

Collaborative group work in primary schools

RESEARCH ARTICLE

Improving the effectiveness of collaborative group work in primary schools: effects on Science attainment.

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Abstract

This longitudinal research tests the effectiveness of the SPRinG programme which was developed through a collaboration between researchers and teachers and designed to provide teachers with strategies for enhancing pupil group work in ‘authentic’ classroom settings. An evaluation study involved comparing pupils in SPRinG classrooms and trained in group work skills with those who were not in terms of science attainment. There were 560 and 1027 pupils (8-10 years) in the experimental and control groups respectively. ‘Macro’ attainment data were collected at the start of the year. ‘Micro’ attainment data were collected in the spring and summer before and after science lessons involving either group work (intervention) or the control teachers’ usual approach. SPRinG pupils made greater academic progress than control pupils. Findings are discussed relative to enhancing the quantity and quality of group work in schools and a social pedagogic approach to classroom learning.

Introduction

There is now a large research literature indicating that cooperative and collaborative group work has positive effects on pupil academic and social outcomes (see Slavin, Hurley & Chamberlain, 2003; O'Donnell & King, 1999; Webb & Palincsar, 1996). However, this picture contrasts with accounts of the use of groups in UK schools which have consistently shown that little genuine group work takes place and still less is of good quality (Baines, Blatchford & Kutnick, 2003; Galton, Hargreaves, Comber, Wall & Pell, 1999). In an often quoted finding, Galton, Simon and Croll (1980), showed that within the majority of primary classrooms children sit *in* groups but rarely work *as* groups. Instead, pupils work individually or as a whole class. A replication study two decades later showed only a slight increase in pupil social interaction in favour of task related exchanges within groups. Even then, these task-focused interactions between pupils mainly involved exchanging information rather than discussing ideas (Galton et al., 1999).

A main reason for this state of play in UK schools is that the predominant pedagogy adopted by teachers emphasises the teacher-child relationship, and this is rarely extended to allow for relations involving co-learners or peers. Yet pupils spend greater amounts of time with their peers, than with their teachers (Galton et al., 1980; 1999). Research providing a systematic, multi-dimensional description of grouping practices and learning contexts in primary and secondary school classrooms shows that groupings are rarely formed on the basis of a strategic educational view of their purpose (Baines et al., 2003; Blatchford, Baines, Kutnick & Martin, 2001a; Blatchford, Kutnick & Baines, 1999; Blatchford, Kutnick, Clark, MacIntyre & Baines, 2001b; Kutnick, Blatchford & Baines, 2002). Teachers' grouping practices were, to a large extent, an adaptation to the demands of maintaining pupil attention, to classroom control, and to classroom layout. Teachers typically plan for their interactions with pupils, but not for interactions between pupils. This is not surprising given that a sizeable number of pupils and teachers do not appear to have specific preparation in the use of group work (Blatchford et al., 1999). There is thus a need for an appreciation of group work as part of a teacher's general approach to classroom organisation and learning, and to support such a view we need to revise theories of classroom learning and approaches to pedagogy (Blatchford, Kutnick, Baines & Galton, 2003).

Another main reason for the lack of genuine good quality group work in schools is that much research on cooperative, collaborative and other types of co-learning does not take place in authentic settings and provides little practical advice for teachers to use and adapt group work to their particular contexts. Typically research involves working with small groups one at a time, predominantly explores the effects of a highly structured co-operative framework, experimentally restructures classes into grouped (or non-grouped) situations, often involves working on novel tasks

that are unrelated to the curriculum and typically provides a specific mandatory training programme for teachers in the management of co-operative groups. Many of these studies demonstrate that with training and support, teachers using small groups can enhance certain forms of pupil learning and social interaction (Kulik & Kulik, 1992; Lou, Abrami, Spence, Poulsen, Chambers & d'Apollonia, 1996; Slavin et al., 2003). However, imposed structures and methods provide few strategies for dealing with common management issues and may not always meet the needs of teachers operating in everyday classroom settings where multiple groups and learning tasks may be undertaken simultaneously (Blatchford et al., 1999). Teachers need to be able to use flexibly a variety of types of co-learning, including co-operative, collaborative, helping and tutoring, and to be able to adapt these for use in different contexts to benefit pupils. More recent research (see chapters in Blatchford & Kutnick, 2003; Joiner, Littleton, Faulkner & Miell, 2000) has extended understanding of specific aspects of working in groups, for example, help seeking and information giving (Webb & Mastergeorge, 2003), processes involved in decision making (Howe, Duchak-Tanner & Tolmie, 2000; Howe & Tolmie, 2003; Pine & Messer, 1998), the role of exploratory talk (Mercer, 2000), and peer tutoring (Topping, 1994). Such studies are valuable but still do not provide a basis for teachers to implement group work across the curriculum and over the school year.

