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Beyond class size reduction: Towards more flexible ways of implementing a reduced pupil–teacher ratio

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ABSTRACT

The effect of a reduced pupil–teacher ratio has mainly been investigated as that of reduced class size. Hence we know little about alternative methods of reducing the pupil–teacher ratio. Deploying additional teachers in selected subjects may be a more flexible way, both pedagogically and financially, to exploit the opportunities for adapting instruction inherent in reducing the number of students under a teacher's responsibility. In this paper, we discuss limitations to previous class-size research and suggest more flexible ways to implement a reduced pupil–teacher ratio. One alternative approach is illustrated with a change in national policy in Norway to increase teacher density as well as research following this initiative.

1. Rationale for reducing the pupil–teacher ratio

Students excel when teachers differentiate material for each student's zone of proximal development (Connor et al., 2013; Coyne et al., 2013; Walpole, McKenna, & Corley, 2007), provide frequent formative feedback (Hattie & Timperley, 2007) and build close relationships (Cadima, Leal, & Burchinal, 2010; Curby, Rimm-Kaufman, & Ponitz, 2009). However, teachers experience many challenges in providing such individualized support, including time for multi-level instruction (i.e. teaching one primary objective or concept to the class while allowing for varying outcomes for an individual student or a small group of students), management of multiple groups and flexibility for uneven pacing of students' progress (Ankrum & Bean, 2008; Schumm & Vaughn, 1995; Schumm, Moody, & Vaughn, 2000). Those challenges amplify with an increasing number of students. Hence reducing the number of students under a teacher's responsibility is often suggested as a way of enhancing academic achievement.

Both the debate and research about the pupil–teacher ratio (PTR) have been dominated by a focus on class size. In this paper we discuss limitations to class-size reduction (CSR) and suggest alternative ways of conceptualizing a reduced PTR. In the final part of the paper, we use a recent change in Norwegian educational policy as an illustration of a more flexible approach.

2. What has class-size research taught us about the effect of a reduced PTR?

In a review of class-size research, Blatchford (2011) identifies two generations of research and argues for a third. The first one examined effects of class-size differences and CSR on students' academic outcomes, but studies and even meta-analyses arrived at different conclusions concerning the magnitude of the effect of class size on academic outcomes (Blatchford, 2011; Hattie, 2005).

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Consequently, opinions vary greatly: some argue that reducing class sizes is not a cost-effective way to improve academic outcomes (e.g. Hanushek, 1999) while others claim that it should be a cornerstone of education policy (Achilles, 2000).

To address the lack of conclusive findings from that first generation of research, a second – more recent – generation has concentrated on relationships between class size and classroom processes, i.e. on understanding how class size might affect interactions between teacher and students. Blatchford (2011) argues that this change of research focus was essential not only to understand class-size effects but also to provide practical guidance on how to maximize the opportunities offered by classes of different sizes. Various aspects of classroom processes have been investigated, with the process most consistently identified as affected by class size being the individualization of teaching (e.g. Blatchford, Bassett, Goldstein, & Martin, 2003; Pate-Bain, Achilles, Boyd-Zaharias, & McKenna, 1992). In addition, studies have looked into classroom management and control (e.g. Blatchford, Bassett, & Brown, 2008; Cooper, 1989), teacher stress (e.g. Biddle & Berliner, 2002) and on-task behaviour (e.g. Blatchford et al., 2008; Cooper, 1989; Finn & Achilles, 1999). However, this second generation of research has also yielded mixed evidence, with some studies concluding that the effects and benefits of CSR for classroom processes are relatively trivial (e.g. Ehrenberg, Brewer, Gamoran, & Willms, 2001; Slavin, 1989) and others arriving at more positive conclusions regarding the effect of class size on classroom processes (e.g. Anderson, 2000; Finn, Pannozzo, & Achilles, 2003).

Blatchford (2011) concludes his review of class-size research by identifying some limitations to previous research, especially the lack of studies evaluating good practices. Arguing that such research is crucial in order to figure out *how* increased teaching resources should be applied to achieve a maximum impact on teacher–student interaction and students' academic outcomes, he calls for a third generation of research that will explicitly test which teaching methods are effective in small classes.

