CLASS SIZE AND CLASSROOM PROCESSES

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INTRODUCTION

In recent years there has been much debate about the size of classes in schools. The commonly held view of many teachers and parents, supported by experimental research in the United States, is that children educated in small classes will academically outperform those taught in large classes. A contradictory picture is provided by results from international tests. These would seem to indicate that children from Asia Pacific countries such as Taiwan, Japan, and Singapore which generally have larger classes, are better at science and mathematics than those from countries which have smaller class sizes such as the United States. Despite this, there have recently been moves by countries in the Asia Pacific region to reduce class sizes. In this chapter we argue that further progress in this area rests largely on clarification of classroom processes connected to class size differences. The vast majority of research has been carried out in the USA and Europe but we also review research from other countries. We highlight cultural differences between countries, including those in the Asia Pacific region, both in their teaching practices and views on education. We examine issues that remain unanswered and identify areas for educational research.

CLASS SIZE AND EDUCATIONAL ATTAINMENT

Many teachers and parents believe that small class sizes will allow a better quality of teaching and more individual attention to children, who will consequently achieve more. The STAR project in Tennessee, USA, has been influential. Although findings are still contentious (see Goldstein and Blatchford, 1998, Grissmer, 1999), there is agreement that this is an impressive large scale study that provides evidence that smaller classes, at least below 20, have positive effects on pupil academic performance, and are most pronounced if introduced with the youngest children in school (e.g. Finn and Achilles, 1999). In the USA, President Clinton pledged $1.2 billion of the 1999 fiscal budget to reduce classes with a further $1.3 billion awarded in the 2000 fiscal year. Class size reductions have been implemented by a number of states, e.g., California, which have made class size reduction mandatory. This has been followed by much debate in other countries and also initiatives, for example, in the Netherlands, and Asia Pacific countries as diverse as New Zealand and China to reduce class sizes despite high achievement scores in for example, international maths tests such as TIMMS (Reynolds & Farrell, 1996). In China, the *Xinmin Evening News* (December 8, 1999) reported that there had been a reduction in class sizes following the Shanghai Education Commission call for a reduction in 1997. The Shanghai Education Commission was also reported to be

planning to establish 100 small class experimental schools in 2000 (*Liberation Daily*, February 13, 2000). In Taiwan too, the '410 Education Reform League' have called for smaller classes. Recently in the UK the Labour Government legislated for a maximum of 30 children per class at Key Stage 1 (5-7 years), and extra funding for teaching assistants in classrooms. However, there is still considerable disagreement about the cost effectiveness of class size reductions, with some arguing class size reduction should be a main Government priority and others arguing that the academic gains are modest at best and funds would be better spent on other initiatives such as teacher training.

There are a number of reasons why results on connections between class size and educational achievement are difficult to interpret, and these difficulties mount when comparing results across countries with very different educational systems. Factors such as the popularity of schools (which may result in larger classes but of more committed students and parents), special needs classes (where classes may be smaller but likely to have lower achievements), will affect the connection. In Singapore and China, classes in popular schools tend to be larger than normal while in rural areas class sizes are smaller. Another factor that has contributed to difficulties in comparing studies concerns how class size is measured. As described in Blatchford, Goldstein and Mortimore (1998), defining class size may appear straightforward but there are actually difficulties, e.g., because the number of children in a class at a given time may be different to the number on a register. Pupil teacher ratios and class size are often used to be synonymous but they can be very different, e.g., because the number of teachers includes all teaching staff whether actually teaching in a classroom. Another complicating factor will be the physical size of classrooms. Physical limitations of the classroom such as not being able to move furniture or have pupils move around for groupwork, if this is desired, will be important, as well as physical problems encountered by the teacher, e.g. having to raise her voice, use of microphones, OHPs, sharing books, etc. In Thailand, many Thai English teachers are concerned by the physical constraints imposed by large numbers in their classrooms (Hayes, 1997), not surprising given that the average size of classes in this study were between 45 and 55 people. Despite the fact that on paper some schools in China could reduce class sizes because of a low teacher-pupil ratio, the physical conditions in schools may not provide the extra room required (Jin & Martin, 1998).