The need for practical strategies for setting up and managing group work in natural classroom settings is further highlighted by studies showing that teachers and pupils have doubts about, and difficulties implementing, group work in classrooms (Bennett & Dunne, 1992; Cowie, Smith, Boulton & Laver, 1994; Galton & Williamson, 1992). Teachers' concerns about group work include: the loss of control, increased disruption and off task behaviour (Cohen & Intilli, 1981); beliefs that children are unable to learn from one another (Lewis & Cowie, 1993); beliefs that group-work is overly time consuming and that assessing children when working in interactive groups is problematic (Plummer & Dudley, 1993). A particular concern held by many teachers is that it is only the more academically able who profit from group work or that they get held back by having to work with pupils who have more ground to make up. Teachers also hold the view that some pupils, particularly boys, will misbehave during group work and that this will adversely affect others and the quality of group work and its performance. These views contrast with research findings that suggest that all ability groups and boys and girls gain equally from cooperative and collaborative group work (Palincsar & Herrenkohl, 1999; Slavin et al., 2000). These problems suggest a need for improved pupil training in group-work skills under normal classroom conditions. More importantly, they suggest that little improvement will take place unless researchers work in partnership with teachers so that these concerns are fully taken into account. Appropriate strategies for dealing with these concerns need to be developed and be applicable to authentic classroom settings. This was the basis of the SPRinG project reported on in this paper.

The SPRinG project

Overcoming the problems identified in the last section suggested to us that a new approach to conceptualising group work in classrooms was needed. We adopted an inclusive view of classroom groups that recognised the contributions of previous research but sought to put them together in a more general application. We were keen to focus on types of group work that encourage high level talk and that potentially benefit learning and attainment rather than group work models that involve just low level skills. Group work was conceptualised in general terms as involving children as *co-learners* (Zajac & Hartup, 1997), and was inclusive in that it incorporated cooperative, collaborative, and helping interactions.

In collaboration with groups of teachers over the course of a year we developed a programme of group work that could overcome concerns held by teachers and pupils and which could be successfully integrated into primary and secondary school life. Approaches and materials were developed at three sites - KS1 (5-7 years) at the University of Brighton, KS2 (7-11 years) at the Institute of Education, University of London, and KS3 (11 – 14 years) at the University of Cambridge. This paper is just concerned with KS2. The SPRinG programme and social pedagogical approach was set out in a ‘handbook’ for teachers. This programme was then evaluated systematically by examining pupil progress over a full school year and in comparison to pupils in a control group.

The approach was based on 4 key principles with practices associated with each.

A relational approach. A key feature of the SPRinG programme is that group work skills have to be developed (Webb & Mastergeorge, 2003). We cannot just put children into groups and expect them to work well together. It is well known (see Gillies, 2003) that pupils need to have the skills to communicate effectively through listening, explaining and sharing ideas. But effective group work involves more than this; pupils have to learn to trust and respect each other (Galton, 1990). They also need skills on how to plan and organise their group work, make considered group decisions, reach a compromise and avoid petty disputes. The approach is based on a naturalistic study of close social relationships (Kutnick & Manson, 1998), and has been devised to overcome problems associated with social skills training programmes. Pupil skills for group work are unlikely to be long lasting if they are approached in isolation. They will benefit from integration into more general class rules.

A central aim in effective group work is the development of pupil independence, and a shift in responsibility for learning from teacher to pupil. Pupils should also be encouraged to work in groups

whatever the personality types involved and to resolve their problems together. If not addressed directly then difficulties between pupils may lie below the surface and inhibit classroom learning. So, paradoxically, the setting where difficulties in children's behaviour and relationships are most evident may be where such problems are most effectively dealt with.

Preparation of the classroom context for group work. The approach rests on the view that effective group work can be facilitated by structuring the group work context in a number of key ways. For instance, by altering the classroom layout, increasing the proximity of pupils with each other, ensuring group size (usually small groups of 2-4 pupils) is appropriate to the experience of pupils and the task at hand, can all help to reduce noise and encourage group interaction.

