprehensive analysis of the literature made it possible to arrive at the above conclusions about the relative costs and benefits of class size reduction. While several thorough reviews exist, in the main, our reading seemed like the fable of the “blind men and the elephant,” where each article or report we read revealed a partial and somewhat different portrait of the content and effects of class size reduction. While this is not an unusual state of affairs in educational research on any topic, we were taken aback at the extent of the gaps between studies and the lack of consistency of the terms and measures used across studies. As suggested earlier, in our review of the large class size reduction initiatives, we also discovered that a number of claims and conclusions made by the research were questionable because, within many individual studies, so much was left unexplained or unexamined to our or other researchers' satisfaction. In this section, we first summarize some of the shortcomings of the research to date and then identify the implications for policy research more generally.

Fundamental to these problems, as we understand them, is that class size reduction is very often a kind of policy by remote control, with decision makers at a significant distance from actual classrooms and schools attempting to coordinate resources and activities in a uniform way. In their attempt to respond to what they perceive as decision makers' concerns, many policy analysts end up wielding blunt research instruments that, while they may provide simple answers, are not often able to articulate the complex realities of implementation across a wide range of different settings.

Policy researchers recognize that the influence of research on policy making is uneven because the policy making process is influenced by so many political and logistical factors, and because research is viewed more as justification for the decisions that policy makers wish to make rather than helping decision makers make wise decisions (Johnson, 1999; Louis, 2005; Weiss, 1982; Werner, 1991). Another part of the problem, as we see it, especially after analyzing the literature on class size reduction, is that the quality of research within and across studies itself may contribute to decision makers' inattention to educational policy research in other ways, and to its utility for those interested in improving educational practice. In this section, we review what we see as some important shortcomings in how the research on class size reduction has been conducted and that inhibit the development of credible and useful recommendations for improving educational practice.

Our major concerns are these: many of the studies of class size reduction we reviewed suffer from a lack of specificity that makes it difficult to evaluate the reliability of the claims made, especially with respect to minimal attention to student characteristics, teacher characteristics and actions, school capacity issues and policy contexts which are factors that have been identified as critical to educational improvement in other bodies of educational research. In some cases, a reliance on available data that was originally collected for other purposes (such as achievement test scores, annual class counts, teachers' educational credentials, etc.) results in only a partial picture of means and ends. As a body of research, the studies are inconsistent in their use of terms and in their acknowledgment of other research that has been done, leaving it up to the skill of readers to discern the relative value of the studies and what they mean in the aggregate.

NECESSARY INFORMATION

Often the research on class size reduction has been conducted at such a distance from the action that we could not tell what was actually going on in practice. Most of the research we read seemed to pay little attention to factors we knew make huge differences: other factors occurring simultaneously with class size reduction that might have supported or impeded its positive effects, the characteristics of involved teachers and the actual teaching strategies they used, how advantaged or disadvantaged involved students were, and so on.

Many studies we read ignored the effects that student characteristics might have on the apparent effects of class size reductions. There is a wealth of educational research outside of the bounds of the class size reduction topic that documents the ways that large-scale policies, school-level programs and teaching strategies systematically result in fundamentally different learning environments for different kinds of students. Some of the research identifies practices that might challenge this status quo. In light of this body of research and the importance placed on equity as an educational goal in recent years, these omissions are troubling and raise a number of specific questions. For example, what effects might the tendency to treat students differently have on students' opportunities to learn in a smaller-sized class, and how would we know? In the study of any instance of class size reduction, were students chosen to be placed in smaller classes typical of the general school population or did they reflect unusual skills or difficulties? What kind of difference might English language ability, developmental issues, gender, race or culture have on students' relative ability to not only make use of, but be well served in, smaller-sized classes? Were the systematic differences in students' opportunities to learn noted in the literature present in these schools, or were these school environments where efforts had already been made to provide more equitable learning opportunities for all children? In recent years, studies have begun showing greater sensitivity to such issues, focusing on the differential effects of class size reduction between students at different grade levels (Finn, *et al.*, 2001; Gilstrap, 2002; Guillemette, 2005) and between students in traditionally high achieving and underachieving groups (Blatchford, *et al.*, 2002; Egelson & Harmon, 2000; Hall & Nuttall, 1999; Krueger & Whitman, 2002; Molnar & Zahorian, 1999; Reichardt, 2001) but many studies have ignored student issues, as if students (and the ways they are treated in schools) are pretty much all the same. Even in the studies where learning outcomes were compared between groups of students, there was no information on the reciprocal influences of student diversity and learning opportunities in small classes.

Most studies we read similarly ignored how "who teachers are" and what they do might influence the effects of class size reduction. The all-too-vivid illustration of the difference made by teachers' skill and comfort level when California reduced primary class size is a reminder that when school districts scramble to find sufficient numbers of teachers and end up resorting to non-certified teachers, teachers are not all the same; a teacher who does not know what to do in a smaller class provides no better, and often a worse, teaching environment for children. Some research simply comments that "teacher quality matters," without identifying how teaching quality can be achieved, implying that it is dependent on how well they are trained before they reach the school (LeFevre & Rankin, 2000). Teachers who teach a small class the same way they teach a larger class are not necessarily providing a better learning environment and only a handful of the studies we read reported that teachers had opportunities to learn new teaching strategies through targeted professional development with only a handful of studies reported on what it was teachers were actually doing in class (see Burke, 1986; Finn, 2002; Korostoff, 1998; Shapson, *et al.*, 1980; Steeher, *et al.*, 1002; Stearik, 1999). Only a handful of studies noted that it takes time for teachers to develop observably different pedagogical strategies and must be observed over a longer rather than a shorter time period (Edmonton/University of Alberta, 2001; Egelson & Harmon, 2000; Korotsoff, 1998; Kreuger & Whitman, 2002). Studies that take place very soon after

implementation of class size reductions will not necessarily capture any potential differences in what teachers do and how students benefit.

