

The Three Generations of Research on Class Size Effects

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Chapter to appear in: The American Psychological Association (APA)

Educational Psychology Handbook

Editors-in-Chief Karen R. Harris, Steven Graham and Timothy Urdan

Expected publication date Fall 2011

Key terms: class size, pupil-teacher ratios, teacher-pupil interaction, classroom processes, academic achievement, research design

Abstract

Despite the common sense view that small classes are likely to lead to a better quality of teaching and learning, research evidence is not always clear, and has proved contentious. This chapter will argue that research has concentrated on two ‘generations’ of research: first, effects on pupil academic outcomes, and, second, a more recent interest in effects on classroom processes. It will then argue for a third generation of research which tests effective teaching and pedagogies in small classes. Throughout the chapter there is attention to methodological issues and suggested areas for further research. A final section will critically review theories of class size effects, covering ecological and social psychological approaches, and address implications for policy and practice.

The Three Generations of Research on Class Size Effects

Of all the educational topics covered in this Handbook, none has probably had so much public and media attention as class size. This attention is truly international and in many countries over the world there has been a highly contested debate over the educational consequences of class size differences. Opinions vary from those who argue that class size reduction (CSR) does not lead to significant educational benefits and is not cost effective (Hanushek, 1999, Slavin, 1989) to those who argue that it should be a cornerstone of education (Achilles, 2000). There is a good deal at stake for politicians and policy makers because teachers usually represent the main element of education funding and even small reductions in class size can be extremely expensive.

Across the world the debate over class size is intensely political. There are influential groups in favor of small classes like teacher unions and organised parent groups, and there are powerful groups resistant to change, including politicians and policy makers. A measure of the topic's importance can be seen in the case of California where the popularity of the governor doubled within a two or three week period after he announced class size reduction for the state. Following this, over 20 other governors announced their own class size reduction policies! (Graue & Rauscher, 2009). In the USA the debate is often partisan with Democrats generally favoring class size reduction and Republicans remaining hostile (Biddle & Berliner, 2002). In many countries, policy has changed in favor of small classes. This is evident in the U.S.A, Britain, Holland, Canada and in East Asia (Mainland China, Hong Kong, Singapore, Korea and Japan). The controversy about class size has been very noticeable in Hong Kong where in the context of a sharp decline in birth rates class size reduction became a central point of difference between rival political figures in political campaigning. As a result of mounting political pressure the Government implemented CSR in primary schools starting from 2009/10.

Role of research (L3)

Alongside this heated debate there has been a good deal of research and this has focussed on effects of class size on educational attainment, followed more recently by research on relationships between class size and classroom processes like teaching and pupil attentiveness in class. An interesting feature of main research programs on class size is the way they have been sponsored by political forces, at Government, state or local authority levels. This is true of the STAR, SAGE, California, and CSPAR research projects described below. Perhaps the most vivid recent example of this is in Hong Kong where the Government commissioned a large scale study of CSR in order to inform (some argue delay) policy decisions. This interplay between professional view, policy and research evidence continues to underpin research on class size.

Politicians, policy makers, teacher unions and the media commonly look to research findings on class size effect for answers. Perhaps the most interesting feature of the class size debate is the often wide gap between professional experience – which is usually that smaller classes will tend to result in more effective teaching and pupil learning – and research evidence which has been far less sure about the effects of class size differences. One reason for this is that a number of methodological limitations adversely affect a coherent overall picture emerging.

This chapter (L3)

This chapter has several aims. First it will seek, on the basis of a review of evidence, to arrive at judgments about what is known about class size effects. It will provide a commentary on the key points to arise, the key tasks that remain unaddressed, and identify problematic areas where more research and theory is required. Second, because of the importance of high quality, reliable and valid research evidence, this chapter will also be concerned with commenting on research approaches and methods adopted. Class size research touches on important issues connected to causality and methodological issues connected to the identification, measurement and analysis of mediating, explanatory processes. Third, the study of class size effects is also an illuminating one for

educational psychology because it raises questions about effective pedagogies, theory relevant to classroom contexts and processes, and an evidence base needed to inform educational policy and practice. Generally there has not really been a distinct psychological perspective used to structure and test views on class size but psychological perspectives have been used to interpret findings. Later in this chapter the role of psychological theory will be explored.

I will argue that there have been some areas where there have been notable successes – the STAR research project, for example - but in my view some research directions and debates have become sterile and attention needs to move to more profitable areas. This chapter inevitably reflects the author's own perspective but is informed by extensive research experience on the class size topic in the UK over many years.

I will organize this chapter under three headings which broadly speaking follow the chronology of research conducted. Each heading represents a different stage or 'generation' of research on class size. The first generation examined effects of class size differences and class size reduction (CSR) on pupil academic outcomes. The second generation then progressed to researching relations between class size and classroom processes, e.g., teaching and pupil engagement. I then identify what I see as a pressing need for a third generation of research that tests the efficacy of different forms of pedagogical approach in different sized classes. This is not meant to imply a strict chronological progression. It is also not implied that there is no need to revisit previous generations of research – indeed there is much that is still not known about effects on classroom processes – but there is a strong case for now concentrating on the third generation of research, not the least to aid policy makers and practitioners in terms of what to do when faced with fewer pupils in a class.

The chapter deliberately adopts an international perspective because it allows an examination of the generalizability of findings and encourages recognition that relationships involving class size need to be set in a cultural and political context. In developing countries the notion of what constitutes a large class can be quite different, with 60 – 100 in a class compared to

far smaller classes in Western countries. The situation in East Asia is particularly interesting with huge potential for policy relevant research. This chapter will draw on the author's experience gained as Visiting Professor to the Centre for Development and Research in Small Class Teaching at the Hong Kong Institute of Education.

The chapter will end with a section on theory relating to class size effects. Research on class size has tended to be practically rather than theoretically driven and, as Anderson (2000) has argued, more conceptual work on class size effects is needed. It is therefore intended to review relevant theories as applied to class size effects, again because they can help inform policy makers and practitioners, but also help direct future research on class size effects.

Given word limits this chapter is inevitably selective and will concentrate more on the pedagogical and educational implications of class size effects. It will also concentrate on school based research at primary and secondary, and will have little to say about further and higher education.

What is class size? (L3)

In order to study the effect of class sizes it is first important that we use reliable measures of class size. Although this may appear straightforward, in practice there are a number of complications. As Graue & Rauscher (2009) have argued, the terms class size, PTRs (pupil teacher ratios) and CSR have been used interchangeably. Class size might seem to be the most obvious and easily available measure, but the number of children actually in the class at any time may be different to the number according to the class register; children may be away, for example, and the extent of absences may vary from school to school. Moreover, over the course of the school year the number of children may change. The registered figure is probably more related to curriculum planning and resourcing while the class size at any given moment is likely to be more a factor in teacher pupil interaction. Class size figures do not take into account the contribution of non-teaching staff, e.g., teacher aides/assistants, who have been growing in numbers in recent years.

PTRs are usually calculated by dividing the full-time equivalent pupils on a school's roll by the full-time equivalent number of qualified teachers. PTRs are different from class size because they take no account, for example, of non-contact time. It should not be assumed that teachers entered into the calculation are teaching for all the time and the pupil element in the PTR is a smaller figure than in the class size figures. PTRs are important for administrative purposes because they are closely related to funds spent per child. It might appear more realistic to calculate an adult child ratio (where adults would include teaching and non-teaching staff) but this would assume that non-teaching staff were equivalent to teaching staff - an assumption that many would challenge. Although class size figures are probably more helpful as a guide to what pupils experience in schools, figures on PTRs are commonly given, and for some purposes class sizes are not available. International comparisons are often only available in terms of PTRs.

These characteristics of class size and PTR measures are not trivial. Generally speaking, it is preferable for a measure of class size to be closely tied to a child's experience if it is to be precise enough to be examined in relation to educational progress. From a social psychological point of view the class size experienced by a student on a moment by moment basis is the unit most likely to be connected to pupil learning and teaching.