Preparation of lessons and activities involving group work: curriculum and group work activities. One common assumption, which can hinder the development of group work, is the view that the demands of the curriculum mean there is no time for group work. But it is important that we do not examine small group learning independently of the curriculum and the culture of the classroom (Webb & Palincsar, 1996). Much research on group work has tended to be rather curriculum specific, or extra curricular, but our aim was to encourage the development of group work skills that are both generic and also applicable to specific curriculum areas. If effective learning is to take place the relationship between the task and the quality of group interaction is important (Bossert, Barnett & Filby, 1985). Yet designing tasks that encourage group work is difficult. It is important that the task is set up in a way that is conducive to working together and not individual work.

Involvement of teachers in the support of group work. A major part of the programme was the need to develop classroom and interactive strategies for teachers to promote and support high quality group processes. We suggest several ways of conceiving how teachers can make group work productive. One way is by lowering the risk for pupils, while ensuring the challenge remains high (Doyle, 1986), through a process of 'scaffolding' or structuring the task, group context and/ or the interaction (see Palincsar & Herrenkohl, 1999; Tolmie, Thomson, Foot, Whelan, Morrison & McLaren, 2005). Scaffolding, when it comes to supporting group work, has not been fully researched but will involve the teacher structuring lessons, encouraging reflection on group processes, and monitoring and guiding group interactions.

Evaluation of the SPRinG programme

This paper is about the evaluation of the SPRinG programme in terms of its effect on pupil attainment over the course of the intervention year. In other papers we have examined the effect of the SPRinG programme on pupil-pupil and teacher-pupil behavioural interactions (Blatchford, Baines, Rubie-Davies, Bassett & Chowne, 2006) and on attitudes and motivation (Blatchford, Galton, Kutnick & Baines, 2005).

The decision to assess group work under normal classroom conditions over a full school year resulted in difficult decisions about research design and data collection. Given the breadth of the programme there was no possibility of controlling all aspects of how teachers implemented group work into the curriculum. Indeed part of the rationale and ecological validity of the programme was to encourage teachers to make informed decisions about how to use group work in their classrooms and for which curriculum areas. But to conduct a valid evaluation of the group work programme at KS2 we imposed some commonality by ensuring teachers used group work on a regular basis in science as well as in their preferred curriculum areas. Science was chosen because of the coverage in the curriculum of separate and clearly defined topics, the relatively easy way in which group work can be introduced, and the acknowledged role of social interaction in science understanding (Adey & Shayer, 1994). But a more practical reason was that in many English schools pupils are allocated to 'sets' (i.e., classes formed of pupils of similar ability) usually for the teaching of the core subjects of maths and English (see Blatchford, Bassett, Brown, Martin & Russell, 2004). Setting complicated matters because it was common for pupils to be taught by a teacher not involved in the SPRinG project and thus not implementing SPRinG group work. In contrast pupils were not set for science, and it would therefore be easier for teachers involved in SPRinG to carry out group work activities in that subject.

In order to evaluate the effect of the programme we measured pupil progress over the year by way of general 'macro' science assessments at the start and end of the year. It was anticipated, however, that it may prove difficult to trace any effects identified on these general assessments back to particular group work experiences. General assessments of science would incorporate learning where group work had and had not been used and thus may cloud findings. To impose further commonality on SPRinG pupils' experiences of group work in science, we developed lesson outlines involving group work on two science topics. All teachers were asked to cover these lessons and we also sought to assess progress due to these lessons on a range of types of knowledge ('micro tests'). If we found effects of SPRinG on attainment at both micro and macro levels there would be a good case that these effects were due to the group work intervention.

There is also uncertainty about the types of knowledge most affected by group work. Most studies use cooperative methods to help children master well defined skills or information (Slavin et

al., 2000). However, Damon (1984) argues that group work is best suited to learning processes which involve transcending current levels of understanding to reach a new perspective, rather than learning processes which involve the acquisition of new skills or procedures (which may be best furthered in contexts involving more skilful partners, for example see Howe et al., 2000), or the practising of skills. It has also been argued that the act of engaging in collaborative interaction is good for developing critical thinking skills (Davidson & Worsham, 1992) and higher order thinking strategies, such as the analysis, synthesis and evaluation of knowledge (Bloom, 1956). Research on group work in science indicates that group work is effective for progress in conceptual understanding (Howe et al., 2000). This research also reports delayed effects whereby students that have experienced group work continue to improve in their understanding after immediate testing without further coverage of the topic. In one study delayed effects were evident 11 weeks after the initial experience (Tolmie, Howe, Mackenzie & Greer, 1993).