There was no information in any of the studies we reviewed about characteristics of schools in which class size reductions took place. The adequacy of classroom space, teaching resources, program coherence, leadership practices, curriculum priorities, parental involvement, and teachers' ability and willingness to work on improving their teaching are some of the major factors that school improvement research has indicated are significant in promoting or impeding the quality of teaching and learning, yet no study of class size reduction either reported deliberately selecting schools that varied in terms of these factors or paid attention to their presence, absence or effects. For example, Imazeki (n.d) argues that in the California CSR schools serving students living in poverty received less CSR revenue under the financing scheme, because they started out with larger class sizes and must as a result pay slightly higher salaries. That is, schools were given a uniform per-student grant regardless of their characteristics or location. As Imazeki (n.d) notes "a policy that gives a per-pupil grant for each student in a small class without accounting for salary levels or starting class sizes, may buy more for some districts than others" (p.23). In addition, there was little mention even about the model of class size reduction being used and whether it varied or was consistent across schools, how it interacted with any other programming issues and what, if any, consequences it might have for other programs such as special education (see Milesi & Gamoran, 2006; Wiley, *et al.*, 2001).

There was little attention paid to the policy context in which class size reduction was implemented and how that might vary in important ways across districts, states or provinces or national jurisdictions. No educational initiative operates in a vacuum; other governmental priorities, funding adequacy, and different cultural expectations for what teachers should be expected to do, just to name a few obvious examples, all influence how an initiative such as class size reduction unfolds.

ADEQUACY OF INFORMATION

Large scale research is costly, and as a result large scale studies have tended to work when possible with existing data sets – data whose original purpose may have been somewhat different than the uses to which researchers now wish to put it. One example of how this occurs in the class size reduction literature is a reliance on information on average class sizes across a school or even school district rather than actual class sizes (but see Guillemette, 2005). Looking at averages, unfortunately, tells us little about the possible real differences across classes (two schools, for example, could have the same average class size but one could have much more constant numbers across classes than the other). Knowing averages tells us little about the actual consequences for learning opportunities across classes. Reports of average class size are not adequate to present an accurate portrait of what the phenomenon actually looks like on the ground in school districts, schools and classrooms (see OECTA, 1999).

Another example of imperfect fit in the literature is a confusion between class size (the number of students in a class), pupil-teacher ratios (the number of students for whom a teacher is regularly responsible, calculated as the number of students divided by the number of educators in a school district), and pupil-adult ratios (which could include all adults in a school, including resource specialists, administrators, parent volunteers, teaching assistants, librarians, janitors, and so on). However important these other adult roles are in supporting student learning, these are not measures of the same phenomenon. When these terms are used as if they are relatively interchangeable, it is less clear what is being measured, and it becomes understandable why different results are reported across different studies of class size reduction. Furthermore, if researchers

have not paid attention to what actual roles classroom aides play and how actively they contribute to student learning, it is hard to interpret findings that aides have “no positive impact” on student learning.

Working with data that has been collected for other purposes and working on a large scale have the unfortunate tendency to leave lots to the imagination. If we know a class size is x and student achievement scores on average are y , it is easy to fall into the trap of assuming a causal relationship between the two for which there is little empirical evidence.

MAKING LINKS

As earlier sections of this report suggest, the field of research on class size reduction is contentious, with a number of ongoing debates and a range of research strategies. Some of the difficulties we encountered in making sense of the aggregate were compounded by many researchers' apparent disregard for research that had been done before. That is, many articles and reports did little to articulate a sound knowledge of the research base and identify the relationship between the study at hand and other studies. Did the new study extend what had gone before, or challenge it, or take existing ideas and apply them to new instances of practice? When research outcomes contradicted those of other studies, how might the differences be explained? Were researchers across studies using the same terms in the same ways? Were studies that compared instances of class size reduction across jurisdictions really comparing similar activities? What might readers interested in implementing class size reduction in another jurisdiction need to consider about the particular features of any case described in a study?

When researchers are careful to make these connections, it is easier to develop a coherent set of understandings about the phenomenon in question. When this does not occur, it is much more difficult to develop knowledge as a field. Class size reduction is an example of a field that has not paid much attention to these factors, and it is perhaps no surprise that the evidence is so little known.

RECOMMENDATIONS FOR POLICY RESEARCH

To the extent that policy research is really intended to contribute to solving problems over more than the short term, it behooves researchers to take some care in how research is conducted and communicated. Our literature review has resulted in our understanding of the usefulness of several broad strategies. We would therefore recommend that:

1. Research syntheses like this one that are exhaustive and critically examine the value of the evidence be a more common production of research effort.
2. Researchers more frequently read beyond the boundaries of the topic at hand to understand how various dynamics might play out in complex institutional undertakings such as schools and school systems.
3. Researchers take care when comparing policy outcomes across jurisdictions in order to understand the common and unusual factors that may be in play.
4. Researchers take some care in how they make use of any empirical evidence, identifying its limitations and strengths in supporting any claims.
5. Researchers take the trouble to situate their work in relation to work being done or having been done by other researchers, in order to build more robust understandings of the phenomena being studied.

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