The Scottish Government

Group Work:
Transition Into Secondary

Education and Training

social research

GROUP WORK:
TRANSITION INTO SECONDARY

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EXECUTIVE SUMMARY

Background

This report presents the findings of a study consisting of 2 projects concerning primary to secondary transitions and the use of group work. These 2 projects built on a previous project, **ScotSPRinG**, undertaken 3 years ago in 24 Scottish primary schools which found that significant gains in science attainment and social connectedness between pupils were promoted by using collaborative learning techniques to teach science. Due to the success of these collaborative learning techniques in the primary project, the 2 follow up projects were planned to:

- look for the longevity of the gains observed and particularly how robust the observed changes were after transition from primary to secondary school; and
- see if these techniques could be utilised as effectively in secondary school settings.

Overview of the projects

The first follow up project dealt with effective transfer of skills for pupils between primary and secondary school (the '**Transition Project**'). The second project dealt with exploring the effectiveness of collaborative groupwork at raising attainment and promoting more positive attitudes towards science in secondary school (the '**Collaborative Learning/Group work Project**').

Findings

The Transition Project

Primary pupils who were involved in the original project (follow-up pupils) were significantly advantaged on the **Forces** science test which related to their primary experience, and the new specific science test on **Materials** compared to pupils who were not involved in the original project (non follow-up pupils). **This suggested that the ScotSPRinG project had a continuing effect into the early stages of secondary school**. **In addition follow-up pupils from both urban and rural primary schools reported significantly more positive attitudes towards science than pupils who were not involved in the original study prior to transition.** On other measures (e.g. self-esteem) there were few consistent differences between the groups.

The Collaborative Learning/Groupwork Project

On the specific science tests given before and after the implementation of the collaborative learning teaching methods, the scores of both the experimental and control groups increased. On the pre-post implementation general science attainment (AAP) test, again both the experimental and control groups showed increased scores. In Earth in Space the experimental groups increased their pre-post science test scores by a significantly greater amount than the control groups. In each of the additional topics tested (Earth in Space and Materials) the follow-up control children showed significantly greater increases in their science test scores than non follow-up pupils. **Therefore, considering all the results together, there was no evidence that the project in secondary school resulted in significant gains in science**

attainment. However, there was evidence that follow-up pupils (in both the experimental and control groups) were advantaged in their learning of science by the original primary school project. This finding adds weight to the findings of the transition project that transfer of gains obtained through the primary school project in collaborative learning into secondary school was possible. The fact that the implementation of the collaborative learning project in secondary school did not yield significant results in the same manner as the primary school project could have a number of explanations. It could be that the instability caused in the breaking and reforming of peer groups causes collaborative work to be less effective than when implemented in a setting where the children have been at school together and possibly in the class for up to 6 years. Another explanation may be that the pedagogical approaches that form the basis of collaborative group work approaches are more suitable to the flexibility of the primary school context or that more stable and established peer groups are required to maximise their potential to promote learning. The implications here for transfer of other forms of learning are considerable.

However, there might be a differentiation between those follow-up pupils from rural locations and those from urban locations. Rural pupils seemed to do better. This is in contrast to the expectation that rural pupils would have greater difficulty adapting to secondary school. On sociometric measures at pre-implementation test, the non-follow-up pupils reported significantly greater percentages of other pupils that they worked with in class and saw socially outside of class (at break time and out of school) indicating greater social orientation to their peers in the class as a whole. Follow-up pupils tended to focus upon group relations (i.e. those with peers who were in their science work group) rather than relations with the whole class, and by post-implementation test the non-follow-up pupils also tended to have shifted in the same direction. **The follow-up pupils who originated from primary schools in both rural and urban settings reported significantly more positive attitudes towards science.**

Thus there is evidence of the ScotSPRinG primary group work project having enduring effects on attainment and attitudes 2 years later in secondary school. In addition there is evidence that the effect may have been as a result of gains in social dimensions of learning (particularly attitudes towards science and level of connectedness to the peer group). **However, there is no consistent evidence of effectiveness for the secondary collaborative learning/group work project in science.**

Policy and practice implications

The implications for policy and practice are straightforward.

- Primary collaborative learning / group work projects have an enduring impact on science achievement and can be recommended as a project of choice
- Secondary collaborative learning / group work projects have no consistent impact on science achievement and cannot be recommended as an intervention on this evidence

It might be that the project was not sufficiently powerful to produce effects. However, a more intensive project would struggle with issues of expansion and sustainability. Alternatively, it might be that a different kind of project working within the same timetabling, staffing and organisational constraints as the collaborative learning project may have worked in secondary schools, but it is difficult to see how such a project might be structured.

CHAPTER ONE INTRODUCTION, CONTEXT AND BACKGROUND

1.1 Introduction

This report presents the findings of a research study involving 2 projects that ran in tandem. The first project was designed to see if pupils involved in group work in science in primary school retained the gains achieved in this area 2 years later after transfer to secondary schools, and whether these gains transferred to other forms of science learning. The second project was designed to see if intervention by implementation of collaborative learning /group work in science at secondary level would lead to similar gains as in primary schools. The project involved recruiting teachers who would be willing to form an experimental group to try to teach science for 6 months using collaborative learning techniques. To help the teachers develop collaborative learning in science continued professional development (CPD) for secondary teachers in science collaborative learning techniques/ group work was planned and delivered. The teachers' abilities to implement the collaborative learning techniques in their science classrooms were then observed. This was coupled with pre-implementation test measures undertaken before the implementation of collaborative learning group work and post-implementation test measures taken 6 months later to assess any changes that may have been attributable to the project. The measures included specific and general tests of science attainment, including topics taught in both primary and secondary school and those taught in secondary schools only, and socio-emotional measures. In order to assess the potential impact of collaborative learning in comparison to what may have been expected to happen, control schools, who undertook the pre-implementation and post implementation tests at the same time as the experimental schools but did not use collaborative learning techniques, were also identified.

1.2 Background to the study

This study built on and extended various Economic and Social Research Council (ESRC) Teaching and Learning Research Project (TLRP) projects on effective collaborative group work in primary schools, particularly in science.

A Phase II TLRP project: 'Improving Effectiveness of Pupil Groups in Classrooms', involved the universities of London (Institute of Education), Cambridge, and Brighton[1]. It sought to establish the conditions necessary for group activities to produce definite educational benefits, in terms of learning and quality of classroom relationships, and to design ways of helping teachers to introduce effective group work into their classes at Key Stages 1-3 of the National Curriculum in England.