3. Why the need to reconceptualize PTR reduction?

Although class-size research has contributed important knowledge about the effects of a reduced PTR, there are some clear limitations. First, research into CSR, for obvious reasons, has regarded class size as a static school factor. Such a view, however, is somewhat out of step with current trends in the staffing of classrooms. In many countries, schools vary their classroom organization during the day and between subjects. For instance, regularly deploying an extra teacher to particular lessons has been suggested as a cost-effective way of providing students with individualized support. In such a scenario, teaching resources may be directed towards specific age groups and core subjects. In addition, frequent use of assistants and additional teachers (e.g. special-education teachers) also makes it less relevant to operate with a fixed number for class size. This increased classroom flexibility requires more flexible research approaches as well.

3.1. Co-teaching as an alternative approach to reducing the PTR

In the present article, we have chosen to use the term 'co-teaching' for the type of collaboration between teachers that occurs when the PTR is reduced by having more than one teacher involved in the teaching of the same student group. We are aware that this term has previously been used in a slightly different sense about collaborative teaching between a general educator and a special-needs teacher when including children with learning disabilities in mainstream classrooms (Friend & Cook, 2016). Our use of this term in the present context reflects a wish to emphasize that (i) the PTR is reduced, (ii) two or more educators work collaboratively, (iii) the educators deliver instruction to the same group of students and (iv) the focus is on the teaching as such, not on other forms of collaboration such as meetings, teams or parent conferences. To this should be added that while, in principle, all students belonging to such a group attend the same class, individual students or groups of students may work with a teacher in a separate classroom during some lessons or parts of lessons.

Previous research into the effect of having an additional teacher in the class is, at best, scarce. However, experiences from Teachers Teaching Together (TTT) within the Primary Needs Programme in Leeds (Alexander, 1997), literature on team teaching and more recent studies on co-teaching (see e.g. Friend & Cook, 2016) all include relevant perspectives on emerging possibilities, practices and challenges when teachers teach together. In our view, a reduced PTR seen through the lens of co-teaching could help to revitalize the discussion about CSR. Below is a brief discussion of some relevant findings.

3.1.1. Effectiveness of co-teaching on student academic achievement

Only a few studies have investigated the effect of co-teaching on student outcomes, and those studies typically concerned students with learning disabilities in inclusive settings. In 2001, Murawski and Swanson (2001) summarized articles pertaining to co-teaching between general teachers and special-education staff. Of 89 reviewed studies, only 6 reported sufficient data to calculate effect sizes. The outcome variables used included grades, achievement scores ($n = 5$) and social and attitudinal variables ($n = 4$). The average total effect size was 0.40. Rea, McLaughlin, and Walter-Thomas, (2002) investigated students with learning disabilities in co-taught classes and found that they performed better on measures such as report-card grades and attendance than students in single-teacher classes. However, student performance on standardized tests was comparable across the types of classes. In an evaluation of inclusive practices in eight elementary and secondary schools, Idol (2006) found that scores on state-wide tests were little affected by co-teaching, for students with and without disabilities alike. Murawski (2006) investigated student achievement by comparing the achievement of students with disabilities in resource (i.e. separate) classes, co-taught classes and general-education classes without co-teaching, finding no significant differences across settings.

3.1.2. Collaboration between co-teachers

Rather than focusing on learning outcomes, research into co-teaching has been concerned with the nature of the collaboration and the roles and responsibilities of the teachers. In the following, we will introduce three of the key issues that have emerged as important for understanding co-teaching: organizational forms, collaborative style and collaborating teachers. It is important to note that co-teaching may be carried out in various organizational forms – there may be two or more teachers teaching a group or class of students together in the same classroom or two or more teachers teaching a group or class of students by separating the group between them and teaching one group each. Friend and Cook (2016) describe six distinct co-teaching approaches that differ in the degree to which each educator contributes in the delivery of content and/or engages with students: 1) *One lead, one observe*: one instructor is the primary deliverer of content while the other instructor observes. (2) *One lead, one assist*: one instructor is the primary deliverer of content while the other instructor moves among individual students or student groups to answer questions, direct activities and provide support to the lead instructor. (3) *Station teaching*: students migrate to stations to participate in different learning activities and each instructor serves as an expert guide for one or more specific stations (and students rotate among all stations). (4) *Parallel teaching*: instructors facilitate the instruction of the same material and activities by engaging with sub-groups of students within the larger teaching space or in separate classrooms. (5) *Alternative teaching*: co-instructors address the needs of different student groups; one instructor may be working with the majority of students while another is engaged with a smaller group of students who have a particular instructional need such as remediation. (6) *Team teaching*: each educator contributes equally with other instructors who all engage in trading-off or "tag-teaming" at specific signals or content breaks. Given this variety and given that some organizational forms may turn out to be more effective than others, any investigation into the effect of co-teaching approaches should be contextualized in that attention should be paid to whether certain approaches are more effective for certain subjects and age groups (Friend, Cook, Hurley-Chamberlain, & Schamberger, 2010). To this should be added that organizational forms may also differ in the degree to which they affect the teachers involved and their collaboration.