The effect of class size on educational outcomes (L1)

The first and most common type of research has addressed effects of class size on pupil academic outcomes. For the most part interest has been on whether smaller classes lead to better educational achievement. There have been a number of key research projects (e.g., STAR, SAGE, and CSPAR) and research reviews and this section will cover key findings and conclusions from them. The early research on connections between class size and pupil outcomes was reviewed in the USA by Cooper (1989); Glass and Smith (1978); Glass, Cahen, Smith, and Filby (1982); Slavin (1989); Robinson (1990); and Robinson and Wittebols (1986). Early reviews of British research included Burstall (1979) and Dewhurst (1993). There have been a number of more recent

comprehensive reviews of the class size literature: Anderson (2000); Biddle and Berliner (2002); Blatchford & Mortimore (1994); Blatchford, Goldstein, & Mortimore (1998); Day, Tolley, Hadfield, Parkin, and Watling (1996); Ehrenberg, Brewer, Gamoran, and Willms (2001); Finn, Pannozzo, and Achilles (2003); Galton (1998); Grissmer (1999); Hattie (2005) and Wilson (2006). Reviews and commentaries vary in their conclusions with some very positive about class size effects (e.g., Achilles, 1999; Biddle & Berliner, 2002; Finn et al, 2003), some relatively lukewarm (eg Ehrenberg et al, 2001), and some openly negative (eg Hanushek, 1999; Slavin, 1989).

Reviews have drawn attention to methodological limitations of much research. (Blatchford, Goldstein, & Mortimore, 1998; Ehrenberg et al., 2001; Finn et al., 2003). Much early research was based on practitioner views and, valuable as these can be, they cannot be considered to be sufficient for reliable judgments about associations or effects. This is seen clearly in the disparity found by Shapson, Wright, Eason and Fitzgerald (1980) between observation measures of teacher behaviour and teachers' own views of how they felt their behaviour changed in smaller classes. It is therefore very important, as Finn et al. (2003) conclude, to carefully address the quality of research methods when making judgments about research evidence.

In this section research is reviewed in terms of four successive approaches that have been used: correlational, meta analysis, experimental and longitudinal, regression approaches.

i. Correlational/cross sectional designs (L2)

The key feature of this research approach is to examine associations between class size on the one hand and some measure of pupil academic performance on the other.

This is the kind of approach adopted by early large-scale correlational studies in the UK (Davie, Butler & Goldstein, 1972; Little, Mabey & Russell, 1973; Morris, 1959; Wiseman, 1967). These studies were usually well designed and carried out, with large numbers of pupils, but counter intuitively tended to find that pupils in larger classes did better than pupils in smaller classes.

Attempts were made to control for other variables that might explain this result, such as parental occupation and school size, but the advantage of pupils in larger classes was still there. A later study by Massey (1997) found in an analysis of 9000 candidates for national exams at 16 years a positive correlation between class size and achievement.

The general problem with correlational research, which looks at naturally occurring associations between size of class or PTRs and pupils' performance, is that we often do not know whether the results can be explained by another factor. To list but three: the results could be explained by the poor attainers tending to be in smaller classes, teachers being forced to change their style of teaching in larger classes, or experienced (and possibly better) teachers tending to be given the larger classes.

Correlational research has also tended to characterize studies from an economist perspective. There have been a number of recent studies (e.g., Corak & Lauzon, 2009; Sims, 2009). It is not intended to review these studies in detail, though it is noted that they do not tend to engage in a substantive way with pupil learning, pedagogy or classroom processes, have questionable design features (Biddle & Berliner, 2002), and many use a measure of pupil teacher ratio (PTR) rather than class size.

Another way of approaching associations between class size and pupil performance is to compare the educational performances of countries with different class sizes. In recent international comparisons (Dept. for Children, Schools and Families, 2010) countries with the largest class sizes - Japan and South Korea - have the highest levels of performance while countries with the smallest class sizes - e.g., Italy - have the lowest levels of educational performance. Woessmann and West (2006) used data from the Third International Mathematics and Science Study (TIMSS) and found inconsistent effects across different countries, further complicated by different levels of teacher education in different countries (smaller class size effects where teacher education is higher). Though intriguing, global international comparisons of this sort are fraught with many

methodological caveats and the often counter intuitive results might be attributable to a host of other cultural, educational and economic differences.

ii. Meta analyses and other reviews (L2)

One of the main efforts to arrive at coherent evidence on the effects of class size on pupil outcomes has been through reviews of the extant literature. There have several different types of reviews: general narrative (e.g., Biddle & Berliner, 2002), meta-analyses, (Glass & Smith 1978; Glass et al., 1982), and best evidence (e.g., Slavin, 1989). Glass et al.'s meta-analysis was influential at the time. It involved taking the results from 77 studies and calculating overall effects using a common metric for each study. Results showed that effects on attainment increased as class size decreased, with the largest effects for classes smaller than 20. However, results are difficult to interpret because conclusions will inevitably depend on the quality of the studies included, and some of these are suspect (Slavin, 1989). Other meta-analyses were conducted by economists. Hanushek (1989) argued that his results show that class size is not important, but other economists argue that his work seriously underestimates effects (e.g., Krueger, 2000). Another review by the Educational Research Service (Robinson, 1990; Robinson & Wittebols, 1986) was critical of Glass et al.'s findings, and more cautious about the benefits of small classes. They argue that within the range of 25-34 pupils, class size makes very little difference in most subjects above the primary stage. As mentioned above, other reviews arrive at different conclusions about the magnitude of the class size effect on academic outcomes.

Another way of approaching effects of CSR is to compare them with other initiatives in terms of their effects on pupils' attainments. A number of authors conclude that class reductions are less effective than other and less costly alternative reforms (Hattie, 2005; Robinson, 1990; Slavin, 1989). A recent paper has calculated that CSR is far less cost effective than rapid formative assessment (Yeh, 2009). However, one needs to be careful with this kind of comparison – it is not a fair test in the sense that initiatives such as one-to-one tutoring, peer tutoring and computer-assisted

learning represent a distinctive *method* of teaching while CSR merely set limits on the numbers of participants involved. We would then need to consider what teaching and instruction would be appropriate in classes of different sizes. We return to this point later in the chapter.

iii. Experimental Studies (L2)

The difficulty with simple correlational research, as we have seen, is that it is difficult to overcome the problem that it could be something about the kinds of pupils (or teachers) in small or large classes which might explain any differences found. Another way of expressing this point is to say that the allocation of pupils and teachers to classes of different sizes may be non-random, and may be biased.

STAR (L3)

This is why the designers of the STAR research, in Tennessee, decided to employ an experimental design involving the random allocation of pupils and teachers to three types of classes in the same school: 'small' classes (13-17), 'regular' classes (22-25), and 'regular' with full-time teacher aide. Any later differences between groups, according to the logic of experimental designs, could not then be attributable to pre-existing differences between teachers or pupils.

The STAR project involved over 7000 pupils in 79 schools and students were followed from kindergarten (aged 5) to third grade (aged 8). In both reading and math pupils in small classes performed significantly better than pupils in regular classes. In fourth grade the pupils returned to regular classes and the experiment ended, but gains were still evident after a further three years, that is, grades 4 - 6 (Nye, Achilles, Zaharias, Fulton & Wallenhorst, 1993; Word, Johnston, Bain, Fulton, Boyd-Zaharias et al., 1990), and then at later points still (Konstantopoulos & Chung, 2009).

The STAR project was a bold and timely study and results have provided the basis for a number of educational initiatives and policies in the USA and other countries. Specific criticisms have focused on relatively small effect sizes and cost effectiveness (eg Slavin, 1989), alternative explanations in terms of the distribution of student abilities in large and small classes (Mitchell, Beach & Badarak,

1991; Prais, 1996), student attrition from the study, and the lack of baseline data at the start of the intervention (Goldstein & Blatchford, 1997). More general concerns include the generalizability of results beyond the narrow range of class sizes studied and the large sized schools involved, and the possible effect of the allocation to experimental conditions on the validity of conclusions (Goldstein & Blatchford, 1997). Class size effects will not occur in isolation but will be part of a complex set of influences, yet experimental studies are in a sense predicated on a decontextualized view of these influences. Nevertheless, reanalyses of the STAR data using more sophisticated multi-level modelling techniques tend to support the main findings (Goldstein & Blatchford, 1998).

There have also been several other research projects that, although they fall short of the STAR project in terms of the strength of the research design, still involved quasi experimental design and evaluations of interventions. They are briefly summarized here (for other reviews see Biddle & Berliner, 2002; Ehrenberg et al., 2001).

Prime Time (L3)

The state of Indiana initiated Project Prime Time between 1984 and 1986. This was a state wide policy to reduce classes in elementary grades 1-3 to an average of 18 per class. It used a combination of pre and post test achievement tests and evaluation of learning outcomes in mathematics and reading (McGivern, Gilman & Tillitski, 1989). Results were in favor of small classes but the study was criticized for the way classes were allocated to experimental and control conditions and the possible influence of other changes in policy.