The Group Work Scotland (ScotSPRinG) project was an extension and development of this project into the Scottish context, also wholly funded by the ESRC TLRP programme. The full title of this project was "Supporting Group Work in Scottish Schools: Age and Urban/Rural Divide"[2]. The project extended group work support to science teaching with 10-12 year olds in 4 types of primary school in Scotland:

[1] The Social Pedagogical Research in Groupwork (SPRinG) project - www.tlrp.org/proj/phase11/phase2a.html
[2] Web sites at www.tlrp.org/proj/phase111/Scot_extb.html and www.groupworkscotland.org

- Small rural schools with composite classes and cross-age group work;
- Rural schools with same-age classes and group work;
- Urban schools with composite classes and cross-age group work;
- Urban schools with same-age classes and group work.

A brief list of main conclusions of the ScotSPRinG project is presented in **Table 1.1.**

Table 1.1 Conclusions of the ScotSPRinG project

1	Experimental pupils engaged in group work in science gained in science tests significantly more than control pupils.
2	There was some evidence of gains in mathematics in experimental pupils, suggesting some spontaneous transfer.
3	Regarding achievement gains, the differences between urban and rural, composite and single-age classes were not large – all types gained, although single-age urban tended to gain most.
4	In the social domain, both rural and urban pupils showed gains in the number of relationships reported. Single-age classes showed gains in in-class relationships, while rural classes showed gains in out-of-class relationships. Rural pupils started from a higher baseline in terms of a higher degree of connectedness at the beginning.
5	Urban single-age classes showed gains in self-esteem.
6	Positive changes in the quality of pupil to pupil interactions likely to promote learning and attainment, and linked with better attainment outcomes, were noted with urban single-age classes achieving the biggest gains albeit starting from the lowest baseline.
7	There was some evidence of different "types" of group work consisting of different types of "interaction talk" in practice – one more cognitive-discourse focused which resulted in higher achievement gains; and one more socio-emotionally focused which resulted in higher social gains.
8	The type of interaction noted was mostly cooperative learning in all class types – but where peer tutoring did occur it seemed very effective.

1.3 The theoretical background to the research

The principal issue motivating this research is that group work exists, but it is frequently not *effectively planned.* This leads to a key question: how can the quality of group work be improved in both primary and secondary schools, and does any improvement in this have any consequences at long-term follow-up in another school? Sustaining effective progression and transfer of learning between primary and secondary school has been a cause for concern for some time. Research suggests schools are relatively effective in "smoothing" transition with regard to socio-emotional aspects, but relatively ineffective in terms of students' learning progress (e.g., Galton, Gray, & Ruddock, 2003). In parallel, the teaching of science (and particularly low attainment in science) in secondary schools (especially in the first 2 years) has been a cause for concern for some time (e.g. Scottish Executive, 2000). Small-group discussions have been advocated in secondary school science for a number of years. However, a recent systematic review found that whether and how such discussions were structured was crucial for effectiveness (Bennett, Lubben, Hogarth, & Campbell, 2004).

Beyond such specifics, the concept of "transition" has rarely been clearly defined, let alone been embodied in an over-arching theoretical model. Research into the 'transition' of pupils from primary to secondary schools has tended to focus on the organisational structures and processes surrounding the progression of pupils from one part of the education system to another. By contrast, the theoretical concept of 'transfer' of learning has been explored very thoroughly in the cognitive science literature. However, the link between these has not often been made explicit.

From a theoretical perspective, the issue of transfer of learning across time and space has been a subject of sometimes polarised debate. The researchers took the (evidence-based) view that transfer of learning is possible but not automatic, and especially for "far" rather than "near" transfer the process requires scaffolding to ensure that it happens for all children. This essentially means that for transfer to occur in a context quite far removed from the original context, help and support may be required as well as illustrations of how to use the previous learning in the new context. From the research literature, a number of factors important in promoting transfer have been identified as shown in **Table 1.2**.

Table 1.2 Key factors for the promotion of learning transfer across time and space

1. A realisation by student and tutor that transfer is required.
2. Motivation (including perceptions of utility).
3. Self-confidence.
4. Teaching of generalisable principles and concepts to provide links to previous learning and wider concepts.
5. Appreciation of the social construction and communication of knowledge and skills.
6. Meta-cognitive/rule-induction strategy instruction, questioning, prompting, and feedback and coaching whereby, tutors asking the right questions help students question, reflect on and understand what they know, how they know that they know it and why they know that they know it.
7. Fostering the abstraction of principles from examples to help students to think beyond the immediate problem and make links between what they are doing at the moment, what they have done in the past and what they may do in the future.
8. Emphasis on structural similarities of diverse problems by providing additional experiences that are different to the problems already explored, but similar enough to allow some degree of knowledge and skills transfer to the new problem.
9. Control information-processing demands by reducing distracters i.e. keeping the student on the right track.
10. Student self-monitoring of process strategies used i.e. students asking themselves how they are doing and reflecting on what they have achieved and what they have learned.
11. Student self-monitoring of strategy effectiveness.
12. Student personal goal-setting.
13. Scaffolded self-regulation by giving students support and help to help them realise the things they are learning.

In the original ScotSPRinG project, experimental group primary teachers were encouraged to have pupils engage in activities likely to address a number of these factors (particularly 1-5, 8, 10-11 and 13). The activity cycle for each session included briefing and planning prior to activity and debriefing after it, the latter giving an ideal opportunity for transfer-enhancing discussion. However, it was evident from the classroom observations that different teachers were able to use these opportunities more or less well. The new investigation presented the

opportunity to address issues of considerable significance concerning the role that might be played by group work in smoothing the transfer from primary to secondary school. The Scottish system encompasses a wide variety of primary school sizes and methods of organisation. Such variation is lessened at secondary level, however, where schools tend to be larger, and there might be greater emphasis on whole class teaching and less use of exploratory group work.

1.4 Outline of the current project

The current study investigated knowledge and motivation transfer across contexts, principally between primary and secondary education and transfer of collaborative learning techniques developed in the primary sector to the secondary sector. The conditions fostering such transfer were identified from previous research and from the materials and techniques previously found to have been successful in Scottish primary schools as outlined in Table 1.2 above.