Co-teaching requires a high level of commitment to a collaborative process. In the Primary Needs Programme, the researchers identified two main forms of collaboration: working alongside and withdrawal (Alexander, 1997). As Alexander (1997) notes: "[c]learly, it is far less problematic for the teachers involved if they take full responsibility for separate groups of children and work independently – especially when their independence is underlined by physical separateness" (p. 95). The project revealed that many teachers struggled with working alongside others, even if they had good intentions, and insights from both TTT and co-teaching projects emphasize shared planning as a prerequisite for successful co-operation (Alexander, 1997; Friend & Cook, 2016). Even if teachers do manage to work alongside each other to some degree, their collaboration can take different forms: (i) one of them may take the leading role in planning, teaching and evaluation whereas the other one helps where needed, (ii) one of them may take the leading role in planning, teaching and evaluation but assign the other teacher distinct tasks for each lesson, or (iii) the teachers may make plans, teach and evaluate together and take similar responsibility for all students in the class. Only in the last scenario do teachers share leadership and take on the same obligations.

Finally, even if collaborating teachers bring similar or different expertise to the classroom, much will depend on the mutual relationship that they are able to establish. One challenge in this respect noted by Alexander (1997) is that teachers are used to having "their" class and that the notions of territory, ownership and autonomy are deeply embedded in their professional consciousness. In the Primary Needs Programme, it was found that TTT could threaten those notions, especially if the second teacher had higher status than the class teacher, and that both parties could find the situation difficult: for the class teacher, the problem was one of territory and ownership; for the second teacher, it was one of access. To sum up, there are several issues beyond the themes considered in previous class-size research that become important when a reduced PTR is conceptualized in alternative ways.

4. Teacher density in Norwegian educational policy: an illustration

To illustrate how an alternative approach to a reduced PTR might be implemented, the last part of this paper will be devoted to describing a change in Norwegian educational policy, from a specific class-size limit to a more flexible approach involving overall "teacher density". The teacher-density approach differs from CSR in that each school makes its own decisions about how to implement a reduced PTR. This allows greater flexibility in the organization of classrooms and teaching (as opposed to simply reducing fixed class sizes on a permanent basis). We will also describe a research initiative which is designed to generate knowledge about the effects of increased teacher density at Norwegian lower-primary schools (6–9-year-olds) by providing new insights into the effects on students' learning and learning environment exerted by different ways of using more teaching staff at schools. As a background, we will first give a brief introduction to the Norwegian school system.

4.1. The Norwegian educational system

Primary and lower-secondary education in Norway is founded on the principle of a unified school system that provides equal and adapted education in an inclusive environment based on a single national curriculum (Ministry of Education & Research, 2013a). Within the framework of statutes and national curricula, municipalities, schools and teachers are free to decide what learning materials to use and what teaching methods to adopt. Public (i.e. non-private) schools dominate the educational sector: less than 4 per cent of students attend private primary or lower-secondary schools (Statistics Norway, 2017). Children also have a statutory right to attend their neighbourhood school. This right applies to all children, including those with special needs. Hence only 0.6 percent of primary-school students are enrolled in public special schools (Norwegian Directorate for Education & Training, 2017). Taken together, this results in heterogeneous student groups.