SAGE (L3)

The Wisconsin Student Achievement Guarantee in Education (SAGE) program began in Wisconsin in 1996/7 for K-3 pupils and involved four parallel interventions that targeted more disadvantaged schools and included reducing pupil teacher ratios to 15 students. The SAGE evaluation used matched comparison classrooms from the same districts where there were no reductions in PTRs. Results suggested that SAGE students significantly improved as a result of

being in smaller classes, the gains for African-American students being greater than for white students (Molnar, Smith, Zahorik, Palmer, Halbach, & Ehrle, 1999). One of the limitations of this study was that it involved changes to PTRs, not class size as such, and also that the effect of PTR reductions was not separated from other interventions in the program.

California (L3)

This began in 1996 and involved a massive state-wide implementation of CSR in grades K-3 at cost of well over 1.5 billion dollars and involving 1.8 million students. The overall aim was to reduce class sizes from 30 to 20 or less. Results showed a disappointingly small advantage in achievement for students in smaller classes (Bohrnstedt & Stecher, 1999; Funkhouser, 2009) but it is commonly recognised that it is very difficult to interpret results because the research design was limited, e.g., the intervention depended on the hiring of many unaccredited and inexperienced teachers and the use of portable classrooms and non-classroom space (Bohrnstedt and Stecher, 1999).

Hong Kong Study (L3)

The final and most recent study to be reviewed in this section is a study commissioned by the Hong Kong Government, originally to address a policy debate about the value of CSR (Galton & Pell, 2010). This adopted a complex research design within which experimental CSR classes were compared with control classes in the same schools. Along with CSR the teachers in the experimental schools also took part in extensive and varied professional development (PD) and so it is not possible to distinguish effects of CSR and PD. Even so, differences between experimental and control classes on academic outcomes were not marked. Galton & Pell (2010) offer a number of explanations for these findings, including the tendency of teachers to rely on textbooks and not change their teaching in small classes (see below for more on the issue of change of teaching in small classes).

iv. Longitudinal Correlational Studies (L2)

There may be an obvious attraction to the adage 'to understand something, change it', but an alternative approach is to seek to capture the real and complex world of education rather than control one feature of it. It may, in other words, be more valid to seek better understanding by measuring and examining relationships between factors, including class size, as they occur in the real world, and to make adjustments for relevant factors such as baseline attainment. In this connection Slavin (1990) compared the effect sizes of randomised experiments with seven correlational studies which matched classes or schools in terms of student characteristics, and found that the effect sizes (about .2 -.3 standard deviations) were similar for both. This suggests that correlational approaches were effective in adjusting for intake differences and supports the view that they may be as informative as experimental studies.

CSPAR (L3)

A large scale study in the UK (the Class Size and Pupil Adult Ratio (CSPAR) project) used a longitudinal naturalistic design and studied the effect of class size on pupils' academic attainment and also classroom processes such as teaching, pupil attention and pupil relations (Blatchford, 2003a, Blatchford, Bassett, Goldstein, & Martin, 2003). It tracked over 10,000 pupils in over 300 schools from school entry (at 4/5 years) to the end of the primary school stage (11 years). It employed a non-experimental multi-method longitudinal design, measuring the effects of natural variations in class size with multi-level regression statistical analyses in order to determine effects of class size controlling for other factors, such as pupil prior attainment.

There was a clear effect of class size on children's academic attainment over the first year of school (4/5 years), in both literacy and mathematics, even after adjusting for other possible confounding factors. The effect sizes were comparable to that reported by the STAR project. Results for literacy in the first year of school are shown in Fig 1. This indicates the advantage of using a naturalistic design like this in that effects of class size can be examined across the actual distribution of class sizes rather than fixing comparisons on pre-selected class size sizes.

Insert Figure 1 about here

Fig 1 shows that the relationship between class size and reception year progress in literacy varied for pupils of differing baseline attainment (bottom 25%, middle 50% and top 25%). There was a significant increase in attainment for all three groups, though the effect was larger for pupils with lower baseline attainment. A reduction in class size from 30 to 20 pupils resulted in an increase in attainment of 0.35 standard deviations for the low attainers, 0.2 standard deviations for the middle attainers, and 0.15 standard deviations for the high attainers. Small classes below 25 therefore worked best in literacy for children who were most in need academically.

Effects were still evident on literacy progress at the end of the second year of school (Year 1), though by the end of the third year the effects were not clear. There were no clear longer-term effects of class size differences on mathematics achievement. Though this indicates that the early benefits 'wash out' after two years in school, there were no restrictions in terms of which size of class they moved to from year to year. In other results it was also found that moving to a class of a different size, especially a larger class, had a negative 'disruption' effect on students' academic progress.

Although sophisticated, the CSPAR was still essentially correlational in design and so one cannot be exactly sure about causal effect or direction. However, key potentially confounding

variables were controlled for and one can be fairly confident that results reveal an *independent* effect of class size over and above other variables.

Some issues connected to class size effects on attainment (L2)

As a way of summarising effects of class size on student academic outcomes, several general conclusions are identified in this section.

Who benefits most? (L3)

One of the clearest findings, cited by many studies and reviews, is that the effects of class size on academic outcomes are clearest with the youngest students. This offers support for policies involving CSR in the first years of school. There is little or no evidence that class size reductions benefit students later in their school careers. This is why Achilles concludes that reduced class sizes in the first years of schooling can *prevent* problems developing in pupils but they are not sufficient to *'remediate'* problems later (Achilles, personal communication).

Many studies (e.g., STAR, SAGE) also conclude that CSR benefits minority and disadvantaged pupils the most (e.g., Krueger & Whitmore, 2001). However, results from other studies call into question this conclusion. Wilson (2006) points out contradictions in reports using the STAR data; e.g., later reports by Konstantopoulos (2008) show that it was higher ability students who benefited most from small classes and small classes did not reduce the achievement gap. The CSPAR results showed that small classes had most beneficial effects in the early years for those further behind academically, which might help explain the effect of minority pupils in other studies.

Benefits for how long? (L3)

There is debate about the long term benefits of CSR, which mirrors similar debates about the long term effects of pre-school education. In the STAR project effects lasted after the four year intervention, once students had re-entered normal class sizes (i.e., after Grade 3), and there were longer term effects at grade 8 (Konstantopoulos & Chung, 2009), student graduation from high school, especially among poorer students (Finn, Gerber & Boyd-Zaharias, 2005), and drop out, grade retention,

and suspension at grade 10 (Nye, Hedges and Konstantopoulos, 2004). But some re-analyses of the STAR data suggest that the main effects were actually in the first year of the study and effects thereafter were minimal (Ehrenberg et al., 2001). In the CSPAR study, effects were evident in the first and second years only, and this suggests effects ‘wash out’ after two years in school, though, as described above, children in this study (in contrast with the STAR project) were not restricted in terms of which size of class they moved to from year to year.

Threshold effects? (L3)

The Glass meta-analysis showed that reductions to anything over 25 pupils per class had little effect; effects increased for class sizes below 20 and especially below 15, and most noticeably for classes below five! In a way no reduction is ever enough. Slavin argued a class size of three is not as effective as the same time in three one-to-one sessions. The consensus from American research, that effects are unlikely to be marked until classes are reduced to below 20, may have much to do with the class sizes chosen in research. The STAR project, for example, compared classes of about 17 with class sizes of about 23 – and this may be a main reason why the mid-point between the two is seen as important. This range of class sizes is not common in many countries, even in the USA, and an alternative approach, as has been seen, is to examine effects of class size across the full range of class sizes, rather than presuppose class sizes likely to be important. In the CSPAR this approach suggested that 25 or less was important for literacy but this was only for lower attaining pupils in literacy (see Fig 1). There are no social psychological reasons that have been advanced for thinking that there is a threshold below or above which class size effects change in intensity or character. It is also likely that effects will vary between different countries, educational systems and teaching approaches. In general it is probably over simplistic to talk about optimal class sizes in an exact way.

Class size and extra adults (L3)

These days in many countries there are many paraprofessionals in addition to teachers working in classrooms. In the UK, Teaching Assistants (TAs) now make up a quarter of the entire school workforce, and they spend much of their time in predominantly instructional activities with students (Blatchford, Bassett, Brown, Koutsoubou, Martin, Russell, & Webster with Rubie-Davies, 2009); we need therefore to consider the possible effects of adults other than the teacher in a classroom. Although positive findings have come from studies of the effectiveness of specific curriculum interventions given by TAs (Alborz, Pearson, Farrell, & Howes, 2009), other studies report negative results (Blatchford et al, 2009; Finn et al, 2000; Giangreco, Yuan, Mackenzie, Cameron & Fialka, 2005; Klassen, 2003; Reynolds & Muijs, 2003). It therefore seems that additional (non-teacher) staff in classes are not an adequate alternative to CSR.