The study was divided into 2 separate projects. The first project dealt with effective transfer for pupils between primary and secondary school (the '**Transition Project**'). The second project dealt with exploring the effectiveness of collaborative groupwork at raising attainment and promoting more positive attitudes towards science in secondary school (The '**Collaborative Learning/Groupwork Project**').

The **Transition Project** followed pupils who participated in the previous ScotSPRinG primary project into secondary school. It explored transfer to the secondary school environment of pupil domain-specific knowledge and skills and general social, communication and teamwork skills. The extent to which successful transfer was due to the quality of group work in primary school was explored.

The aims of the **Transition Project** were to:

- identify pupils who had been involved in the original groupwork project after they had undergone transition from primary to secondary school;
- explore whether gains in attainment in science, groupwork skills and socio-emotional aspects of learning observed in the original primary school project persisted over time and were still present after transition from primary into secondary school;
- explore if there was a relationship between the quality of primary school group work experiences and the persistence of the observed gains over time; and
- identify pupils for whom comparisons could be made between those who had been involved in the original study (follow-up pupils) and those who had not (non follow-up pupils).

The **Collaborative Learning/Groupwork Project** sought to implement group work techniques developed through the primary sector, in the context of support for secondary teachers through CPD and specially developed materials, and to explore the impact of such techniques on cognitive and social gains compared to existing methods of teaching and learning.

The **Collaborative Learning Project** aimed to:

- recruit secondary schools who would be willing to implement the collaborative learning techniques in their science classroom;

- deliver continuing professional development (CPD) for teachers to support them in developing their pedagogical approaches to collaborative learning;
- establish a new collaborative learning project to see if this technique of learning and teaching could be as successful in the secondary school classroom as it had proved in the primary school classroom; and
- measure cognitive and social gains in an experimental and control sample to see if the collaborative learning technique was more effective than existing practices.

1.5 Overarching aims and objectives of the study

The overarching aims of the study were to explore whether gains (in attainment in science, transferable collaborative learning skills and socio-emotional aspects of learning) accrued from the development of high quality cooperative learning through group work. To this end the projects attempted to find evidence:

- of the transfer of the skills and knowledge developed by the original project in primary school such that there was evidence of these skills/knowledge after transition from primary into secondary school;
- that the provision of CPD and resources for secondary teachers could help secondary school teachers develop collaborative learning in their science classrooms;
- that transfer of the skills and knowledge developed by the original project in primary school would be influenced by the quality of primary school group work experiences; and
- that transfer of the skills and knowledge developed by the original project in primary school would be influenced by the quality of secondary school group work experiences.

Two points that merit examination arise. To what extent can the support for increased provision of group work at secondary school level help bridge the transition from primary school activity, by connecting back to pupils' previous experiences of educational practices, and restoring a sense of engagement in familiar tasks. The second is how far any such effect is moderated by the exact nature of children's primary school experience. For instance, the transition to secondary school represents a substantially bigger shift for rural children than for urban, since it is likely to involve them in being bussed out of their immediate community, and being required to interact for the first time with others who are largely unfamiliar to them. This jump being larger, there is some reason to expect them to experience greater difficulty over the transition, and thus to benefit more from the provision of connections back to prior practices. At the same time, however, this may present greater difficulties, since secondary school organisation might typically preclude cross-age group work, so even where joint activity does occur it may tend to have a less familiar dynamic, and thus to be less effective in smoothing the primary-secondary transition. Gathering hard data on these points not only addressed the issue of transition itself, but served to test further the generalisability of the project intervention methodology at secondary level across different types of circumstance, and in consequence added further to the elaboration of the social pedagogy aimed at by the original project.

1.6 Structure of the report

The remainder of this report is set out as follows:

- Chapter 2 – Research methodology
- Chapter 3 – Results and findings
- Chapter 4 – Discussion and conclusion

The references follow along with 2 annexes, one of which indicates sources of further information and materials deriving from this project and the second of which contains detailed school by school results.

CHAPTER TWO RESEARCH METHODOLOGY

This chapter describes the methodology adopted by the study for both the **Transitions** and the **Collaborative Learning/Groupwork** projects. It explores sample selection, the implementation of the project intervention, the creation of measures of impact and their administration, observation and analysis. It also highlights difficulties encountered and how these were overcome.

2.1 Sampling

The **Transitions** project was a follow-up study involving P6 & P7 pupils from the schools in the ScotSPRinG primary school who were followed up having experienced transition to secondary school. These pupils are referred to as 'follow-up' pupils.

The **Collaborative Learning/Groupwork** project was an experimental intervention study. Pupils engaged in 2 science topics taught through collaborative learning techniques. These classes are referred to as the 'experimental group'. Some pupils were experimental follow-up pupils (they had been involved in the original primary project) and some were experimental non follow-up pupils (they had no involvement in the original project). Other classes were identified who did not participate in the collaborative learning activities but undertook the same range of tests as the experimental group to act as the control group.

Of course, P7 pupils from one primary school do not all attend the same secondary school. Therefore, the secondary schools receiving the majority of P7 pupils from each primary were the focus for the project. A total of 10 relevant secondary schools were identified in the West of Scotland, and a further 11 in the East. Recruitment efforts were focused on the ScotSPRinG project participants who were now attending year 1 of the Secondary school, and some of their classmates for comparison purposes. One science class from each year was targeted in each school, but this was adapted in the light of circumstance. Where possible, this class contained the largest numbers of follow-up pupils in the original sample. The project was implemented in those classes where science teachers expressed their willingness to participate.

In the **Transitions** project data was collected from a total of 644 pupils. Of this total, 204 pupils formed the sample of children who were followed-up after the primary school project, with 440 pupils forming a sample of comparator/control children. In the **Collaborative Learning/Groupwork** project data was collected from 644 pupils. Of these 259 formed the experimental group and 385 formed the control group. In terms of school participation this meant that in the East out of 11 possible schools, there were 4 experimental schools yielding 9 experimental classes, plus 4 control schools and one control class in one of the experimental schools. Three schools declined to participate. In the West, out of a total of 10 schools, 4 agreed to be experimental schools, and 4 agreed to be control schools, while 2 schools refused to take part. However, the experimental schools in the West refused to undertake the collaborative learning / group work teaching as originally planned. Instead they chose to embed the pedagogical techniques within existing curriculum teaching materials. The project thus experienced some sampling difficulties. These had been anticipated, but their scale was perhaps unexpected. In both East and West the numbers of high schools wishing to participate was not large. In the West the absence of schools willing to use the

curriculum materials was problematic. The reasons for this reluctance are explored in 2.2 below.