The present study aimed to evaluate the effectiveness of the SPRinG group work programme on pupil progress in science over the course of a year and relative to a control group. The main research question was whether the group-work programme led to increases in learning/attainment in Science at both the micro and macro levels over the school year and in comparison to a control group. A second research question was whether delayed effects are in evidence after specific group work experiences within every day classroom learning contexts. The final research question was whether the programme differentially affects boys or girls and children of different prior attainment in terms of learning and attainment.

Method

Sample

The experimental intervention sample involved 265 Year 4 (8/9 years) pupils and 295 Year 5 (9/10 years) pupils from 21 classes in 12 London schools. The control group sample came from a different area of London and involved 40 classes from 19 schools providing data on 486 Year 4 pupils (8/9 years) and 541 Year 5 pupils (9/10 years).

Experimental Sample. Schools from eight local educational areas within central London were involved in the research. School were located in areas that were diverse in terms of social background and economic circumstances. Teachers were made aware of the project through presentations to local school networks and, if interested, agreed to commit to the project for the

school year. The SPRinG intervention programme involved the researchers working with a group of teachers over the course of a full year to support them in their implementation and use of the SPRinG ideas. The intervention programme was supported by 7 half day meetings with teachers to discuss key issues, ideas, practices and problems. Teachers were given a handbook which had been developed and trialled in the previous year in collaboration with a different group of teachers. The ideas presented in the Handbook were based on research evidence as far as possible but also teachers' practical experiences during its development. The Handbook provided the key principles and recommended practices (summarised above) to support teachers' use of group work in class and the fostering of new social pedagogic practices, and a set of lesson plans for teachers to use to develop pupils' social, communication and advanced group work skills. Lesson plans were implemented over the course of 14 weeks, with one training session (lasting approx. 1 hour) and a minimum of one reinforcement session per week. Research findings reported elsewhere suggest that SPRinG pupils were successful in developing these social and communication skills (Blatchford et al., 2006). Lesson plans were also designed to support teachers' understanding and implementation of the SPRinG principles and practices. Teachers were further supported in the implementation of the programme through visits to their classrooms to offer independent feedback and discussion on their use of group work during lessons.

Control Sample. A control group was set up in the subsequent (2003-4) school year to the experimental sample and learning measures collected. Control schools came from a different London borough to those in the intervention sample but were comparable in terms of key background characteristics (see Table 1). There were more children in the SPRinG schools for whom English was an additional language but statistical analyses showed that neither this, nor any of the other social background indicators, affected results presented below.

The control group was set up to be involved in a parallel project focusing on 'Peer relations, classroom engagement and learning' and interested teachers agreed to commit for the duration of the year. This project did not aim to affect teaching and teachers followed their usual teaching approaches and covered the same curriculum as all other schools. In this sense they can be considered a 'naturalistic' control group. The control group were committed to the study on the importance of peer relations in school and also received visits from research staff to discuss the research and collect data. The main difference between the experimental and control groups was that the latter had not worked on the principles and activities in the SPRinG programme. Some may have used group work, if that was part of their normal approach, but they predominantly used whole class teaching and individual work.

Methods of data collection

Macro attainment measures. ‘Macro’ attainment measures were collected at the start and end of each school year. Science tests did not exist for the year groups covered and so three specially designed tests were constructed. These were based on items drawn from Standard Assessment Tasks for Year 6 that overlapped with the work covered by pupils in the previous and forthcoming year and were of varying difficulty. Items were simplified for younger children in a number of ways, for instance, by converting questions to a multiple choice format, reducing the number of options and so on. Items related to the themes of ‘physical processes’ and ‘materials and their properties’. Three tests in total were developed. Test 1 was given to Year 4 pupils to complete at the start of the year. Test 2 was completed by Year 5 pupils at the start of the year and by Year 4 pupils at the end of the year. Test 3 was completed by Year 5 pupils at the end of the year. Tests were designed to require interpretation of diagrams, tables and graphs and contained a mixture of forced choice questions and open ended questions. There were a total of 34 questions on each test. Items were included on each test on the two areas covered in the ‘micro’ activities (see below) of evaporation/condensation and forces. On the topic of evaporation/condensation there were 4 questions on tests 1 and 2, and 7 questions on test 3. On the subject of forces there were 4 questions on test 1, and 10 questions on both tests 2 and 3. Tests were teacher administered and blind marked by independent raters and answers to open ended questions were judged for accuracy using Qualifications and Curriculum Authority (QCA) guidelines.