School and cultural effects (L3)

For the most part, studies have examined effects of class size on processes and performance isolated from school and other local contexts within which they take place. But teachers and pupils in any given class will operate in the context of school ethos, social background, local policies and country and cultural differences. One needs to be cautious about generalizing class size effects in isolation from other factors in education systems (Biggs, 1998). In East Asia, research findings from the U.S.A and UK have been extensively cited by both proponents and critics of CSR, despite the fact that the class sizes studied were much smaller and there are major differences in curricular and teaching approaches (Lan, Cameron Ponitz, Miller, Li, Cortina, Perry, & Fang (2009). We return below to cultural factors when considering classroom processes.

Measures of student 'outcomes' (L3)

Most studies of the effect of class size have studied pupil outcomes in the main curriculum areas of literacy and mathematics. This is understandable given the importance of these areas in any consideration of academic progress, but it can provide a narrow picture of class size effects. Cahen, Filby, McCutcheon, and Kyle (1983) noted that small classes seemed to promote

more positive attitudes, enthusiasm and overall learning skills rather than narrowly defined subject domain performance, which might help explain the often cited disparity between teachers confidence in small class effects and more modest results from research. It seems possible that CSR will have effects on other aspects of children's work, for example, in terms of more creative and artistic areas, and problem solving, and there is therefore a case for looking more systematically at other dimensions.

Effects of Class Size in Relation to Classroom Processes (L1)

If the first generation of research was directed at effects of class size on academic outcomes, then more recently attention has moved to a second generation of research, i.e., better understanding of the classroom processes that might be involved (Anderson, 2000; Finn et al., 2003; Grissmer, 1999). Information on classroom processes connected to class size differences is important because without it there are difficulties in explaining class size effects, and it is also difficult to offer practical guidance on how to maximise the opportunities provided by classes of different sizes. Knowledge about mediating processes might also help explain why previous research has not always found a link between class size differences and outcomes. It may be, for example, that when faced with a large class teachers alter their style of teaching, e.g., using more whole class teaching and concentrating on a narrower range of basic topics. As a result, children's progress in these areas might not be different to children taught in smaller classes. Another possibility, as explained below, is that some teachers do not alter their teaching to take advantage of smaller classes (Shapson et al., 1980) and it is this that might explain why class size differences have little effect. In order to more closely examine these possibilities, detailed information on classroom processes is needed.

There have been a number of reviews of classroom processes (Anderson, 2000; Blatchford & Mortimore, 1994, Biddle & Berliner, 2002; Cooper, 1989; Ehrenberg, et al., 2001; Finn, Pannozzo, & Achilles, 2003; Grissmer, 1999) but knowledge about mediating classroom processes is still relatively limited. Finn and Achilles (1999) conclude: "Despite dozens of earlier studies, the classroom processes that distinguish small from large classes have proven elusive." (1999, p102).

This lack of clear research evidence is not helped by methodological weaknesses in much research in this area (Blatchford, Goldstein, & Mortimore, 1998; Finn et al., 2003). There are also likely to be cultural differences that make clearly establishing links between classroom processes and class size a difficult task. Biggs (1998), for example, has argued that westerners often wrongly perceive large classes in Confucian Heritage Cultures, such as China, Japan, Korea and Singapore, and Hong Kong as conducive to teacher dominance and passive and rote learning. Meaningful and active learning can take place in whole class teaching in these countries as children are socialized in ways that make them work.

Generally speaking, reviews of the literature have split into those that conclude that effects and benefits of CSR on classroom processes are relatively trivial (Slavin, 1989; Ehrenberg et al., 2001) and those that have been much more optimistic about the positive effect of CSR on classroom processes (e.g., Anderson, 2000; Finn et al., 2003). On the basis of previous reviews cited above, it is suggested that there are two primary classroom processes affected by class size differences: effects on teachers and effects on pupils.

Teachers (L2)

The most consistently identified classroom process, affected by reduced class size, is individualization of teaching and individual attention.

Teacher Individual Attention to Pupils (L3)

Pate-Bain, Achilles, Boyd-Zaharias, and McKenna (1992) conclude, on the basis of teacher interviews conducted at the end of each school year in the STAR research, that: 'A common benefit cited by teachers in small and regular plus aide classes was that they were better able to individualize instruction.' (1992, p. 254). Achilles (1999) collated a mass of evidence to show ways in which teachers felt they benefit from small classes. In the UK, Bennett (1996) found a common belief amongst parents and other stakeholders that class size reduction increased the degree of individual

attention to students by teachers. Galton & Pell (2010) found there was a widely held view among Hong Kong teachers that smaller classes allowed pupils to receive more attention.

Teachers' and parents' reports are supported by the early meta-analysis conducted by Glass & Smith (1978) who found that smaller classes resulted in greater teacher knowledge of pupils, frequency of one-to-one contacts between teachers and pupils. Another early study by Cahen et al. (1983) found that one of the main consistent effects was individualization. Teachers provided more feedback, help and encouragement in smaller classes. Other studies also report more individual teaching and attention in smaller classes (Bain & Achilles, 1986; Harder, 1990; Pate-Bain et al, 1992; Turner, 1990), more feedback (Bain & Achilles 1986; Cooper, 1989), better relationships with and knowledge of pupils (Finn et al., 2003), and more differentiation (Anderson, 2000). In the Wisconsin SAGE project (Molnar et al., 1999, teachers were asked to rank items in terms of the extent to which they were affected by reduced class size. The most important classroom processes, affected by reduced class size was individualization.

Betts & Shkolnik (1999) present a sophisticated secondary analysis, using an economic production function framework, to model relationships between class size and teacher time allocation. They used data from a national survey of students in middle and high schools in the USA and found that teachers spent less time in group instruction and more in individual instruction in smaller classes. Rice (1999) also conducted a secondary analysis of teacher survey data, this time based on data from a national panel survey of students transferring to high school. Findings showed that as class size increased in mathematics less time was spent on small groups and individuals, innovative instructional practices, and whole group discussions, though increases in class sizes beyond 20 had little effect. There were no relationships between class size and instructional time allocation measures in science.

Both these last studies are methodologically strong though are limited in relying on secondary analysis of rather general retrospective teacher estimates of time spent. The studies also

focus on older school pupils and it would be helpful to have a similar analyses conducted with younger pupils.

Systematic observation techniques allow a direct and reliable method of measuring teacher attention to pupils (Finn et al, 2003). Two early studies reported different results: in an Australian study Bourke (1986) did not find that class size directly affected teacher individualization, while in Canada Shapson et al. (1980) found that one of the few observation measures on which there were differences was the proportion of pupils addressed as individuals. This increased in a linear way as class sizes decreased from 37, 30, 23 to 16. In an observational study in Britain, individual pupils in smaller classes were also found to experience more teacher attention than pupils in smaller classes (Galton, Simon & Croll, 1980).

In the CSPAR large scale systematic observation studies were conducted when pupils were 4/5 years (Blatchford, 2003) and 10/11 years (Blatchford, Bassett, & Brown, 2005). Results showed that at both ages, though there was a heavy reliance on whole class teaching and individual work, pupils in small classes were more likely to experience one-to-one teaching and were more often the focus of a teacher's attention. Blatchford, Moriarty, Edmonds and Martin (2002) concluded that in smaller classes there was more likelihood of what they called 'Teacher support for learning', a main feature of which was individualized teaching in small classes. A further UK study replicated the two earlier studies – and found that the trend continued into secondary schools (Blatchford, Bassett, & Brown, 2008). The connection between class size and individualization therefore seems a robust finding.

ii. Easier Classroom Control and Management (L3)

A number of the early studies reported that in smaller classes management of student behavior is easier (see Cooper 1989; Pate-Bain et al, 1992). Glass and Smith found in their meta-analysis that there were fewer mis-behaviors in smaller classes.

Using systematic observation methods, Blatchford et al (2002) and Bourke (1986) found more non-academic procedural arrangements were necessary in large classes. Blatchford, Bassett, & Brown (2008) found there was evidence of an interaction between class size and attainment level of pupil; teachers spent more time dealing with negative behavior in larger classes, but this tended to be concentrated on low attaining pupils.