Compulsory schooling in Norway lasts for ten years and children start school at the age of six. Compulsory schooling can be divided into two parts: primary education (grades 1–7) and lower-secondary education (grades 8–10). Primary education is also often divided into lower primary (grades 1–4) and upper primary (grades 5–7). Upper-secondary education (grades 11–13) is not compulsory, but most (92%) Norwegian young people enrol in it (Norwegian Directorate for Education & Training, 2017) and all of them have a statutory right to do so (The Education Act, 1998). Responsibility for primary and lower-secondary education rests with municipalities (local authorities) while counties are responsible for upper-secondary education.

4.2. From class size to teacher density in Norwegian educational policy

Before 2003, Norwegian schools had a class-size limit of 18 students in grade 1, 28 students in grades 2–7 and 30 students at lower-secondary school. However, by 2003, many schools did not operate with defined classes but varied the groups and group sizes throughout the day. Hence many responsible authorities found the class-size limit too rigid, which is why the rule was abolished. However, there seemed to remain a consensus, across political divides, about the importance of a high PTR at primary school, and one Section (1.3) of the Education Act (1998) providing that municipalities have an obligation to ensure a particularly high teacher density in grades 1–4 in the subjects of Norwegian, Sami and mathematics was kept despite the reform. In addition, the amount of funding earmarked for primary-school teachers has increased steadily over the past years in order to strengthen efforts in the fields of early intervention and enhanced learning by students. Even so, because of differences in PTR across schools and municipalities, the teachers' union (i.e. Union of Education Norway), the national parents' committee and the national association of school students kept arguing for a common "teacher norm".

The debate about increased teacher density at Norwegian schools has reflected diverging opinions. One side founds its arguments on studies using natural experimental approaches to the issue of reduced class size (e.g. Leuven & Løkken, 2017). Based on those studies, they argue against a major increase in public resources spent on increased teacher density as the effects on student outcomes in Norwegian schools are uncertain and will probably be limited (see e.g. Kirkebirkeland, 2017). However, it has been claimed that natural experiments of this kind are hardly relevant to policy as their conclusions are based on arbitrary variations in class size, and that schools might need more predictability to make use of an increased teacher density in ways that influence students' motivation and academic achievement (Rege & Solheim, 2017). The other side, which includes the teachers' union, have argued that the flexibility inherent in increased teacher density may have additional effects compared with a reduced class size *per se* (see e.g. Handal, 2017). Finally, it has been pointed out that there is a lack of studies evaluating good practice, i.e. trying to determine *how* increased teaching resources should be applied to have a maximum impact on teacher–student interaction and student outcomes (Rege & Solheim, 2017).

Recently, common efforts by the teachers' union, the national parents' committee and the national association of school students have resulted in a policy decision to increase teacher density; a teacher norm was introduced in Norwegian schools starting in the 2018/2019 academic year (Ministry of Education & Research, 2018). Under this teacher norm, teacher density in grades 1–4 may not exceed 1:16 in 2018/2019 and 1:15 from 2019/2020 onwards. While this policy change reduces the flexibility and autonomy of responsible authorities to some extent, schools and teachers have welcomed the fact that they are now free to organize student groups in the way they find best, for example by reducing class sizes or by deploying more than one teacher in the class. For this reason, they find the teacher norm more flexible than the previous class-size limit[1].

4.3. Norwegian research initiatives relating to teacher density

As Norway places strong emphasis on providing high-quality education for all and has a high level of expenditure, substantial resources are devoted to educational research. Recent years have seen growing governmental interest in research that provides knowledge about the causal effects of particular factors in the educational sector (Pontoppidan et al., 2018). The need for more knowledge about "what works" and "why it works" has resulted in several initiatives from the Ministry of Education and Research (Ministry of Education & Research, 2013b, 2017). Given that the efficacy (or otherwise) of increased teacher density might not be directly inferable from the previous studies on CSR, funding was allocated to research into the impact of increased teacher density (Ministry of Education & Research, 2015). A special Teacher Density and Student Achievement Initiative (Norwegian short name: "LÆREEFFEKT") was assigned an overall budget of NOK 490.5 million (equivalent to approximately 49 million Euro) over a four-year period (2016–2020) and was established as a specific research activity at the Research Council of Norway, with the Division for Society and Health given overall responsibility for the project.