2.2 Implementation of the project

Key participating teachers from the receiving secondary schools were identified by the senior management team in each school as leaders in the development of group work methods in their schools. In the event, most of these teachers implemented group work in one or 2 classes they already taught, and in only a small number of cases were other teachers involved in the project. The teachers attended a total of 3 CPD days. Content was developed and delivered by staff from University of Dundee and University of Strathclyde and involved:

1. general group work strategies and activities, pupil training in the skills necessary for effective group work, with emphasis on social and communication skills;
2. specific and structured group work in science in the topics of 'Materials' and 'Earth in Space'; and
3. a final debriefing and evaluation session.

The first of these CPD days was in the autumn term, the second at the beginning of the spring term, and the last at the time of the post-implementation test. At the first 2 days teachers received resource materials and consultation. The plan was that teachers would introduce pupils to generic cooperation activities in the autumn term, and at the beginning of the spring term would start them on the science-related topic activities. In the last session, teachers took part in a brief interview session and completed a questionnaire concerning their experiences and perceptions of the group work initiative or any further issues they felt were relevant.

Initially it had been anticipated that only members of the senior management team might be able to attend the CPD for logistical reasons (supply science teachers can be difficult for schools to find in Scotland). However, this fear proved unfounded. Support from colleagues and the senior management team meant that in general teachers were able to attend the days as planned.

The materials used in the CPD days varied. For CPD day 1, the ScotSPRinG generic cooperation skills materials were felt to be too large and too generic. Consequently selections of activities were made which were not so far away from the intended focus on science and which were relevant to the secondary population. The extent to which the secondary schools used these was probably variable, and observation did not occur until the spring term, but there was anecdotal reportage of these being used in at least some classrooms before Christmas. For CPD day 2 two new sets of materials were devised, akin to the ScotSPRinG specific science materials and incorporating similar principles of group working, but at a higher level and focused on new areas in science: Science topic 1 'Earth and Space' and Science topic 2 'Materials'. Whilst there was overlap between the Materials topic and the primary school topic 'States of Matter', the overlap was limited in nature. During the CPD days the teachers engaged with some of the materials and experienced group work themselves using the materials.

In the East the high schools more or less kept to the plan, although there was some demand for additional materials of modified accessibility which had not been anticipated. However,

there was considerable variation in the quality of implementation of the project. In the West the high schools were more likely to want to depart from the plan, varying what they did more considerably, and this resulted not only in more customisation of materials, but also some changes in materials. The reasons for the different approaches in the East and West were as follows. Teachers were offered curriculum packs for 'Earth in Space' and 'Materials'. These curriculum packs were closely aligned to the 'Earth and Space' outcomes in 5-14 science. However, teachers in the West of Scotland refused to synthesise these curriculum packs into their planned programme of work. The stated reason for this was that the 'Earth in Space' outcomes were not outcomes that they planned to teach that year. Rather than have no participation from schools in the West, a pragmatic decision was taken to provide training and support to help teachers implement collaborative learning into their own science topics. This kept west of Scotland schools involved, but precluded them from using the curriculum packs. This project was launched upon the participating high schools without a great deal of advance notice (given the short time scale), and a longer project with more developmental time to cultivate schools would probably have resulted in greater take-up of a somewhat more orderly nature.

2.3 Developing outcome measures

Outcome measures were taken at 2 main points linked to the timing of the CPD days: the middle of Autumn Term 2006 (before the general skills training) and end of Spring Term 2007 (after the specific skills intervention). Data collection in the middle of the Autumn term 2006 provided a baseline for the post-test.

Measures included some but not all measures from the original ScotSPRinG project, or adaptations thereof, together with some new measures. Particularly important were tests of science attainment of which 4 measures were used:

1. The **Forces** (16 item) science test covering an area of science involved at primary school, was administered at the pre-implementation stage only, to assess enduring knowledge on this topic surviving the transition from primary to secondary school
2. **Earth and Space** (30 items) and **Materials** (30 items) specific science tests were administered pre and post the group work intervention. These tests were developed specifically for this study to measure the cognitive gains that may be attributable to the secondary school collaborative learning project.
3. A 21 item **general science test** based on the AAP assessment in general science derived from the full standard AAP test was also administered pre and post the group work intervention to measure transfer of learning to wider science curriculum.

Self-esteem measures (Harter)[3] together with a measure of attitudes to cooperative learning and group work (*My Feelings About Group Work - MFAGW*)[4], both used in the previous

[3] A modified version of Harter's (1985) "Self-Perception Profile for Children" was used - the What I Am Like questionnaire - which contains a total of 20 items designed to assess Global Self-worth as well as 3 domain-specific judgements of competence or adequacy (Scholastic Competence, Social Acceptance, and Close Friendships).

[4] Attitudes to group work were measured by a 6 item questionnaire, namely the My Feelings about Group Work (MFAGW), the development of which was based on the ScotSPRinG project. Two questionnaires were used based on the CLEF (Cooperative Learning Form) measure used previously - one for pupils (CLEFP-lite), and

ScotSPRinG project, were used to explore affective variables that may be influenced by the **collaborative learning/groupwork** project. Additional measures of attitudes[5]/self concept in science and pupil self-assessment of transferable skills in cooperative teamwork were also used to assess the extent that gains in pupils' attitudes towards science or as effective learners were influenced by the original primary school project or the **collaborative learning/groupwork** project. Attitudes towards science/self concept as a learner of science are widely regarded as important indicators of future performance in school (Marsh, 2007).

Finally, as in the ScotSPRinG project, a (modified) sociometric measure was employed in order to investigate pupils' social relationships and patterns of interaction in and outside school. *People in your Class* was presented in the form of a matrix and asked adolescents to consider 4 key context questions (columns) regarding their relationships with all other members of their science class (rows). *People in your group* asked the pupils to undertake the same task, but only for the named people in their science work group. Both instruments asked the pupils to mark all those pupils in their class / group that they:

- Worked with regularly in a group
- Liked working with in science
- Liked spending time with at break time
- Liked seeing out of school

It was specifically designed to measure the 3 aspects of peer relationships that had shown substantial pre-post implementation gains in the original primary school project.