Micro measures. Activities and teachers’ notes were also specially constructed for the coverage of science topics of evaporation/condensation and forces. These were based on QCA curriculum guidance and consistent with expected coverage of these topics, but we gave a central place to group work activities. The two sets of group work activities extended over at least two and a half hours each and could be covered in at least two lessons. The activities covered higher order problem solving skill (e.g. that involved thinking about and discussing particular scientific concepts, planning controlled science experiments etc.). The evaporation/condensation unit was implemented during the spring term and the forces unit during the summer term. These science lessons were accompanied by pre and post tests to measure change in learning/conceptual understanding and were completed in the spring and summer terms. Pre-tests were built into the start of the lessons and we asked for post tests to be conducted two weeks after the activities were completed. Lessons and assessments were based on previous work (Howe et al., 2000; Millar, Leach, Osborne & Ratcliffe, 2000; Russell & Osborne, 1993) and were piloted in a separate sample of schools. Teachers reported that they found the lesson plans useful and that pupils had found them enjoyable. The tests consisted of items that predominantly focused on conceptual but also some procedural understanding. Questions focused on all of Bloom’s categories of

thinking but predominantly on application, analysis, synthesis and evaluation. Tests consisted of forced choice and open-ended items. The tests for the evaporation module consisted of 13 and 21 items for the pre-test and post-test respectively. Both the pre and post tests for the forces module consisted of 29 questions.

Teachers in control classes covered similar science topics to those in the SPRinG group, including evaporation and forces (because they follow QCA schemes of work), but the main difference was that the same topics were taught in a different way to that used in SPRinG classrooms, and the pupils had not experienced relational skills training. Group work may have been used but not as extensively or effectively as in the SPRinG sample. As for the SPRinG sample, control pupils also completed the pre-test immediately prior to coverage of the topic, and post tests were completed 2 weeks after topic coverage was complete.

*****INSERT TABLE 1 HERE*****

Treatment of data and statistical analyses

To enable comparisons between outcome variables measured on different scales, the results from each of the attainment tests were transformed separately for Year 4 and Year 5 to a standard normal scale with a mean of zero, and a standard deviation of one. Multilevel statistical methods were used to allow for the lack of independence in the results from different pupils with the same class teacher and thus two-level models with pupils contained within classes were used (Goldstein, 1995). Failure to allow for the structure of the data can lead to misleading parameter estimates, and also an exaggeration of the significance of the results. All analyses contained the baseline attainment score as a covariate. Results thus reflect the progress made by pupils during the school year. Treatment group (SPRinG or Control) was included in all analyses, as this was the key variable of interest. The effect of prior ability was also analysed by categorising pupils into three equal sized groups on the macro science pre tests and then examining for interaction effects with treatment group. Other variables examined were: gender, percent of pupils in the school eligible for Free School Meals (% FSM), percent of pupils in the school that had Special Educational Needs (% SEN), percent of pupils in the school where English was not their main language (% EAL). Interaction effects, in addition to the main effect of each variable, were also examined including interactions between treatment condition, pupil ability, and year group, to identify, for example, whether greater progress was made by one ability group more than others. However, no interactions

were found and results did not vary by sex, pupil ability or year group and thus will not be discussed further (see Table1).

Results

Results from the analyses of Macro and Micro tests are presented in Table 2.

Macro tests

Results indicated a significant difference between SPRinG and control groups on the end of year macro science tests, with pupils in the SPRinG group obtaining scores that were, 0.2 standard deviations higher than those in the control group (see Table 2). No other main or interaction effects were found.

*****INSERT TABLE 2 HERE*****

Comparisons of differences between SPRinG and control samples were also made on evaporation and forces items drawn from the macro science tests (see Table 2). Findings showed significant gains by SPRinG pupils over controls on Evaporation macro items (autumn to summer) and that an increase in % FSM was associated with a slight decrease in attainment.

Results for the forces macro test items show significant gains by SPRinG pupils over controls with the average difference between groups being around 0.3 standard deviations. In addition only the % FSM had a slight, though highly significant, negative effect upon attainment on Forces items.

Comparisons between SPRinG and control samples were also made on the macro science tests with the items on evaporation and forces excluded from the data (see Table 2). Findings showed no evidence of a difference between the SPRinG and control groups and no other explanatory variables had a significant effect upon science attainment.