TEACHERS' VIEWS ABOUT CLASS SIZE

The effects of class size on student achievement will also be affected by the view that teachers have about the importance of class size. In the UK, surveys have shown that teachers' and head teachers' believe large class sizes affect teaching and learning, and they were particularly aware that larger classes could have an adverse effect on the amount of teacher attention. Research carried out in China (Din, 1999) on teachers' attitudes towards class size indicated that teachers preferred teaching small classes to large classes (defined as a class with more than fifty pupils). But in comparison to Western countries, classes in China are still large and it would seem unlikely that many of the teachers had experienced teaching small classes on a regular basis. Moreover, while it was found that teachers perceived small classes as beneficial, they did not believe they were necessary for academic achievement. Rather, the teachers felt that small classes facilitated more student-teacher interactions, better classroom

management and reduced teacher workload. Many teachers do not see the point of trying to reduce class sizes. They believe that it is more important to present knowledge in a manner suitable for learning (Jin, 1998).

Teachers in different countries may have a different view about what constitutes a large or small class. The STAR project compared class sizes quite out of the normal range for many countries – even by UK standards it compared small with very small classes. In the UK classes over 30 are often considered large and those below 20 small (Blatchford and Mortimore, 1994). However, one study of English teachers in China found that most agreed a class of 50 to 60 pupils was large while the number of students in the larger classes ranged from 60 to 150 (Xu, 2001).

CLASS SIZE AND CLASSROOM PROCESSES

There is some agreement amongst researchers in this field that the most important issue related to the effects of class size differences is not now whether they affect pupil achievement but what classroom processes are related to class size and therefore mediate effects of class size differences. Another way to express this is to say that class size i.e. the number of children in a classroom does not affect achievement directly; rather its influence is indirect and must be mediated through teachers' and pupils' behaviour. The focus of this chapter is to review what is known about these mediating processes.

At the outset we need to say that knowledge about mediating classroom processes is relatively limited (Grissmer, 1999). The STAR project, like many others, was predominantly interested in the relationships between class size and academic attainment, and has little to say about classroom processes that might explain effects found. Finn and Achilles (1999), two of the STAR research team, acknowledge this when they argue: "Despite dozens of earlier studies, the classroom processes that distinguish small from large classes have proven elusive." (Finn 1999, p102). In a similar vein, Grissmer (1999) has concluded that there is a lack of coherent theories by which to guide and interpret empirical work on class size effects, and with which to make new predictions. The situation in countries other than the USA is much worse, in the sense that there has been little research on classroom processes connected to class size differences. We need, therefore, accounts of classroom processes that might explain why smaller classes differ from large classes.

CLASS SIZE AS A CLASSROOM CONTEXTUAL INFLUENCE

Main traditions of research on classroom processes including teaching effectiveness and pupil learning behaviour have in common a lack of interest in classroom contextual influences on teaching. There is an underlying assumption, in many studies, of a direct model, with teaching affecting, in a causal way, pupils' achievements and learning. But teachers do not meet pupils out of context, and class size can be seen as one contextual influence on classroom life, which plays a part in the nature of the interactions between teachers and pupils. The conceptual roots of this view can be found in Bronfenbrenner and the ecological psychology approach of Barker and Gump. The basic idea is that the classroom context has distinctive forces or ‘signals’, different to

other contexts, which pull events and participants along with them. Here we argue that different class sizes may well involve different forces or signals, that influence both teachers and pupils.

CLASS SIZE AND WITHIN CLASS GROUPINGS

In line with this contextual approach there are also in some countries, and stages of education, learning contexts nested *within* classrooms. A main within-class context in countries like Britain, the USA and Holland is the organisation of the class into separate groups of children within which they work. It is likely that the classroom environment, e.g., class size and within-class groups are connected, e.g. the number and size of groups. Blatchford et al (2001) found that one consequence of larger classes is the likelihood of larger, less educationally effective groups.