2.4 Observations

Researchers visited secondary schools at 2 intermediate points throughout the experimental period during the spring term to offer consultative support and assess the implementation quality of group work. This involved direct observation in classrooms, using an adaptation of the observation schedule utilised in the ScotSPRinG project. The nature and role of children's interactions in group and class learning contexts was recorded. Aspects of language were classified under 2 headings, Collaborative and Tutoring, as shown in Table 2.1.

Table 2.1 Codifying aspects of language from observation

Collaborative codes – learning is co-constructed
Proposition: child suggests an idea or course of action (whether low or high level), or otherwise makes some form of statement that someone else could disagree with
Disagreement: child explicitly disagrees with a suggestion or explanation offered by another
Explanation: child offers an explanation of a proposition

one for their teachers (CLEFT-lite). Each comprised 17 items and was designed to assess the development of transferable skills in group work.

[5] A 31-item questionnaire Attitudes to Science was used to explore pupils' attitudes towards the school subject of science.

Reference back/continuation: child explicitly refers back to a previous suggestion or explanation, irrespective of originator (i.e. they must refer to the content of the previous statement and point to the fact that this is something that has been said before – saying e.g. "I think the same" is not sufficient)

Resolution/compromise: child acknowledges previous statement of other and adjusts own to include content (i.e. there must be some explicit fusion of ideas)

Tutoring codes – learning was led and managed by one member of the group

Instruction: child tells someone to say something or carry out some action

Question: child asks open-ended question (or gives other form of prompt) that directs attention to something not yet considered (e.g. "What about keeping weight the same?" "Do you think it would make any difference if we used something solid?"); NB the key marker here is that this is a question that the asker does not want to know the answer to (they already know it)

The role of pupil explanations, questioning and responding was of particular interest. In addition to the micro-measures of implementation of group work, the broad layout, organisation structure and management context of each classroom was mapped.

2.5 Analysis approach

Analysis was undertaken on a number of bases. The **Transition** project explored whether experiences in the ScotSPRinG project in rural or urban schools or in single-age or composite classes advantages or disadvantages pupils on transition to secondary. The **Collaborative Learning/Groupwork** project led to a range of analyses. Firstly the experimental/control differences were explored. Previous data on quality of interaction in group work in the primary school was related to outcomes in the secondary school, as was new data on quality of interaction in group work in the secondary school. This was principally done via descriptive statistics and graphs using *analysis of variance* for the pupils as a whole, but exploration of individual classes was also undertaken to explore variation among them.

Analysis of Variance is a statistical test. It can be used to determine whether the differences between 2 groups of numbers (e.g. the results of pupils before and after an experimental intervention) are a result of chance, or whether any differences are probably due to a pattern (i.e. tests results improving or getting worse). Commonly the chance (or probability benchmark) used for whether differences are as a result of a pattern as opposed to just being as a result of chance is 1 in 20 (or 5% or less). This is normally expressed as a 'p' value. A p value <0.05 indicates that a result is likely to be as result of a real, rather than a random change.

CHAPTER THREE RESULTS AND FINDINGS

3.1 Introduction

This chapter will first consider the results for the experimental pupils who were followed-up from primary schools. It will then consider the results for the pupils who formed the experimental group in the secondary school - first at the overall level and then at the class level – and compares these to the control pupils. Finally, it considers the relationship between the outcomes achieved and the process skills that were observed to have been used. In each section, a narrative summary of the results is provided first for readers who are less interested in the statistical detail that follows. An overall summary is provided at the end of the chapter.

In many of the detailed sections, descriptive statistics are supplemented with the inferential statistical test of analysis of variance (ANOVA). Results of the analysis of variance are expressed as F (the base statistic), with an indication in brackets of the degrees of freedom (approximating to the numbers of cases involved in the calculation) and a probability (expressed as a number, where any number less than 0.05 indicates statistical significance[6]). Some of the analyses of variance are one-way (a single comparison), while others are more than this (involving simultaneous comparisons between more than one variable) - this is indicated in the text.

The following reminders may be useful in the interpretation of what follows:

1. **Follow-up pupils** were those who had been part of the previous project in primary school and had been pursued after they had undergone transition to secondary school. **Non follow-up pupils** were those who were not involved in the previous project. Pupils involved in the Transition Project fall into one of these 2 categories.
2. **Experimental pupils** were those involved in the secondary school collaborative learning / group work project.
3. **Control pupils** were those not involved in the collaborative learning/group work project in secondary school.

It is possible therefore to identify 4 groups of pupils: follow-up pupils who were not involved in the secondary project (follow-up controls) contrasted with non follow-up controls and follow-up pupils who were involved in the secondary project (experimental follow-up pupils, contrasted with experimental non follow-up pupils).

3.2 Transition project

3.2.1 Summary

In summary, the ScotSPRinG follow-up pupils did significantly better than the non-follow-up pupils on a test of the specific science they had encountered in a group work context in primary school (the **Forces** test). The follow-up pupils also did significantly better than the non-follow-up pupils on one specific test of the science encountered in a group work context in the secondary school (the **Materials** test). This was evidence of the generalisation of group work skills to new curricular material.

[6] For example any differences are probably not as a result of chance, but are present because the 2 sets of numbers are actually different, or as ns meaning non-significant with differences not present between the data sets being compared

During the secondary collaborative learning project the experimental follow-up pupils did not do better on the other specific test of science (**Earth and Space**) than the experimental non follow-up pupils. Additionally, there was no evidence that the experimental follow-up pupils had any advantage in general science or in attitudes to science. Nor were there any significant findings on: feelings about group work, transferable skills in cooperative learning and self-esteem. However, there was some evidence of significant variation in the nature and type of social relationships formed by follow-up and non follow-up pupils. The follow-up pupils showed a stronger inclination to form positive social relationships with peers from the science work group rather than the class in general. These findings related to both children that they reported that they liked to play with at breaks and those whom they reported that they liked to spend time with outside of the classroom.

3.2.2 Detailed findings

Comparison of follow-ups with non-follow-ups at pre-test in secondary school identified a range of results with a mixture of significant and non-significant findings. Looking at the tests of attainment, there is evidence of superior performance in the attainment test of the **Forces** and in one of the specific standardised science tests developed for the secondary project, **Materials** as shown in Table 3.1.