Micro tests

Results for evaporation micro tests are shown in Table 2. Significant gains by SPRinG pupils over controls were found on Evaporation micro tests (pre-post). The results indicated that both group and % EAL had a significant effect upon the evaporation micro score. Pupils in the

SPRinG group had scores that were over 0.5 standard deviations greater than pupils in the control group.

While all SPRinG and Control classes covered the unit on forces, unfortunately insufficient numbers of control classes returned both pre and post test data on this unit and thus micro test comparisons between conditions are not possible. However data for SPRinG pupils show progress between pre and post test (pre-test mean = 46.6%, post test mean = 56.0%, mean gain = 9.4%) and, as already reported, end of year forces items on the macro test were in favour of SPRinG pupils.

Delayed Effects

It is also possible to examine whether effects of the micro evaporation lessons extend beyond the two week gap after the lessons and thus whether there is further progress by the end of the year. This was examined by using the micro post test data as the baseline measurement and the evaporation macro test items as the outcome measure (see Table 2). Pupils in the SPRinG group had significantly higher attainment progress than the control group (0.23 standard deviations). This suggests that some of the benefit of group work lessons on evaporation came after the lessons were completed.

Discussion

This longitudinal study tested the effectiveness of the SPRinG programme which was developed through a collaboration between researchers and teachers and designed to provide teachers with strategies for enhancing pupil group work in 'authentic' classroom settings. We found marked effects on most of the measures used. As far as we are aware, this is the first time positive effects on academic progress, attributable to a programme of group work implementation in everyday classroom settings, have been found in the UK. Advances have been found for similar interventions which involve pupils working together (see Mercer, Wegerif & Dawes, 1999) but these focus on talk and thinking skills rather than group work training and interactions. In this study, we find that the pupils who took part showed more progress over the school year than a control group on the overall 'macro' science tests, more progress on the two 'macro' sub tests covering the areas of evaporation/condensation and forces, and also more progress between pre and post test over specific lessons covering evaporation/condensation. We also found that there was additional progress after the micro science lessons on evaporation to the end of year macro test. Overall, results show that involvement in the group work programme does not, as some teachers feared, impede progress in a mainstream curriculum area. Indeed, it seems to have a positive effect in terms of pupils' measured

progress in science. The effect sizes associated with the difference between the SPRinG and control groups are equivalent to an average pupil moving up into the top third of the class. These results are impressive and consistent with those from another study of collaborative problem solving in science (Palincsar & Herrenkohl, 1999).

Evidence of greater progress on the micro evaporation tests made by SPRinG, as opposed to control, pupils emphasise the beneficial effects of using high level group work in science lessons. This study was not set up to examine the mechanisms behind group work but there are a number of possible processes that might explain why group work had an influence on learning. Previous research suggests that group work provides pupils with the opportunity to process content information in greater depth (see Webb & Palincsar, 1996), imitate others' strategies (Tomasello, Kruger & Ratner, 1993), to come into contact with alternative views (Doise & Mugny, 1984), or to construct new understandings with others (Rogoff 1998; Tomasello et al., 1993). Further research is needed to examine these mechanisms before a clear idea can be reached on exactly how group work affects learning and attainment.

Findings also showed, however, that once items on evaporation and forces were removed from the macro test data, the difference between SPRinG and control treatments disappeared. This suggests that while SPRinG pupils benefited from the lessons involving group work on evaporation/condensation and forces, they did not benefit from group work in relation to the other topics covered by the macro test. This raises questions about whether SPRinG develops skills in both a general and a specific way. Previous research has suggested that group work may influence learning by encouraging motivation to learn (Johnson & Johnson, 1986; Slavin et al., 2000). Alternatively group work may have a general impact by enhancing argumentation and higher order thinking strategies such as the ability to apply, analyse, synthesise and evaluate knowledge (Davidson & Worsham, 1992; Wegerif, Mercer & Dawes, 1999; Wegerif, 2004). Further research is clearly needed to examine these possibilities further. It may be the case that these general skills develop more slowly and are not easily transferred to other areas.