These findings therefore support the common sense view that with fewer students in a class it will be easier for the teacher to maintain classroom control and discipline. However, one interesting point is that there may be cultural differences involved in how easily teachers adapt to having fewer pupils in a class. Lai (2007) found some teachers in Hong Kong and Shanghai felt overwhelmed by the increased level of student activity and movement in small classes, compared with traditionally large classes under tight teacher control

iii. Teacher Stress and Morale (L3)

Many studies report that teachers are put under more strain when faced with large classes (Biddle & Berliner, 2002). Effective teaching may be possible in large classes, but this may be at some cost to teachers, e.g., in terms of pressures on them during the day, eating away at spaces like breaks in the day, extra marking at weekends. The underlying point, which informs much research stemming from teacher report, is that teachers feel better about teaching in small classes. Galton and Macbeath (2008) point out that teachers across the world work very long hours, way beyond those allocated to teaching, and smaller classes help because they necessarily help by reducing marking and administrative tasks. Morale can be affected most obviously by increased demands in large classes

but it may also be because in large classes teachers are faced with compromises to their preferred pedagogy (Moriarty, Edmonds, Blatchford & Martin, 2001).

Students (L2)

iv. Active Involvement with Teacher (L3)

There is a good deal of consensus across many countries, including East Asia, that there is an important role for the encouragement of active as opposed to passive learning in students. It might be thought that smaller classes help promote the more active participation of pupils who are more likely to be reluctant to take such an active role in large classes. Using observation methods, the UK CSPAR study found that children in larger classes were more likely to simply listen to the teacher while in smaller classes they were more likely to interact in an active, sustained way with teachers (Blatchford, Bassett, and Brown, 2005). This finding was replicated in a later study in the UK (Blatchford et al., 2008), and was found in secondary as well as primary schools.

v. Pupil Attentiveness / On-task Behavior (L3)

There is a good deal of evidence that pupil inattentiveness, active learning time, time on task or some equivalent term is a major variable having negative effects on pupils' achievement (Creemers, 1994; Lan et al., 2009; Rowe, 1995). Research supports the connection between size of class and pupil attentiveness. Cooper (1989) reviews studies that show that pupils in smaller classes attend more and spend more time on task, participate more and are more absorbed in what they are doing. Cahen et al. (1983) argue that pupil attention is greater in smaller classes because pupils are not lost in the crowd and have more opportunities for participating. The authors speculate that the effect of class size on attentiveness is most pronounced in the case of low attainers, because teachers can bring them out more. Studies report an allied connection between class size and student misbehaviour (Bain and Achilles, 1986; Glass & Smith, 1978; Johnston, 1989; Nye et al., 1992).

Finn & Achilles (1999) have perhaps expressed the connection between small classes and pupil attention most clearly. They argue that:

The evidence indicates that the key to the benefits of small classes is increased student engagement in learning. In a small class, every student is in the firing line. It is difficult or impossible to withdraw from teaching-learning interactions in a small-class setting. ...When class sizes are reduced, the pressure is increased for each student to participate in learning, and every student becomes more salient to the teacher. As a result, there is more instructional contact, and student learning behaviors are improved. (1999, p103)

Finn et al. (2003) later developed a theoretical and empirical case for why student classroom engagement is the key process that explains why smaller classes lead to better attainment. They conclude that class size affects student engagement more than teaching.

But as with other classroom processes, it is important to look at results from systematic observation research. In this respect, Shapson et al. (1980) did not find that pupils in smaller classes participated more in assigned tasks and Bourke (1986) found no class size effect on student engagement at primary level. However, results from systematic observation studies in the UK mostly offer support for Finn et al's conclusion. The CSPAR study showed that young children (4/5 years) in large classes were twice as likely to be off task, though this effect was not replicated when they were 10/11 years. The off task behavior at 4/5 years was evident across different settings: they were less likely to attend to the teacher and to be off task in contacts with her, more likely to be actively off task with other children, and more likely to be off task when on their own, especially in the passive form of being disengaged from allocated work.

Later research in the UK (Blatchford, Bassett, & Brown, 2008) allowed a more complete examination of class size and pupil attentiveness across both primary and secondary years. As with classroom control, there was a statistical interaction with pupil attainment group, in the sense that low attaining pupils were far more likely to be off task in larger classes.

Galton & Pell (2010) have made an important point about the cultural factors that will affect the relationship between class size and attentiveness. They show that in the UK, average rates of on task

behaviour are between 60-70%, which leaves some time for pupils to be off task. In Hong Kong, by contrast, observation studies show that on task rates are much higher – more than 90% - and there is therefore very little time left for pupils to be off task. Lan et al. (2009) also found higher levels of classroom engagement in China vs. the USA.

vi. Peer Relations (L3)

It might be expected that in larger classes there would be more negative and aggressive behaviors between children, and this is supported by some reviews (e.g., Finn et al., 2003). Research on children at nursery level has found that less favorable staff pupil ratios result in more negative relations between children (Smith et al., 1989; Russell, 1985). However, Shapson et al. (1980) in their observation study found no difference in conflicts between pupils. The CSPAR study found that children in larger classes spent more time interacting with each other about work, about social matters, and also 'mucking about' but against expectation, there was no support for the view that relations between children would be worse in large classes (Blatchford, Edmonds, & Martin, 2003). Indeed, controversially it was found that there was a slight tendency for worse peer relations in the smallest classes, in terms of aggression and rejection of peers (from teacher ratings). It was suggested that young children in small classes can become more dependent on the teacher, some children can dominate and small more intense cliques can develop. Smaller classes may therefore be better academically but not necessarily socially. However, as suggested by Bourke some years ago, the effect of class size on student interpersonal relations is still in need of further study.

One other classroom process affected by size of class is mentioned here.

v.ii Class size and within-class groupings (L3)

There are large country differences in the size and organization of classes into groups. In China and other Asian and African countries, large classes and large groups are common (Lan et al., 2009). By contrast in many Western countries classes are smaller and organized into separate groups of children. It is likely that class size and within-class groups are connected; indeed, as the size of

the class increases, the size and/or number of within-class groups necessarily increases. Lan et al. (2009) found in the USA and China less classroom engagement in smaller groups though this was affected by teaching methods used in China in large groups which maximized pupil attention. Bourke (1986) found that teachers in larger classes in Australia tended to form more groups during mathematics lessons and that this led to fragmentation of the lesson and inefficient use of the teacher's time. However, in the CSPAR study it was found that larger groups within the class (more likely in larger classes), tended to result in more off task behavior, and pupils in the groups could miss out on a teacher's attention (Blatchford, 2003). It was suggested that within class group effects may be a more important direct effect than class size. Lou, Abrami, Spence, Poulsen, Chambers & D'Apollonia (1996) found, on the basis of their meta-analysis of within-class grouping studies, that smaller group sizes were optimal for students' learning; larger groups of 6 to 10 members were less effective.

Summary (L3)

The search for clear connections between class size and classroom processes is inevitably complicated because relationships will be affected by a number of factors, such as views on differentiation, the rigidity of the curriculum, deployment and views of teachers, and cultural and country difference. However, overall in Western countries at least there is most support for the conclusion that class size reduction affects classroom processes in terms of allowing more individual attention, more active, sustained interaction with teachers and more student classroom engagement. Finn et al (2003) think the balance of evidence favours effects of class size on student engagement while the UK CSPAR and later studies suggest that both are important.

The research literature therefore suggests that class size effects are not singular but multiple, and we will therefore need multiple theoretical or conceptual frameworks to account for these effects and to judge their implications, e.g., connected to teaching, pupil attentiveness and social relations. Further, the different effects may have conflicting outcomes, e.g., in the sense that smaller

classes can lead to positive academic outcomes but problematic social effects. Perhaps the most sophisticated model to date of classroom processes affected by class size is that put forward by Anderson (2000). Another model, used as a way of summarizing results from the CSPAR, can be found in Blatchford (2003a).

Methodological advances in research on classroom processes connected to class size (L2)

One of the limitations of research on class size and classroom processes has been limitations in the research methods used. Progress in research on the connections between class size, classroom processes and outcomes is largely dependent on much needed advances in methods. There is little point in further research repeating the findings (or contradicting the findings) using many existing methods of data collection and analysis. It is argued that there are several developments needed:

i. Constructing reliable measures of classroom processes (L3)

Sounder knowledge about processes requires the development of well constructed and reliable measures of classroom processes. This is why Finn et al. (2003) suggested the use of systematic observation methods because of the way they can provide moment by moment reliable measures of classroom behaviours and interactions. In some cases, dimensions of classroom behaviour may be tangible and relatively easily measured - for example, the amount of teacher attention to individual children can be assessed using systematic observation methods (see Blatchford, Bassett and Brown, 2008), and more studies with well constructed observation measures would be valuable. However, further advances in understanding class size effects will also be aided by studying other less easily observed mediating factors. One of the paradoxes of quantitative observational research is that relatively low inference, easy to recognize measures of teaching or pupil behavior, are probably more reliable but can also be more superficial and perhaps less valid. In reality teaching is complex and nuanced. Class size research has barely scratched the surface in terms of capturing these qualities, and more research is required. It is easy to see why many have used more open ended,

impressionistic and teacher report accounts because they seem to capture something of the true essence of teaching, and of the benefits of small classes experienced by teachers.

ii. Better statistical modelling of class size, classroom processes and outcomes (L3)

Assuming that mediating processes can be measured reliably and organised in a conceptual framework then an important design feature would be to set up statistical models in order to test the most important mediating factors. Although there have been sophisticated studies of class size effects on academic outcomes, there have been very few where classroom processes have also been included. Following the lead of Anderson (2000), much more effort needs to be put into examining causal connections linking class size, type of pupil, teaching practices, pupil behavior and academic outcomes. This would be strengthened by more large scale studies with careful and sophisticated statistical modeling, controlling for potentially confounding variables like teacher experience and pupil prior attainment.