Table 3.1 Significant differences in test performance

		N	Mean	Std. Deviation
Pre-test - Forces				
Score out of 37	Follow-up	246	23.06	5.725
	Non Follow-up	351	21.40	5.782
		One way anova F(1,594) = 10.04, P=.002		
		Controlling for age/class achievement F(15,87) = 11.00, p=.001		
Pre-test - Materials:				
Score out of 30	Follow-up	160	13.63	5.094
	Non Follow-up	297	12.27	5.546
		One way anova F(1,484) = 4.67, P=.031		

Follow-up pupils outperformed non follow-up pupils in the **Forces** and the **Materials** tests even when controlling for age/class achievement. This suggests that the primary project did indeed have a continuing effect into secondary school. Further, this effect was not only an effect in the area of follow-up, but also a generalised effect into a new area of the science curriculum covered by the **Materials** test which had some overlap in terms of content with one of the science topics (States of Matter) previously covered in the primary school project.

However, there was no evidence that follow-up pupils had any advantage in general science or in the **Earth and Space** test.

Turning to variables concerning attitudes, skills and feelings no significant difference between follow-up and non-follow up pupils at pre-test stage were noted as shown in Table 3.2.

Table 3.2 Pre-test results with no significant difference (p=ns)

Variable	Scores
Feelings about group work	F(1,400) = 0.75
Transferable skills in cooperative learning (CLEFP)	F(1,562) = 0.02
Self-esteem	F(1,462) = 0.158
Attitudes to science	F (1,460) = 1.175

Perhaps surprisingly no significant differences were noted regarding feelings about group work, transferable skills or self-esteem. In addition, no significant difference was evident on attitudes to science. However, this begs the question of whether respondents were considering science as it was in primary school or science as it was in secondary school.

A range of other relationship variables were examined which demonstrated no significant difference between follow-up and non-follow-up pupils as shown in Table 3.3.

Table 3.3 Pre-test results showing no significant variance (p=ns)

Variable	Scores
% of the class that pupils reported that they liked working with in science	F(1,485) = 0.66
% of the science work group that the pupils reported that they liked working with in science	F(1,479) = 1.84
% of the class that pupils reported that they liked spending time with at break	F(1,485) = 1.77
% of the science work group that the pupils reported that they liked spending time with at break	F(1,479) = 1.85
% of the class that the pupils reported that they liked spending time with out of school	F(1,485) = 0.43
% of the science work group that the pupils reported that they liked spending time with out of school	F(1,478) = 1.05

However, there was some evidence of significant variation in relation type between follow-up and non follow-up pupils. The follow-up pupils showed a stronger inclination to focus on the group rather than the class, especially in relation to the percentage of the science work group that they reported that they liked spending time with out of class. Taking the sociometric variables and aggregating them into relationship type (work vs. play) and focus (class vs. group), considering overall relationships (based on 174 follow-up vs. 306 non-follow-up cases), significant differences were found with follow-up pupils reporting:

- more positive work relationships with members of their science work group ($F(2,956) = 257.63$, $p < .001$);
- more positive personal relationships overall within the class (class vs. group) ($F(1,478) = 284.69$, $p < .0010$); and
- more positive work relationships within the class (relation type x class vs. group) ($F(2,956) = 28.88$, $p < .001$).

Other related comparisons were non-significant.

Thus in general, the follow-up pupils and the non-follow-up pupils appeared to be fairly similar at pre-test in this project (which was good for the next stage of the project), with the exception of performance in the **Forces** test, the **Materials** test, and some of the relations items, where the follow-up pupils showed a sustained advantage.

3.3 Collaborative learning/Groupwork project

3.3.1 Summary

Experimental pupils increased in terms of their science attainment scores (AAP) during the course of the project. However, there was no evidence of a significant gain in attainment for the experimental pupils in comparison to control pupils. This was partly due to the fact that control groups also increased in attainment. There was some evidence of an experimental effect in **Materials**, but this was largely owing to the follow-up pupils rather than the non-follow-up pupils who were also experimental pupils in the secondary collaborative learning project, with non follow-up pupils remaining static. Thus this finding really belongs to the previous section, as the performance of these pupils was influenced strongly by the previous project that they had undertaken in primary school. In **Earth and Space** the experimental groups did not show significantly greater gains than the control groups. However, this was predominantly due to the fact that follow-up controls performed well in the post-test. In this topic the follow-up pupils (combined follow-up experimental and control) showed significantly greater gains than the non follow-up controls. This finding indicated that the enduring effect of the original primary school intervention was stronger than the effect of the secondary school intervention. Attitudes to science, self-esteem and transferable skills in cooperative learning showed no significant differences. For attitudes to group work, pupils in the experimental group decreased while pupils in the control group increased, but again this might have been partly due to follow-up pupils increasing while non-follow-up stayed static.

On the relational measures, the percentage of the group that pupils reported that they liked working with in science increased in the control group more than the experimental group. However, in both the other relational measures, the percentage of the group that the pupils reported that they liked spending time with at break and also the percentage of the group that the pupils reported that they liked spending time with out of school, the experimental pupils increased significantly more than the control pupils. There was some indication that the experimental follow-up pupils tended to focus upon group relations rather than relations with the whole class at pre-test. By post-test, the experimental non-follow-up pupils also tended to have shifted in the same direction. At pre-test rural pupils performed more highly than urban pupils on **Forces**, **Earth and Space, Materials** and **general science**, with the second and fourth reaching statistical significance. This suggests that rural pupils are not disadvantaged on entry to secondary school. There was some evidence that the groups were working, with

propositions, explanations, disagreements and continuations (see exemplifications of codes in methods section) significantly more frequently in group as compared to whole class sessions. However, the groups were not working as well as at primary level. There appeared to be a lack of discussion taking place in the classroom. Discussion may be an important factor in promoting attainment as it was found to have a positive influence on attainment scores on both science topics and post-test attitudes to science.