The effects of within class contexts will clearly depend on approaches to instruction and the curriculum in different countries. In the UK the issue of within class groups arises because teachers do not believe that teaching to larger groups or the whole class is appropriate with young children. They feel this may be possible in some curriculum areas, and for some activities, but will inevitably be of limited relevance to primary aged children, especially the youngest children. In Singapore the use of co-operative learning in the class has been promoted by educational departments since 1985. However, whole class teaching is the norm for most lessons followed by individual work after the class instruction. Ng, Chew, Lee, D'Rozario (1997) believe this is in response to large classes as well as tight curriculum time. The use of co-operative learning varies between subjects with the majority of group work being observed in science practical work and for certain English lessons while pupils work individually in mathematics lessons. The authors have suggested that the prominence of individual learning in the core subjects such as maths and English is a reflection of their concerns with monitoring and testing in these core examinable subjects. Indeed, the authors go so far as to suggest that due to parental demands for good examination results, teachers will be reluctant to abandon strategies that have served them well.

In China whole class teaching is the norm. This can be put into context when one considers that teachers believe their pupils, apart from a few exceptions, are at the same level and there is therefore no need for mixed ability groups in the classroom. Pairwork is used, although in a different manner to Western countries. It is nearly always prepared in advance and is performed to the teacher and class (Jin, 1998). In Taiwan it has been proposed that whole-class teaching methods are possible because of the high levels of student motivation and attention – not always the case in other countries. Also, there is the expectation that all children in the class must reach the given standards and therefore there is no allowance for differentiation, unlike primary schools in other countries (Vulliamy, 1998).

CLASS SIZE AND TEACHING

It might be expected that one set of classroom processes affected by class size would be aspects of teaching. The judgement and experience of many practising teachers is that, other things being equal, teaching is likely to be easier and more effective in

smaller classes. Pate-Bain, Achilles, Boyd-Zaharias and McKenna (1992) report, on the basis of teacher interviews conducted at the end of each school year in the STAR research,

> A common benefit cited by teachers in small and regular plus aide classes was that they were better able to individualise instruction. These teachers reported increased monitoring of student behaviour and learning, opportunities for more immediate and more individualised re-teaching, more enrichment, more frequent interactions with each child, a better match between each child's ability and the instructional opportunities provided, a more detailed knowledge of each child's needs as a learner, and more time to meet individual learners' needs using a variety of instructional approaches. (Pate-Bain et al, 1992, p254).

Teachers' reports are supported by the meta-analysis conducted by Glass, Cahen, Smith and Filby (1982) who found that smaller classes resulted in greater teacher knowledge of pupils, frequency of one to one contacts between teachers and pupils, variety of activities, adaptation of teaching to individual pupils, and opportunities to talk to parents. Other studies report more individual teaching and attention and more feedback (cf. Cooper, 1989). However, in direct contrast to teacher views, Shapson et al (1980), in a widely cited study, found no statistically significant differences between class sizes for most teacher activities. Worryingly, they found that these observation results were at odds with teachers' own views about the benefits of small classes.

There have been several more recent USA studies that have examined the effects of class size on teaching. Molnar and colleagues (1999) report results from the Wisconsin Student Achievement Guarantee in Education (SAGE) project - a 5-year Kindergarten to grade 3 project begun in the 1996-7 school year. Though not a study of class size reduction as such, the program required participating schools to implement four interventions, one of which involved pupil teacher ratio reductions to 15 students per teacher. Teachers were asked to rank items in terms of the extent to which they were affected by reduced class size. The teacher behaviours that received the highest rankings were more individualised instruction; more teaching time; more discussion, sharing and answering; more hands-on activities and more content coverage. The most important classroom processes, affected by reduced class size, according to Molnar et al, is therefore individualisation. They put forward a tentative model of teaching in small classes which includes three elements: better knowledge of students, more instructional time, and teacher satisfaction, and these in turn lead to more individualised instruction.