Two studies have begun to approach this task of integrating measures of classroom processes, class size and outcomes. Bourke (1986) conducted an early pioneering study in which relationships between class size and pupil achievement were modeled taking account of student ability, school size and socio-economic status and teacher experience, and teaching practice variables. Bourke found that there was an almost significant direct path from class size and achievement but found more evidence that class size affected teaching practices and through teaching practices were related to student achievement. This was an informative and well executed study and it is a pity that more studies have not followed its lead. More recently Bruhwiler & Blatchford (2010) found a direct relationship between class size and learning but did not find that this relationship was mediated through quality of instruction. This important line of enquiry clearly requires more attention by researchers.

iii Good quality qualitative research (L3)

It is interesting that research on classroom processes has tended to be either rather anecdotal and impressionistic or has adopted hard edged quantitative measures. As argued by Pedder (2006), the development of well designed and executed qualitative studies would be a useful alternative. Classrooms are dynamic, evolving psychological communities and methods able to capture processes over time are challenging but likely to be insightful. Finn et al. (2003) suggest that teachers tend to change their practice quantitatively in small classes, i.e. they do more or less of the same things, rather than qualitatively, i.e., they do things differently. Qualitative methods might be better able to capture such qualitative changes. A start has been made in this kind of research by Graue and her colleagues (Graue, Sherfinski & Rauscher, 2008), but more studies could be developed.

iv. Mixed methods (L3)

Although Shulman (1986) warns against a goulash approach to research methods where methods are mixed without principled choice and application, as a general strategy it seems worth considering different approaches not in opposition to each other but as complementary. Without wishing to gloss over the difficulties involved, there is much to be said for seeking to integrate good quality quantitative and qualitative research approaches around a common frame of reference so that they mutually inform each other. As discussed in Blatchford (2005), in some studies different methods, e.g., observations, interviews with teachers, are integrated in terms of themes. This was essentially the method used in the CSPAR study. An alternative approach, though, would be to use a particular method of data collection to *test* the claims from other forms of data, that is, we could systematically cross check across different forms of data. Data are then strategically collected to as part of a process of interrogation rather than amalgamation.

Effective teaching in small classes (L1)

The two main approaches to research on class size effects have, as we have seen, addressed relationships with academic outcomes and classroom processes. I suggest that a third generation of research is needed to go further and address effective pedagogies in classes of different

sizes. If class size reduction is going to be used as an educational initiative then it is important to ensure that the education provided for students is as effective as possible. Later in this section the kinds of research design that would be needed for this third generation of research are examined, but first we need to look at what might constitute effective teaching in small classes.

One view is that no special forms of teaching are required in small classes. Achilles (1999) is adamant that teachers do not need special training to teach in small classes. He argues that simply reducing the numbers of children in a class will automatically bring benefits to teachers and students. Achilles is not of course arguing that teacher quality is not important but rather that benefits for teaching are an automatic consequence of reducing class size. In a phrase, small classes allow teachers to teach better.

However, a number of studies now show that teachers do not always change their style of teaching and therefore do not capitalize on the potential benefits of smaller classes (Cahen et al 1983; Shapson et al., 1980; Evertson & Randolph, 1989). Stasz & Stecher (2002) conclude that there is a lot of research that shows teaching practice “being resistant to change and that teachers adapt their practices slowly and marginally to new materials and techniques that are introduced.” (p.29) To give an obvious example: if a teacher sticks to a largely lecturing style when given a small class this is unlikely to be the best use of a valuable opportunity. As Graue & Rauscher (2009) say, effective teaching in CSR programs requires specific actions by teachers to change the learning opportunities available for students

The consistent evidence that teachers do not always change their teaching in small classes therefore leads me to the conclusion that there is a need for teachers to carefully consider ways in which they should change their practice to make the most of having fewer pupils. Unfortunately, as Galton (1998) and Graue & Rauscher (2009) have pointed out, there are few clear answers to questions about which strategies to adopt in small classes. In general, of the views that exist, there are two different schools of thought. Both would agree that it is important to draw on a clear

conceptual and evidence base on which to ground effective pedagogical strategies but have a different view about what this evidence should be.

The first view would be to base the strategy on views on effective teaching more generally. Galton and Pell (2010) are refreshingly clear about effective teaching in small classes. They argue that: “..the initial request by teachers that the (Hong Kong Government Education Department) provide a prescriptive list of approved Small Class Teaching methods was a distraction... The principles of effective teaching are the same in classes of all sizes.” (p6/7) Brophy (2000) identifies 12 generic principles of effective instruction to indicate how teaching in small classes might be improved. Evertson (2000) argues that CSR programs should heed research which supports calls for the teaching of problem solving, independent learning strategies, learner-centered classrooms, and higher order thinking skills. In a similar way, Galton & Pell (2010) have recently reviewed the literature on effective teaching to set out the forms of pedagogy they feel should be used as the basis for professional development for small class teaching. This was done for the Hong Kong Government to accompany the roll out of small classes in primary schools. They identified six broad pedagogic principles aimed at developing pupils’ understanding. The review by Biddle and Berliner (2002) also draws heavily on research evidence on effective teaching. The approach here then is to identify ideas for teaching in small classes by extrapolating from the general literature on teacher effectiveness.

Such views about effective teaching are well made but there is enough evidence, as we have seen, of consistent relationships between class size and classroom processes, and enough evidence of the way that teachers can be resistant to change when faced with small classes, to conclude that specific guidance about changes to teaching practices in small classes is warranted. Readers will find ideas on effective teaching in small classes in a number of places, e.g., the books edited by Wang and Finn (2000) and Finn and Wang (2002), and the National Center on Education in the Inner Cities Review (2000). Blatchford, Russell, Bassett, Brown, and Martin (2007) have

addressed guidance for teachers and, drawing from evidence on class size effects on classroom processes, reviewed above, argue that it would be particularly valuable to concentrate on strategies for more individualization or differentiation of teaching and more collaborative learning approaches.

Differentiation (L3)

Hattie (2005) argues that the main reason why CSR programs produce such small changes is that despite many reforms the dominant pedagogy still consists of whole class didactic teaching. One important activity, therefore, would be to spend time working through ways of implementing a more individualized pedagogy and to think through ways of maximizing individual attention. The overall aim, in line with Anderson (2000), would include efforts to increase personalized, appropriate instruction. One strategy is to teach more to small groups. This would have the benefits of interactive whole class teaching, but would be potentially more focused and better differentiated in terms of pupil ability.

Collaborative Learning (L3)

However, one danger to be warned against is to see all the benefits of smaller classes in terms of increased opportunities for individualized teaching. Wilson (2006) concludes that small classes can still remain teacher dominated and controlled. Many authors have found that high quality collaborative group work is an effective approach to the development of student independence and control of learning, productive classroom interactions, classroom engagement and student achievement (O'Donnell & King, 1999; Webb & Palincsar, 1996). Worryingly, Blatchford, Baines, Kutnick, and Martin (2001) found that in smaller classes there was in fact less group work, probably because teachers now attended to individual pupils. Recent evidence supports truly collaborative group work as part of an everyday pedagogical approach (Blatchford, Baines, Rubie-Davies, Bassett, & Chowne, 2006), though it requires careful development and training for both teachers and pupils.

It is worth stressing this approach because it is likely to be effectively introduced with fewer pupils in a class.

What kind of research is needed? (L3)

Having discussed the evidence base on which to derive effective teaching in small classes it is argued that there is now a pressing need for research that evaluates good practice. As Mosteller, Light & Sachs (1996) argue, educational innovations are often introduced but what we lack are careful, long term evaluations of their performance. In China there have been many action research reports and reflective accounts published by principals and teachers (e.g. Nanjing Education Bureau, 2007), though it is difficult to determine impact in the absence of systematic empirical studies. There is therefore a need for what I call a third generation of class size research to examine how teachers can take advantage of reduced class sizes. This is in line with Hattie (2005) who also proposes future class size research within which the effectiveness of innovations on student learning could be tested.