3.3.2 Detailed findings

Turning to the interactions between experimental and control in considering the pre vs. post test scores, disappointingly there were little signs of a significant gain in science attainment for the experimental pupils in relation to control. This was partly due to the fact that control group scores also increased, from a slightly lower baseline. There was some evidence of an experimental effect in **Earth and Space** where standardised gains for follow-up control pupils were significantly greater than those for non follow-up control pupils ($F(1,160)=4.909$, $p<0.05$). A similar effect was observed in **Materials**, due to gains in test scores in the experimental group and by gains in test scores from follow-up pupils, who had undertaken a topic related **Materials** in the primary school project, over inflating the scores of the control group. Pupils in the control group who were not follow-up pupils showed no attainment gains in **Materials**. This suggests some kind of continued group work impact being evident into secondary school.

The scores obtained in **General Science**, **Earth and Space** and **Materials** are shown in Table 3.4.

Table 3.4 Pre-test and post-test gains in General Science, Earth and Space and Materials

		N	**Mean**	**Std deviation**
Pre-test - General Science (AAP): Score out of 61	Experimental	220	29.30	9.349
	Control	351	26.35	10.181
Post-test - General Science (AAP): Score out of 61	Experimental	190	32.95	8.688
	Control	222	31.73	10.035
Pre-test – Earth and Space: Score out of 30	Follow - up	26	10.38	4.54
	Non Follow-up	120	9.98	4.97
Post-test – Earth and Space : Score out of 30	Follow - up	30	12.23	5.91
	Non Follow-up	87	10.75	4.77
Pre-test - Materials: Score out of 30	Follow-up	160	13.63	5.094
	Non Follow-up	297	12.27	5.546
Post-test - Materials: Score out of 30	Follow-up	151	13.92	5.894
	Non Follow-up	259	13.32	6.331
Pre-test Materials standardised within topic	Follow-up	160	.0035	.94241
	Non Follow-up	297	-.0138	1.01007
Post-test Materials standardised within topic	Follow-up	151	.3849	1.09932
	Non Follow-up	259	.3498	1.14159

Table 3.5 looks at the significant differences raising from these test scores.

Table 3.5: Significant assessment results

Test	Results	P value
General science	Pre v post F (1,160) = 2536	p < .0001
	Pre v post x experimental pupils v control F (1,354) = 5.55	p = .019
	Experimental vs. control x follow-up pupils vs. non follow-up pupils F (1,354) = 4.26	p = .04
Earth and Space	Pre v post v experimental vs. control x follow-up pupils vs. non follow-up pupils F (1,211) = 6.18	P<.05
Materials	Pre v post x experimental v control x follow-up pupils vs. non follow-up pupils F (1,296) = 5.749	p<0.05

In general science the experimental group start with higher scores but make lower gains while the control group show greater progress. These remained significant when adjusted for age/class achievement. In other words, there is some evidence that the controls show a tendency to catch up with the experimental pupils.

On **Earth and Space** both the experimental follow-up pupils and the control follow-up pupils had significantly higher gains that the control non-follow up pupils This indicated that not only was there an experimental effect of the secondary school project, but there appeared to be a residual effect of the primary school project evident within the follow-up control pupils.

However, on **Materials**, follow-up pupils progressed, while non-follow-up were static by comparison. This was also true of the pupils' **Materials** scores standardised within topics – a way of accounting for schools having operated somewhat different schemes of work[7] (Table 3.1). Again experimental pupils gained more than control pupils, but only if they were non-follow-up. In other words, again a significant difference, with experimental pupils doing better, but only if they were non-follow-up.

There might be a differentiation here between those follow-up pupils from rural locations and those from urban locations. The statistical[8] results indicated that rural pupils performed more highly than urban pupils on all 3 tests. In 2 cases this difference was significant and in one case nearly so.

Turning to variables concerning attitudes, skills and feelings, there was little change in scores for attitudes, CLEFP or self-esteem. Some changes were noted in Feelings about Group

[7] What standardising the tests entails is to establish by how much from the average score each student varies in each of the different tests taken at different times. It assumes that a standard group of students would attain a similar range of marks in any test that they undertook. When standardisation takes place it adjusts the actual marks scored by the students to take account of the different scores possible on tests (e.g. if one test were scored out of 15 and another scored out of 20), degree of difficulty of tests (e.g. if some subject matter would be likely to be harder for students to learn and perform well in an examination) and other factors that may affect student performance (e.g. tests taken at the end of a long day in school when pupils are tired may yield lower results). Standardising creates a common standard scoring scale and after conversion of the raw score places each student onto it. In this way it allows the results of students who took different tests at different times, under different conditions to be compared. It should be noted that the absolute size of these differences was not great.

[8] One-way ANOVAs on pre-test (in high school) scores on Forces, Specific Science Topic 1, Specific Science Topic 2 and General Science all indicated that rural pupils performed more highly than urban pupils. F (1, 137) = 2.045 (p=.155), 6.100 (p=.015), 2.771 (p=.098) and 9.610 (p=.015).

Work, where there was a marginal decline in positive responses with the experimental group declining while the control group scores increased. However, follow-up pupil scores went up marginally, while non-follow-up pupil scores stayed static overall. Results are summarised in 3.6.

Table 3.6 Feelings about Group Work

F scores	Significance
Pre v post F (1,348) = 4.00	p = .046
Pre v post test effects x experimental v control effects F (1,348) = 15.66	p < .001
Pre v post x follow-up pupils vs. non follow-up pupils F (1,348) = 5.00	p = .026

On the relational measures, % of the class that pupils reported that they liked working with in science, % class liking spending time with at break and % class liking spending time with out of school were insignificant. Meanwhile, some more significant results were obtained when looking at the science work group.

- % of the science work group that the pupils reported that they liked working with in science showed control group greater than experimental group overall (experimental vs. control F (1,277) = 7.94, p = .005); but
- % of the science work group that the pupils reported that they liked spending time with at break showed experimental greater than control (experimental v control F (1,277) = 5.89, p = .016); as did
- % of the science work group that the pupils reported that they liked spending time with out of school (experimental v control F (1,276) = 6.63, p = .011).

However, it should be noted that although the scores of the experimental pupils decreased, those of the control pupils decreased significantly more.