The objective of this initiative is to generate knowledge about the effects of increased teacher density in lower-primary school (grades 1–4, ages 6–10) and to provide new insights into how students' learning and learning environment are affected by different ways of using more teaching staff at schools (The Research Council of Norway, 2015). In 2015, the initiative called for project ideas that would test various ways of increasing teacher density, such as interventions using a two-teacher system, one-on-one teaching, teaching in small groups or increased teacher density for special groups of students. Further subjects deemed relevant were the study of the impact of specific teaching methods and the raising of competency related to increased teacher density. The research

[1] The implementation of a teacher norm introduces a range of other challenges which have been heavily debated. For example, it may be difficult to recruit qualified teachers, especially in rural areas. However, those other challenges will not be discussed in the present article, as its focus is on opportunities for flexibility in the organization of schools and teaching rather than on practical consequences of the teacher norm.

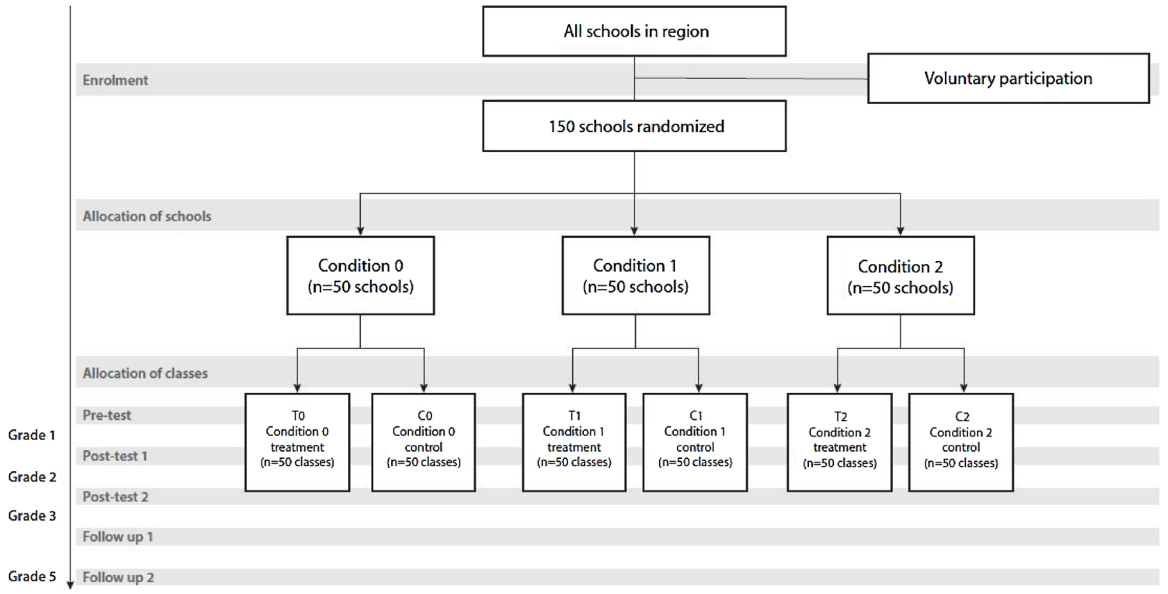

Fig. 1. Study design of the Two Teachers project.

programme gave top priority to randomized controlled trials (RCTs) investigating the effects on student learning outcomes and learning environments in a short- and long-term perspective (The Research Council of Norway, 2015). Following a competitive process, the initiative decided to fund two large-scale RCTs: *Two Teachers: Increasing the opportunities for differentiated reading instruction* (short name: Two Teachers) and *1 + 1 Small group Instruction in Mathematics* (short name: 1 + 1). Both RCTs investigate the effect of deploying an additional teacher during specific lessons, but in different subjects and using different approaches. In this way, the projects provide knowledge about how additional teacher resources can be used to enhance learning in a specific subject. This means that Norway is responding to the above-mentioned call by Blatchford (2011) for a third generation of research encompassing projects that evaluate effective teaching and pedagogies when PTR is reduced as well as Friend et al.'s (2010) recommendation to evaluate whether certain co-teaching practices are effective for specific subjects and age groups.