There are other possible explanations for the lack of progress on other parts of the macro tests. First, it may be suggested that SPRinG teachers did not use group work in the coverage of other science units. Few teachers seemed confident in their science understanding. Alternatively teachers may not have used group work consistently in the same science areas, other than evaporation and forces, such that any effects became watered down or the type of group work used (e.g. peer helping or low quality group work) may not have been likely to bring gains in conceptual understanding. Another possible explanation relates to the timing of the science topic coverage. Evaporation and forces topics were covered in the spring and summer terms. Other topics will have been covered during the autumn term and possibly at the start of the spring term, while group work

skills were being developed, and at the time when teachers were getting to grips with new group work strategies. Teachers may not have used group work in other areas of science or pupils may not have fully benefited from their group work skills until the end of the training period. It is difficult to distinguish between these interpretations but the findings do indicate that where group work was used by all teachers to cover the same topics it had a beneficial effect. Further research is required to examine whether the consistent use of group work as a learning context for the teaching of the Science curriculum can benefit pupils in all areas covered.

Slavin et al., (2000) argue that much research on cooperative learning has addressed fairly well defined skills or information. In this study we deliberately assessed skills and understanding across the range of types of knowledge found in QCA curriculum guidance for science, ranging from descriptive and procedural knowledge to evaluative and analytical understanding. The assessments, particularly in the micro evaluation tests, tended to be weighted more toward higher order conceptual understanding. Results show that SPRinG group work was effective at encouraging all types of knowledge since SPRinG pupils outperformed control pupils on the micro tests and macro tests. However, further research is required to examine group work in relation to the development of different types of knowledge and conceptual understanding since sometimes it may be more productive to work alone (e.g. see Pine & Messer, 1998).

It might also be noted that the effect of the micro science group work lessons continued after the lessons were complete, since further progress was evident between the micro post test and the end of year evaporation macro test items. Though difficult to be sure, this suggests that knowledge and ideas resulting from a group work intervention, rather than fading from memory, may actually strengthen. We are unable to comment on whether this is due to further reinforcement of the area of science through additional work, or through some form of internal cognitive process of 'incubation' arising from peer collaboration, as suggested by Howe, McWilliam & Cross (2005). Either way, these delayed effects are remarkable as they may be part of a more general learning process where partially learned ideas and principles become more stable or explicit, in a similar fashion to that outlined by Karmiloff-Smith (1992), or could be part of an internalisation of ideas developed through interactions with others, as outlined by Vygotskiiian and Socio-cultural approaches (Rogoff, 1998).

We also examined whether pupils differed in how much they benefited from SPRinG. Teachers were worried that only pupils who were already academically confident would benefit academically from group work, but we found that low attainers as well as middle and high attainers at pre-test made equal progress over the year. There were also no differences between boys and girls in the progress made over the year. Furthermore, while pupils from schools with a high proportion of pupils receiving free school meals and/or with English as an additional language made less

progress than pupils from schools lower on these measures, there were no interaction effects with the SPRinG vs control condition. These results therefore suggest that all types of pupils benefited from the SPRinG programme.

Validity issues relating to the research design

The general nature of the SPRinG programme has meant that providing a fair test as part of the evaluation has proved challenging. In educational research there is often a trade off between precision of experimental control on the one hand and the validity and authenticity of the educational intervention on the other hand. One difficulty relates to the status of the experimental vs. control group. The most obvious choice might have been to set up two control groups: an alternative intervention group and a naturalistic, non intervention group. This would allow one to test for the possibility of a ‘Hawthorne effect’ such that involvement in the experiment, rather than particular characteristics of the experiment, was the main factor affecting pupils’ progress. However, in the real world of education this kind of experimental design is difficult to maintain. It became apparent early in the research that there is little sense in talking about a non-intervention group when teachers in the control group were as intent on working hard to improve pupils’ academic attainments and behaviour. Teachers, perhaps especially in the UK today, always seem to be involved in a Government, LEA or school inspired intervention! There are also difficulties in setting up an alternative intervention group. The point of the SPRinG project was to bring teachers on board in a project that they and the researchers believed in. This would also be required for the control group but it was unclear whether we could devise an alternative programme for a whole year that promoted a different way of educating pupils, even if we could then convince teachers to take part in it. Our original plan to get control teachers to concentrate on whole class teaching would have been hard to sell; moreover we know that teachers already spend much of the time teaching to the whole class. We therefore decided to choose for the control group teachers and pupils equally committed to a parallel project on peer relations and classroom engagement, but we put no constraints on what they did in those classes. The main difference was that they had not received the SPRinG handbook or attended meetings.