In another recent study, Betts and Shkolnik (1999) present a sophisticated analysis, using an economic production function framework, to model relationships between class size and teacher time allocation. They conducted a secondary analysis of a national survey of students in middle and high schools in the USA. Results show some evidence that teachers substitute group instruction for individual instruction as class size increases, and devote less time to group instruction and more on individual instruction in smaller classes. There was a small effect on percentage overall instructional time. They argue teachers would make better use of small classes if they did not reduce group instruction, though they agree that further research is needed to identify exactly what changes in teaching style might be most effective.

Rice (1999) also conducted a secondary analysis of teacher survey data. Data came from a national panel survey of students transferring to high school and appear to come from the 1990 follow up (again rather dated). Findings showed that in maths as class size increased 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 raise interesting questions about the effect of class size differences on teaching and non-teaching (e.g. procedural/managerial) time overall, and also on how it is shared between individuals, groups and the whole class. But the studies are limited in that they rely on a secondary analysis of rather general teacher retrospective estimates of time spent, and basic distinctions, e.g. between individual, group and class contexts, which might be expected to be differently affected by class size, are not always clear. Another problem with the studies is the age of students involved. We have seen that greatest effects are reported with younger children and especially children immediately after entry to school, and so results involving much older children may underestimate effects of class size differences and/or involve different processes.

A quite different approach to teaching, with roots more in cognitive psychology, has drawn on Vygotskian thought, e.g., on the Zone of Proximal Development (ZPD), and 'scaffolding' to inform effective teaching and tutoring (see Wood, 1998). The underlying learning context in this tradition of thought is the one to one tutoring relationship. From this point of view the school classroom seems inherently disadvantaged as a site able to provide a contingent learning environment, and a classroom with a large number of young children is particularly problematic. Some studies have examined the reality of teacher scaffolding and contingent teaching in the context of everyday life in classrooms, but connections with numbers of children in the class have not been worked through conceptually or empirically.

Blatchford et al (in press) using a multi-method approach found consistent evidence that children in small classes were more likely to interact with their teachers. There was more teaching on a one-to-one basis, more times when children were the focus of a teacher's attention, more teaching overall, and more times when children were attending to the teacher and actively involved in interactions with them (i.e., responding or initiating rather than just attending). Complementary qualitative analyses of end of year teacher questionnaires and case studies, showed that class size affected the amount of individual attention, the immediacy and responsiveness of teacher response to children, the sustained and purposeful nature of interaction between teachers and children, the depth of a teacher's knowledge of children in her class, and sensitivity to individual children's particular needs. Overall, Blatchford et al (in press) conclude that in smaller classes there is more likelihood of what they call *teacher support for learning*. One aspect of this is more likelihood of individualised teaching in small classes. In general these results appear consistent with other studies reviewed earlier, although we need though to be clear about the nature of individualisation affected by small classes compared to large. Although there is more one to one teaching in small classes, the greater incidence of times when the child was the ‘focus’ of attention indicates that children receive more attention in group and whole class situations as well. This needs to be born in mind when

considering worries that smaller classes might encourage a reliance on individual teaching.

Again there are complications when comparing different countries. The relationship between class size and teaching will vary according to the way teachers are deployed in schools. In primary classrooms in the USA and UK the class teacher takes the pupils for most, in not all, lessons. This is quite different to countries such as China, for example, where the primary school teacher may teach only one subject.