4.3.1. Two Teachers

The Two Teachers project investigates individual and complementary effects of increased teacher density in the form of a two-teacher system, professional development for teachers and specific approaches to co-teaching (Solheim, Rege, & McTigue, 2017[2]). The project involved 150 schools in 53 municipalities across the southern part of Norway. At each school there was one treatment class and one control class. The treatment classes received an additional teacher in Norwegian lessons, 8 × 45 min a week, for 38 weeks, in grades 1 and 2. The control classes received no additional teaching resources. The participating schools were further divided into three different conditions. The 50 schools in condition 0 represented a "business as usual" situation. The 100 schools in conditions 1 and 2 participated in a programme for professional development in literacy instruction, and the 50 schools in condition 2 also received additional instructions on how to use the extra teacher in the treatment class (Fig. 1).

In conditions 0 and 1, teachers in treatment classes were free to choose their co-teaching practices, resulting in typical rather than model approaches to co-teaching. In condition 2, by contrast, specific guidelines for how the extra teaching resources should be used in the treatment class were provided (i.e. model practices). The practices recommended had been chosen to exploit the opportunities that having an additional teacher offers when it comes to implementing organizational and instructional approaches which make it possible to tailor the instruction to the students' individual needs (such as regular informal assessment of skills and motivation as well as guided reading in achievement-level groups).

The treatment effects on the students' motivation and literacy skills will be evaluated immediately after the intervention and at a two-year follow-up. Supplementary analyses will further explore whether teachers' experiences with and approaches to co-teaching moderate any effect (if found). Further, the resulting teaching practices and teachers' experiences are approached qualitatively by means of teacher interviews and classroom observations.

4.3.2. 1 + 1

The main goal of the 1 + 1 project is to study the effects of small-group instruction on students' skills in mathematics. This

[2] Owing to the policy change enacting the teacher norm, which took place while the Two Teacher project was still running, the design had to be changed compared with the original plan as reported in the study protocol. Concretely, the duration of intervention was reduced from 4 to 2 years; interventions were terminated after the 2017/2018 academic year.

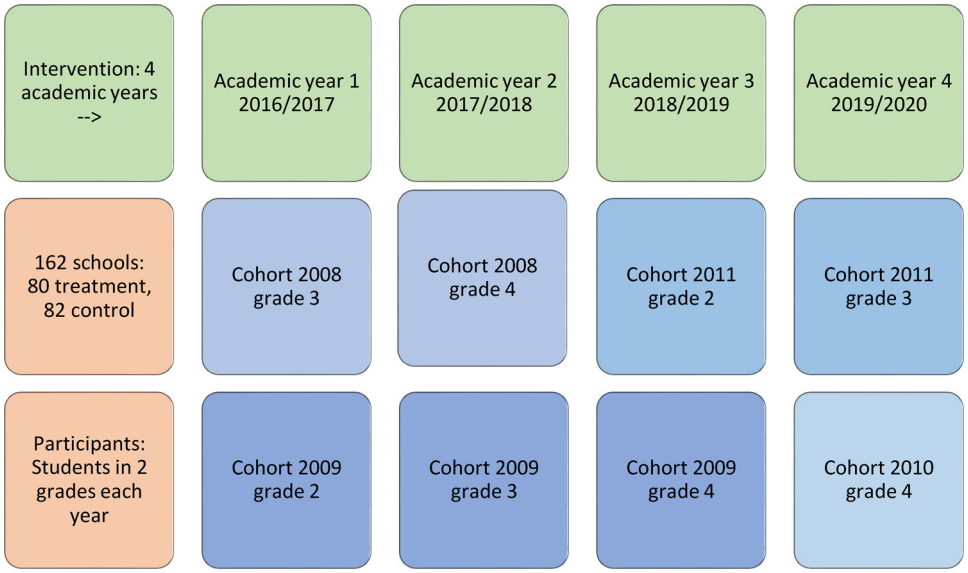

Fig. 2. Study design of the 1 + 1 project.

ongoing project is aimed at students at lower-primary school (grades 2–4) and takes place in ten of Norway's largest municipalities. The project includes a total of 162 schools.

To investigate whether small-group instruction in mathematics improves students' skills in mathematics, an RCT is being carried out during four academic years (2016–2020). The schools are divided into two groups of equal size – a treatment group (80 schools) and a comparison group (82 schools). The treatment-group schools receive the resources needed to employ one full-time teacher[3] qualified to teach mathematics. The schools in the comparison group carry on their normal practice without receiving any additional resources.