Despite the importance of creating an evidence base of effective teaching in small classes it has been possible to find next to no research that helps. This is a serious omission given the enormous policy and resource implications of class sizes. But what kind of research would be appropriate? Conclusions about the efficacy of CSR, as we have seen, are often made on the basis of comparisons with other interventions, e.g., one-to-one tutoring, but this is not a fair test in the sense that CSR is not an intervention like tutoring but simply involves changing the number of people in a room, with no control over what happens in the room. We therefore need to evaluate the effect of CSR *along with* (though separable from) pedagogical changes that are expected to work well. One limitation of the Galton and Pell (2010) study in Hong Kong is the way in which CSR and teacher professional development were combined and so it is not possible to disaggregate effects of the two interventions. A similar problem is found in the SAGE project. To undertake this task, careful, controlled experiments would be valuable. Such studies should be based on random allocation if possible, though high quality quasi experimental designs would also be valuable. Given the situation

in East Asia, where a number of countries are instigating CSR initiatives, there is a valuable and possibly unique opportunity to work towards the creation of an evidence base on effective teaching in small classes, e.g., by addressing the value of CSR and collaborative group separately and in combination. This would be timely and would have benefits in helping to obtain a broader understanding of ways small classes can be used effectively.

Theories to explain class size effects (L1)

Despite the research on effects of class size on academic performance and classroom processes, reviewed in this chapter, there has been surprisingly little work on theories to account for these effects and make new predictions (Grissmer, 1999). With some exceptions, e.g., Finn et al (2003), research has tended to be a theoretical and there is a lack of an overriding conceptual understanding of class size effects. Mitchell, Beach, & Badarak (1989) have argued: "...without an adequate theoretical conception of how changing class size might influence student achievement we are likely to...draw the wrong conclusions." (p.37). It is possible that disagreement over the effects of class size has inhibited efforts to develop theories.

In this section some possible theories will be outlined and an attempt is made to summarize progress and future needs.

i. Mathematical/ logical theories (L2)

The first type of theory is indirect rather than attributable to direct effects of class size; other factors connected to class size differences explain the effects that are observed. One example comes from Mitchell et al. (1991) who divided effects of class size into 'direct' and 'indirect' effects. 'Direct' effects relate to the kind of processes within classrooms that we have reviewed in this chapter. They include such variables as teaching methods, curriculum coverage, pupil attention, and relationships in class. In Mitchell et al's study, direct effects examined were: greater instructional overhead; increased student interaction time and decreased access to instructional resources, though measures were not based on empirical research but derived on logical grounds. Mitchell et al propose a

separate set of explanatory factors, which they call 'indirect' explanations. These derive from the spread of pupil abilities within a class and comprise what they call 'class heterogeneity', 'instructional pacing', and student grouping or achievement modelling. These indirect explanations are logical consequences of class size and are the primary explanations, not class size as such. Mitchell et al found most support for indirect explanations, and none for direct effects. These are provocative results, in the sense that, if true, they mean class size differences in achievement are not attributable to pedagogical or educational factors at all. But there are doubts about the approach adopted. Perhaps most importantly it is not clear if similar results would be found with 'real' data.

ii. Adjustment to school (L2)

One direct theory is that small classes help pupils in their adjustment to school. Mosteller (1995) in a review of the STAR project explains the class size effect in terms of age of the children:

“When children first come to school, they...need training in paying attention, carrying out tasks, and interacting with others in a working situation. In other words...they learn to cooperate with others, to learn to learn, and generally get orientated to being students.”

From this point of view, small classes work with the youngest pupils because the children are new to school, and because small classes help teachers help pupils learn how to be students. The effect of small classes is a ‘start up phenomenon’ and this then affects when to use it as an initiative and what to do pedagogically to help pupils. However, it is not clear if this theory is explicitly linked to the age of pupils. The idea of a start up effect, aiding adjustment to school, is intriguing because it could lead to predictions that at points of transition, e.g., primary to secondary education, not just entry to school, small classes would help pupils adjust and settle. This possibility has not been tested.

The idea of class size in relation to adjustment to school can be approached further through ideas from developmental psychology. Ladd (1996) argued that: "Specifically we define school adjustment as the degree to which children become interested, engaged, comfortable and successful in the school environment..." (p371). This view can be combined with, but extend and make more formal,

the 'start up' notion. "Overall, our findings are consistent with the premise that early school adjustment is a function not only of children's attributes but also the types of relationships they possess during major shifts in school environments." (p380). We might expect, though still need to test, that small class sizes would be beneficial for school adjustment.

iii. Social psychological theories (L2)

Social psychology offers probably the most potential to help understanding of class size effects. Drawing on Finn et al., and also social psychology texts like Hogg and Vaughan (2002), several concepts are discussed here.

First, and interestingly, one social psychological theory would imply a positive effect of larger classes. Social facilitation theories imply that more people present have a positive effect on performance. Zajonc (1965) argued that humans are genetically programmed to find the presence of others arousing and so stimulate performance. Apprehension about how others will evaluate us causes social facilitation, though this is affected by the type of tasks undertaken: simple well learned tasks are facilitated while more complex less well mastered tasks are inhibited.

More in line with a common sense view, other social psychological theories suggest a negative effect from larger groups. Decrease in effort as a consequence of believing one is part of a group has been labelled 'social loafing' (Latane, Williams & Harkins, 1979) – a very different idea to social facilitation. An allied concept is that of the 'free rider' effect, which carries the meaning of exploiting the group product while contributing nothing to it. However, other social psychological research finds that people may actually work harder in groups than as individuals when they value it and when people believe the group will be effective in achieving goals. Karau & Williams (1993) identify task performance and the significance of the group to the individual as key factors in promoting increased effort in groups.

A connected theory is a 'dilution' effect, i.e., increases in the numbers of pupils have necessary effects on the amount of attention a pupil receives from a teacher. Borland, Howson, &

Trausek (2005) argue that dilution of the teacher's time across a large number of students lowers the impact of the teacher on any individual student, and so lowers academic achievement. Finn et al (2003) point to a similar well known social psychological theory - diffusion of responsibility, i.e., people tend to be less likely to help others in distress when part of a group. As group size increases more diffusion of responsibility takes place. Finn et al argue that this applies to the classroom, though no research to date has been conducted.

Another social psychological theory, cited by Finn et al (2003) in relation to class size, is 'group cohesiveness' or team spirit. When applied to class size the idea would be that students in small classes are more likely to be achieve and support each other while in larger classes classmates efforts may be the discouraged and groups may divide, hindering teaching and learning. Group cohesiveness is similar to an allied notion of 'Psychological sense of community' (PSOC), e.g., the perception of similarity and interdependence with others, and feeling part of a larger stable structure. Bateman (2002) argues that PSOC is enhanced in smaller classes.

Although social psychological theories look to have important implications for class size effects it is noticeable that there has been little systematic effort to apply, let alone test, these concepts in relation to understanding class size effects in schools. In a small scale study based on 8 teachers' views, Englehart (2006) examined the relevance of several social psychological theories and found some support for social loafing only. Further work would benefit social psychology and education.

iv. Why class size reduction does not have an effect (L2)

We have seen there is a lot of evidence that teachers do not necessarily change the way they teach when faced with smaller classes and this might well account for the relatively modest effects of class size on achievement. As well as understanding how class size differences affect performance and classroom interactions, it is also important to try to develop explanations for *why* class size does not affect performance and classroom interactions. As Evertson (2000) puts it: "The

important question may not be what smaller classes should look like, but why they so often look just like larger classes.” Another way to express this point is to say it is important to understand *resistances* to CSR.

There are likely explanations at several levels. At the individual teacher level, Cahen et al (1983) found that teachers tend to become comfortable with programs accepted at their schools, and changing the number of pupils in their class may not be enough to change the curriculum and style of teaching very much. Cahen et al therefore argue that teachers need to develop a new program and must put effort and time into developing it. Cahen et al. (1983) also make a connected point that might help explain the disparity between teacher perception and measured results. Teachers face an enormous management task in monitoring and instructing a class of pupils; a reduction in class size may then help reduce teachers’ cognitive load and the effect may appear greater to the teacher than is actually the case.