Blatchford et al (in press) argue that although small classes allow teachers to be effective and large classes will present inevitable difficulties and hard choices, there is no immutable link between class size and teaching. Much will depend on how teachers adapt to class size differences. This in turn will be affected by views on curriculum coverage, the demands of assessment arrangements etc. One study found that there were no differences in the teaching strategies employed by schools in rural and suburban areas of Queensland, Australia (Staunton, 1995). This was somewhat surprising given that in the rural areas, class sizes rarely exceeded 10 students while classes in the suburban areas had, on average, between 25 to 28 students. The instructional approach employed was to the whole of the class, teacher centred and didactic. This persisted despite the teachers' stated preferences to be more accommodating in their instructional practices. It was reported that the teachers found it difficult to employ flexibility in their teaching methods due to the demands of the assessment programme. In Singapore, the pressures of examination results mean that teachers appear reluctant to alter their teaching strategies. In Singapore whole class teaching followed by individual work is perfectly suited to the requirements of the National Curriculum in Singapore (Ng et al, 1997). In Taiwan competition remains so intense that there is no time for diversion from the prescribed curriculum

We return to the issue of teachers adapting to class size below:

AFFECTIVE CONSIDERATIONS

There is another effect of class size differences which illustrates the complexities involved. Effective teaching is possible in large classes, but this may be at some cost to teachers, e.g., in terms of eating away at spaces like breaks in the day, marking at weekends, but also in terms of the teacher's professional satisfaction and enthusiasm. Moriarty et al (2001) found that teachers' experiences of class sizes are connected to their emotional involvement in the job of teaching. It was very clear that some teachers with large classes felt they could not provide the quality of education they felt was important for young children, and this upset them. This gap between a vision of what is appropriate for young children and the realities of teaching a large class may be particularly wide in the case of teachers of the youngest children in school.

PUPIL ATTENTIVENESS AND OFF-TASK BEHAVIOUR

Regardless of any connection with class size, studies of classroom processes related to achievement support the view that a key aspect of educational success is attentiveness, or active learning time, time on task or some equivalent term. There is a good deal of

evidence that pupil inattentiveness is a major variable having negative effects on pupils' achievement.

Common sense and logic suggest that with more children in the class there will be more potential for distraction, and more possibility of being off task. Conversely in small classes there will be more opportunities to engage children and keep them on task. This might be expected to be particularly relevant in the case of the youngest children in school who are less likely to have developed the capacity for independent work.

Studies indicate that pupils in smaller classes attend more and spend more time on task, participating more, and are more absorbed in what they are doing (cf. Cooper, 1989). Some have speculated that pupil attention is greater in smaller classes because pupils are not lost in the crowd and have more opportunities for participating. The effect of class size on attentiveness being most pronounced in the case of low attainers, because teachers can bring them out more (Cooper, 1989).

Finn and Achilles (1999) have expressed the connection between small classes and pupil attention or engagement in class perhaps 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. Social psychologists have long recognised the negative relationship between group size and participation of individuals - the principle underlying concepts such as 'social loafing' and 'diffusion of responsibility'...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 behaviours are improved. (Finn & Achilles, 1999, p.103)

Blatchford (in preparation) found on the basis of a systematic observation that children in large classes were less likely to attend to the teacher and to be off task in contacts with him or her. They were also 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.

There does not appear to be much research from Asia Pacific countries on connections between class size and attentiveness, though there is anecdotal evidence that children in large classes, especially those at the back of the classroom, lose attention. While behaviour and discipline does not really feature in the literature on the Asian countries, noise levels would appear to be a problem, and one of the main problems of large classes might be expected to be the noise produced. This is a particular problem for those countries which have open classrooms such as Singapore. This might in turn be expected to have an impact on student attention in class, though this will not necessarily follow.

PEER RELATIONS IN CLASS

There is a lot of evidence that children's early social behaviour toward peers is an important predictor of later social and personal adjustment. The effects of children's aggressive, withdrawn and prosocial behaviours toward peers have received most empirical support. There is also a large literature on the value of collaborative or co-

operative group work in classrooms and naturalistic studies of children's interactions in classrooms, which will include those with peers. However, as in the case of teaching and on pupil on task behaviour, there is little research on the effects of contextual classroom factors like class size on peer relations and behaviour. Research on children at nursery level indicates that less favourable staff pupil ratios can lead to more negative relations between children, including more aggression, annoying and teasing. This research has also found that increasing the numbers of adults can lead to more talking between adults rather than to pupils. But other research with older pupils seems less clear, and Shapson et al (1980) found no difference in conflicts between pupils.