The additional teacher at the treatment schools is instructed to pull out one group of students a time for tuition in a separate classroom. Pull-out groups consist of no more than 6 students and are maintained for 4–6 weeks before a new group of students are pulled out. Group composition may vary across the academic year, but all students should have received two periods of small-group instruction in mathematics by the end of the year. This treatment includes an element of reduced class size, as the remaining class will naturally be reduced in size when a group of students receive small-group instruction in a separate classroom. Students in two different grades are included in the project each academic year; a total of four cohorts are included in the overall intervention. One of those cohorts participates in the intervention for only one academic year, while the other three participate for two or three years. Fig. 2 illustrates the main features of the design of the 1 + 1 project. This design allows ample analyses of students' age, length of treatment and implementation quality during the four years of interventions.

Students' skills in mathematics are measured through short tests before and during the intervention (pre-test, intermediary tests), and the Norwegian national test in numeracy for fifth-grade students will serve as a post-test for all four cohorts of students.

5. Concluding remarks

We have seen in this paper that several issues, beyond the themes considered in previous class-size research, become important when a reduced PTR is conceptualized in more flexible ways. For instance, the choice of organizational format and the type of collaborative teaching must be considered to fully understand factors that might affect implementation. The carefully designed studies in the major Norwegian research initiative described in this paper will add to the knowledge base in substantial ways. First and foremost, those studies represent innovative approaches to the study of a reduced PTR. Further, as much existing research is becoming dated and the majority of it was conducted in a limited set of countries (the United States, the United Kingdom, France and Hong Kong), they provide more up-to-date information from new contexts. Insights from present-day classrooms in various educational contexts are urgently needed to revitalize the debate about the PTR.

The two projects presented also offer more data on implementation than has often been the case in previous studies of class size. Close collaboration with the participating schools and responsible authorities will provide insights into the barriers and drivers that come into play when new forms of collaboration, organizational structures and learning methods are implemented in schools. Both projects involve a frequent dialogue and regular feedback meetings with the participating schools and municipalities, which is likely

[3] The schools have employed either one full-time teacher or two teachers who spend 50% of their time on the 1 + 1 project. At 26 of the 80 treatment schools, there are two teachers who share the task of conducting small-group instruction in mathematics (they often take on students in one grade each, as the project includes students in two grades each year).

to ensure their relevance on various levels. Also, both projects collect data on treatment fidelity throughout the project period, which makes it possible to conduct studies of whether fidelity to the intervention is stable or varies. For instance, it may be interesting to know to what extent treatment fidelity varies during the project period or across participating schools and municipalities. Additionally, the longitudinal approach of both projects entails a unique opportunity to investigate whether teachers change their approaches to co-teaching over time (as they gain more experience).

In previous research, different explanations have been suggested for the failure to find increased student achievement in small classes and co-taught classes. Those explanations frequently highlight a lack of training in the approach taken (both CSR and co-teaching) and a lack of common planning time (co-teaching only). The underlying objective of conducting RCTs with multiple levels of data (e.g. teachers, students, administrators) and multiple conditions (e.g. with or without additional training) is to confirm or refute such explanations.

Also, following Blatchford (2011) suggestion, the Two Teachers project evaluates the effect of increased teacher density along with (though separable from) another approach that is expected to influence student learning, namely professional development for teachers. Recent reviews suggest that teachers' instructional practices might be more important than class size for improving student learning (see e.g. Konstantopolous & Chung, 2011). For this reason, we have chosen to implement a programme for professional development ("Language Track") which has been designed on the basis of characteristics found to be essential when it comes to increasing knowledge and practice, including collective participation, active learning, content focus, coherence and duration (Stoll, Bolan, McMahon, Wallace, & Thomas, 2006). More knowledge about the potential benefits of investing in professional development compared with those of investing in increased teacher density might guide educational policy in terms of how resources should be used in an educationally effective manner.

Finally, although both projects will provide new and important knowledge about the effects of increased teacher density, there will still be a need for further research on this topic, in relation to other types of co-teaching approaches, classroom organization, age groups and subjects. Also, to understand the interactions between teacher density and teachers' instructional practices and to gain more knowledge about factors that potentially mediate or moderate any effect on students' learning outcome, future research would benefit from studies that combine achievement data with systematic observations of classroom practices.

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