There are also explanations for resistance to CSR at school/institution level. Graue & Rauscher (2009) argue that teachers’ methods are highly resistant to changes in school structures. Ehrenberg et al. (2001) also point out that schools, as institutions, can be resistant to change. In this regard it is likely that other theoretical viewpoints will be helpful, e.g., in terms of management change. There are also many possible ideas from the large literature on school improvement.

Resistances to change can be extended to an international context. Galton’s (2008) explanation for the relative lack of impact of a major class size reduction program in Hong Kong is because teachers there are rigidly dependent on the textbook for curriculum and teaching approaches and the number of pupils in the class is a relatively trivial contextual factor. This explanation is similar to that identified by Evertson & Randolph (1989) in a study of schools involved in the STAR project who show that the adherence of teachers to the mandated curriculum in Tennessee may have minimized differences between small and regular classes.

v. Contextual approach (L2)

Blatchford et al. (2003) concluded that research evidence supports “a contextual approach to learning, within which class size differences have effects on both teachers and pupils” and therefore, “much will depend on how teachers adapt their teaching to different class sizes” (p.709-710). There are a number of models of contextual influences on school progress that could be drawn on. One of the earliest and most widely cited is Dunkin & Biddle's (1974) model which supported research in the 'process-product' tradition. There were four stages - presage, context, process and product. Class size, in this model, is a context variable. Bennett (1996) used this model in his survey of teachers', parents', and school governors' views on class size effects. Another model by Pianta, La Paro, Payne, Cox, & Bradley, (2002) divides influences on education into ‘distal’ vs. ‘proximal’ and predictably finds that distal structures like class size have less influence than proximal factors like classroom processes, teaching and the emotional quality of the classroom setting.

One of the limitations of models like these is that class size is seen as one of the background, necessarily ‘distal’ factors affecting teachers and pupils, and is therefore consigned to a relatively minor role, when an alternative is to position class size as a factor that might not be as directly important as teaching but will still interact on a moment by moment basis with it. The interesting question is not therefore which is important, distal or proximal, class size or teaching, but how to describe and make the most effective use of their interconnection.

Class size as a classroom contextual influence (L3)

Studies of teaching effectiveness have in common a lack of interest in classroom contextual influences on teaching. There is an underlying assumption of a direct model, where teaching affects, in a causal way, pupils' achievements and learning. But, as argued by Blatchford (2003a), teachers do not meet pupils out of context, and class size can be seen as one contextual influence on classroom life, to which teachers and pupils will inevitably have to adapt, and which will affect their behavior and the nature of the interactions between them.

One expression of this view can be found in Bronfenbrenner (1979) and the ecological psychology approach of Kounin & Gump (1974). The basic idea is that within the school there will be smaller contexts, such as the classroom and the playground, which have qualitatively distinct sets of relationships, rules and dynamics (Pellegrini & Blatchford, 2000). Different class sizes may well induce different dynamics, which influence both teachers and pupils. This is a very different view of class size to that in the Dunkin and Biddle model because there it was a static variable that fed into influences on teaching and pupils. The ecological approach is better able to account for the influence of class size on both teacher and pupils.

Social pedagogical approach (L3)

However, the ecological approach in a strong form can become overly deterministic in the sense that it assumes that the behavior of teachers and pupils are both affected by contextual factors. One important extra feature is the adaptability needed by teachers when faced with a given contextual factor, like the number of students. Teaching is an intelligent activity and intelligence is required in adapting constructively to new opportunities.

There are other ways in which the ecological model is limited. As well as class size, teachers and pupils will also face two important other factors in classrooms, the curriculum and pedagogy. Models are needed in which all these factors, i.e., class size, teaching, curriculum and pedagogy come together in a dynamic relationship. It is important to adapt teaching to 'fixed' classroom level factors which will include class size but will also include classroom size and seating arrangements. Blatchford, Kutnick, Baines, and Galton (2003) coin the term 'social pedagogy' to help show how classrooms are not so much the undefined context within which teachers simply exert an influence on students but distinct physical and social settings within which decisions are taken about how to best coordinate and manage the various factors involved, including class size. These components exist in dynamic relationship with each other and effective teaching requires an understanding of their separate and interconnecting influences.

Conclusion (L1)

In this chapter, a review of research on class size effects as been organised in terms of three ‘generations’ of research. It has been argued that the first generation of research on the effects of class size on academic progress has revealed several key results, e.g., that effects tend to be most likely for younger pupils, and that extra adults in the class are not as effective as CSR; and several points of discussion, e.g., who benefits most and the long term benefits of CSR, and the possibility of an optimal class size.

The second generation of research - on relationships between class size and classroom processes - has indicated that effects are most likely on teacher individual attention toward students and student engagement. It is argued that further advances in this area depend on more attention to the construction of reliable measures of classroom processes, better statistical modelling of causal connections between class size, classroom processes and pupil progress, and the development of more good quality qualitative and mixed method approaches. It is suggested that further advances would be best brought about through relatively large scale projects, and advances could help development of research methodologies as well as better understanding of class size effects.

The chapter has also made the case for a third generation of research which would systematically evaluate the effectiveness of selected pedagogical changes in small classes. It was argued that enough is known about the lack of change when faced with small classes to suggest that deliberate steps need to be taken by teachers and schools to make the most of reduced class size. There are many ideas about what to do in small classes but for the most part this is based on general views about pedagogy and is inconsistent and sometimes contradictory, and difficult to synthesise. It was suggested that now is the time to invest in high quality, adequately funded research to systematically test the effectiveness of CSR along with specific pedagogical approaches so that separate and combined effects can be judged. Given the enormous financial and staffing stakes involved in decisions about class size it is vital that we move toward an evidence base which can

help. It is also important for the students of the future that they benefit from informed decisions based on systematic evidence rather than partisan views.

There is also huge and exciting potential for truly international cooperation on research and research informed policy. The issue of CSR affects many countries and deliberate efforts to coordinate third generation research studies would do much to develop research on CSR specifically but also better international understanding of the interplay between curriculum, pedagogy and classroom factors like class size, at a time of growing international cooperation in educational research.

Lastly, the chapter noted the largely a theoretical nature of much research on class size and looked at the application of several possible theoretical approaches: mathematical/logical theories; adjustment to school; social psychological theories; theories concerning why class size does not have an effect; and contextual approaches. It was suggested that one promising route for future conceptualizations of class size effects would be contextual approaches within which the interconnections between classroom level factors like class size and teaching, the curriculum and pedagogy are recognized in a dynamic relationship. It was suggested that a social pedagogical approach would be of value in showing how physical aspects of classrooms are not just a taken for granted context for schooling but part of a distinct social and physical setting which teachers need to recognize and adapt their teaching to meet curricular and pedagogical considerations. But more work is needed on conceptualizations that do justice to the research evidence and which also chart a way ahead for third generation research.

Professional development (L3)

Some have argued that CSR is less important than teacher quality and that funds would be better spent in training and professional development for teachers (Rivkin, Hanushek & Kain, 2000). However, the view taken in this chapter is that it is a false dichotomy to either support teacher training or reduce class sizes. We need to consider both together, and ways of making the most of the

opportunities of smaller classes. As Anderson (2000) has said: “Smaller classes provide opportunities for teachers to teach better; they do not cause teachers to do so.” p7). Teachers have to work just as hard to manage learning effectively. Evertson, Sanford, & Emer (1981) showed that teachers skilled in classroom management were able to make adjustments necessary to cope with academically heterogeneous classes, but that less skilled teachers were not.

There is a clear role here for initial and continuing professional development. It is difficult to make judgments about initial teacher education across different countries, but it seems there is a strong case for more consideration of classroom contextual features, of which the number of children in the class is one.

“In order to take advantage of these opportunities, teachers must understand the types of changes they need to make when teaching in smaller classes and be helped, via soundly designed, well-implemented professional development programs, to learn how to make these changes.” (Anderson, 2000, p7).

But Galton, Hargreaves, and Pell (1996) suggest that there is little preparation in initial teacher training concerning ways of adapting teaching to class size.

It is unlikely that isolated in-service work focused on local class size initiatives will be effective in the long run. What is required is systemic work in initial teacher training that, for example, encourages an awareness of contextual factors and social pedagogical principles, that will then become integrated into everyday teaching. Evertson (2000) has argued that professional development is needed to help teachers in small classes change to more complex instructional strategies. Lai (2007) has also shown the important role of school leaders in providing a supportive environment for teachers to prepare for small class teaching and engage in professional development. But in line with what has been argued in this chapter we are still a long way from understanding effective teaching strategies in small classes, to help inform professional development and training, and this remains the pressing need for new research.

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Figure 1: Relationship between first year class size and literacy progress (adjusted for school entry scores).