As with teaching, therefore, associations between peer relations and contextual factors like size of class are not clear. One might expect that in large classes children will be more distracted and that this would include more off task behaviour with their peers. One might also expect more negative and aggressive behaviours between children in larger classes. Blatchford (in preparation) found that class size differences affected the balance of interactions between pupils and teachers and pupils and other pupils. In large classes children spend more time with each other, working and socialising. Intriguingly, there were some signs that relationships between children, in terms of teacher ratings of asocial, aggressive and social exclusion behaviours were *worse* in smallest classes under 20 children. Smaller classes may be better academically but not necessarily socially.

There does not appear to be much research from Asia Pacific countries relevant to the connection between class size and peer relations. In Singapore teachers do not believe in the benefits of children working with their peers; expressing the notion that learning is a passive process and a cognitive activity taking place in the head and not through talk (Ng et al, 1997). One study of large English classes in China found that there were no significant differences in students' preference for learning English in large or small classes (Xu, 2001). The author refers to cultural differences and concludes that Chinese students may not uncomfortable learning in large classes uncomfortable because, as opposed to small classes, they suit their cultural characteristics. The same study also reports the benefits of competition and the increased opportunities to make friends.

CONCLUSION

It seems clear that the effects of class size on classroom processes are far from straightforward because they will be affected by a number of factors, such as views on differentiation, the rigidity of the curriculum, deployment and views of teachers, and so on. It also seems clear that the effects will be multiple not singular, and it follows that we need multiple theoretical or conceptual frameworks to account for these effects and to judge their implications, e.g., connected to teaching, 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. There may be other complications, for example, a teacher 'compensation effect' which may serve to cushion the expected effects of larger classes. Perhaps the most sophisticated model to date of classroom processes affected by class size is by Anderson (2000). To this model we would add the separate level of within class learning contexts such as groupings and peer relations.

We have argued that class size should be considered a classroom contextual feature. Though classroom processes have tended to be viewed in terms of a direct model, where teachers' actions toward pupils are seen as having effects on pupils' learning or attainments we suggest class size is one environmental contextual factor that will influence teachers and pupils in a number of ways. It is not, as some argue, a case of either supporting teacher training to improve teacher quality, or reducing class sizes. We need to consider both together, and ways of making the most of the opportunities of smaller classes. An important next step is therefore how teachers *deal* with this classroom contextual feature, i.e., with class size. A teacher can deal with it effectively, as shown in case studies from the London Class Size Study (Blatchford et al, in press). We have documented examples of teachers in small classes doing a marvellous job - with observers coming away inspired by the quality of teaching and children's educational experiences. In these classrooms teachers were taking full advantage of the extra opportunities for individual, focused and sustained attention provided by small classes. The benefits of having fewer children will not flow in any natural way – indeed, as we have seen, the benefits resulting from more contact with children can create problems, e.g., in terms of interruptions. Teachers have to work just as hard to manage learning effectively.

This suggests that initial teacher training and professional development courses could do more to consider how to make the most of the opportunities provided by smaller classes, e.g. in terms of opportunities for sustained and responsive contacts. In Britain, Galton et al (1996) suggest that there is not likely to be much preparation in initial teacher training concerning ways of adapting teaching to class size. Student teachers on teaching practice tend to graduate through teaching individual children, then small groups and then the whole class. When they get their own class they are left to adapt to it on their own. Galton et al suggest allowing student teachers opportunities with smaller classes. For example with half the class, while the teacher takes the other half in another location. This would help the student teacher gain experience of teaching the whole class, and getting experience of the kind of sustained and focused teaching Galton and many others recommend.

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