There are several other reasons why a ‘Hawthorne effect’ is unlikely. If there was an effect it would apply to teachers, who were involved with the researchers, but it would not directly apply to pupils whose progress, after all, was the main means of assessing the programme. Moreover, results from the observation component of the SPRinG study (see Blatchford et al., 2006) showed that the pupils in the SPRinG project altered their behaviour in the ways predicted. It therefore seems most

likely that these effects owed more to the involvement in a particular programme rather than a Hawthorne effect on the teachers.

It might also be argued that the results could be attributed to something other than the group work context, for example, to the use of certain types of language that facilitate scientific knowledge and understanding. So, from this point of view, it is the kind of talk that is important rather than anything to do with the characteristics of the group work. Our view of this is that both talk and group work are inextricably linked. Training in social and advanced group work skills, as well as creating contexts that will facilitate effective group work, are central in encouraging particular types of talk and interaction that are supportive of learning. A case, however, can be made that it is a particular type of group work that leads to a particular type of dialogue (e.g. collaborative discussion as opposed to peer tutoring) and thus the learning gains found. This is very likely to be the case, since at least in the science lessons on evaporation and forces the activities were predominantly on collaborative decision making tasks.

The SPRinG programme therefore seems to have positive effects on academic attainment in science, but the general nature of the SPRinG project makes it difficult to establish whether some aspects of the programme were more important than others, for example, whether it was the relational approach, structuring the classroom context for group work, different aspects of peer collaboration (consensus, argumentation etc.), or the curricular activities, which were more or less important, or whether all contributed together to the positive effects. Further research is thus required to examine these aspects in more detail.

Social Pedagogy

We have argued that the educational advantages of peer based interactions have been neglected in the UK both in terms of current educational policy and classroom practice. The aim of the SPRinG programme is to complement and extend other teaching and learning contexts and to help teachers to extend their repertoire of teaching approaches. Grouping arrangements that currently characterise many classrooms are just as likely to inhibit learning, as they are to promote it. In parallel work (Blatchford et al., 2004) we have found that teachers have a strong belief in the value of addressing pupils' individual needs. This informal pedagogical view can conflict with pressures arising from the curriculum and the classroom context, especially in large class sizes. Teachers feel forced to use more adult led and whole class teaching than they might like. It seems to us, therefore, that we need to rethink both informal and formal pedagogical theories. We suggest teachers could help themselves by making more use of a social pedagogy of classroom learning which incorporates group work as a way of facilitating pupil involvement. This offers learning

possibilities for pupils not provided by either teacher led situations or individual work. Such a social pedagogy, as outlined in Blatchford et al. (2003), emphasises the importance of thinking about the 4 key principles relative to group work but also other teaching and learning contexts. Such a social pedagogy needs further consideration and deserves to be given a much more central role in educational policy and school practice.

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Table 1: demographic background descriptive data on the SPRinG and control samples

	School Roll		FSM		Statements		SEN		EAL	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
SPRinG	319.6	98.6	35.8	20.2	3.8	3.4	26.9	10.5	60.6	33.1
Control	322.9	126.4	34.0	16.9	2.0	2.9	23.3	7.9	27.0	10.2

Notes: FSM=Free School Meals, Statement Special Educational Needs statement, SEN = non-statemented Special Educational Needs, EAL = English as an Additional Language

Table 2: The effect of SPRinG vs. Control and other explanatory variables on scores on the macro science, evaporation and forces macro test items and micro evaporation tests

Outcome variable	Coefficient (SE)	P-value
MACRO TESTS		
Macro Science test		
Group (SPRinG vs control)	0.208 (0.083)	0.01
Evaporation items on Science Macro test		
Group (SPRinG vs control)	0.429 (0.081)	<0.001
% pupils eligible for FSM	-0.111 (0.022)	<0.001
Forces items on Science Macro test		
Group (SPRinG vs control)	0.294 (0.077)	<0.001
% pupils eligible for FSM	-0.074 (0.021)	<0.001
Macro Science test with evaporation and forces items omitted		
Group (SPRinG vs control)	0.089 (0.17)	0.37
MICRO TESTS		
Evaporation Micro test		
Group (SPRinG vs control)	0.576 (0.220)	0.009
% pupils with EAL	-0.076 (0.025)	0.002
DELAYED TESTS		
Evaporation items on Science Macro test (micro post test as covariate)		
Evaporation micro post score	0.214 (0.046)	<0.001
Group (SPRinG vs control)	0.234 (0.111)	0.03
% pupils eligible for FSM	-0.094 (0.028)	<0.001