Table 3.7 Sociometric within group scores

	Experimental vs. Control Participant	N	Mean	Std. Deviation
Pre-test - No. of pupils marked as 'work with often as part of group'	Experimental	223	4.96	4.413
	Control	265	3.97	3.095
Post-test - No. of pupils marked as 'work with often as part of group'	Experimental	184	4.36	3.138
	Control	164	4.18	3.384
Pre-test - % of pupils from group marked as 'like working with in science'	Experimental	221	58.85	43.318
	Control	261	69.33	39.497
Post-test - % of pupils from group marked as 'like working with in science'	Experimental	184	55.96	41.486
	Control	157	71.09	39.063
Pre-test - % of pupils from group	Experimental	221	38.29	38.603

marked as 'like spending time with at break'				
	Control	261	50.52	40.038
Pre-test - % of pupils from group marked as 'like spending time with at break'	Experimental	221	30.89	34.955
	Control	260	39.26	38.915
Post-test - % of pupils from group marked as 'like spending time with out of school'	Experimental	184	36.41	36.227
	Control	157	51.38	38.738
Post-test - % of pupils from group marked as 'like spending time with out of school'	Experimental	183	27.34	33.310
	Control	157	43.30	37.744

There was thus some indication from the sociometric data that the follow-up pupils tended to focus upon group relations rather than relations with the whole class at pre-test. By post-test, the non-follow-up pupils also tended to have shifted in the same direction.

Turning to the researcher observations that took place twice during the experimental period in the spring term, there were rarely differences between time one and time two, but there were differences between the average number of times a communication behaviour was observed per observation window during the whole class and group observations. This indicated that when the class were meant to be doing groupwork, evidence that they were actually doing so was obtained through the observations. The increase in learning productive dialogues indicated that the project was having an impact on the teaching strategies that the teachers utilised. The following types of dialogues were observed with significantly greater frequency during group work as compared to class work:

- Propositions per window (Context $F(1,145) = 82.94$, $p < .001$);
- Explanations per window (Context $F(1,145) = 25.14$, $p < .001$);
- Disagreements per window (Context $F(1,145) = 11.34$, $p = .001$); and
- Continuations of theme per window (Time $F(1,145) = 15.41$, $p < .001$; Context $F(1,145) = 11.10$, $p = .001$).

Further details regarding the meaning of the dialogue codes are available in Table 2.1.

Only the number of times a pupil was observed per window referencing back to something another pupil had said earlier in the learning experience increased significantly. The S-TOP[9] measures (indicating a measure of the differences in suitability of learning context, activities undertaken, teacher role, and level of group skills displayed) were all insignificant.

Despite the disappointing results with regards to attainment, the whole class vs. group contrasts are much as would be expected. In the primary school project significant differences had been observed with experimental classes increasing more than control classes. One may have hypothesised that similar patterns may be observed in the secondary project as well.

[9] Index used to assess the wider, class-level measures of the quality of group activity and its management by teachers and pupils derived form the original primary school project (SPRinG – Teaching Observation Protocol)

This is evidence that the groups were working. However, the impression is that neither context generated as much discussion as it did at primary level, and this may be the reason for the lack of experimental effects. Dialogue did help, however. Discussion, particularly at Time 2, had positive effects on post-test attitudes to science and scores on both science topics. The overall impression is that the same basic processes are at work as in the primary science project, but that there is less difference between group and non-group sessions than was previously seen.

In general, considering all the results together, there is evidence here that the project resulted in a gain in science attainment, but the control pupils advanced as much as the experimental pupils. This means that in the promotion of attainment, the alternative collaborative learning strategies in this study proved just as effective as methods already employed by the teachers in the control classes, but not more effective and the non-follow-ups advanced significantly more than the follow-ups. Thus there is little evidence of any enduring impact of the primary school project when the pupils come through into the world of secondary school.

3.4 Experimental effects - Individual analysis

3.4.1 Summary

Overall any positive findings at class level were almost equally balanced by negative findings, explaining the failure to find an overall gain in attainment when comparing intervened pupils to controls. Significant positive increases in attainment and social measure are reported for schools C and E. Otherwise it is difficult to see any consistent pattern, with every other experimental school showing at least one result in the 3 available that appears to be inconsistent with the general pattern being observed in the school as a whole.

3.4.2 Detailed findings

The analysis in the previous section considers the data as a whole, in a way which masks the variation between experimental schools. Additionally, there is a question about the control schools, since these were somewhat self-selected, and might have been schools of higher socio-economic status or offering alternative programmes of equal effectiveness.

For instance, comparing experimental teacher 1 with experimental teacher 5 (in different schools), we find a significant difference between the pupils they did group work with for both science topics despite these pupils being in more than one class. It seems that quality of implementation was variable within the experimental schools.

However, the outcomes for individual schools were very mixed. Because there was little consistency in the attainment results, attitude and observational measures were not further considered in depth. However, there were significant correlations between standardised test score gains and the frequency with which observations recorded an instance of the continuation of a theme by a science work group member for both **Earth and Space**[10] and **Materials**[11]. This observation related to the number of times that a science group member would sustain or develop a conversation about science whilst working in their group. For more detailed investigations to be worthwhile in respect of the observation schedules then a

[10] rho=.387, n=150, $p<0.0001$

[11] rho=.169, n=141, $p<0.05$

more widespread effect would have to have been evident in the experimental classes that could have been significantly related to the collaborative learning project. As such effects were either weak or not present the value of undertaking more in-depth analysis of this nature would have been limited. A summary of the effects in classroom settings is presented in Table 3.8.

Table 3.8 Summary of effects of collaborative learning in experimental classrooms

School Code	Summary of effect
A	Both classes gained modestly on both specific science tests and on the general science test. One class gained more substantially on the general science test. However, while the controls gained less on the specific science tests, they gained more on the general science test.
B	The experimental group declined on one specific science test while gaining on the other. There was a big increase in the general science test. Controls gained almost equally on the specific science tests but less on the general science test.
C	There were modest gains in both specific science tests and the general science test (but no controls).
D	First and second year classes taught by the same teacher showed variability. Thus a first year class showed gains on all 3 attainment measures while a second year class showed zero or negative gains. Another first year class showed gains on only the second specific science test while a second year class showed gains only on the general science test.
E	Showed modest positive results on all 3 attainment measures (no control).
F	Showed modest gains on the specific science tests and a larger gain on the general science test. However, the controls did even better on the general science test.
G	Showed a positive picture of gains on all 3 outcomes. However, the gain on the first specific science test was larger for the control group, the other control results being lower.
H	Had a modest positive result on the first specific science test, with negative results for the second specific science test and the general science test. Controls did worse on the first specific science test, but better on the other 2.
I	Had a small positive score on the first specific science test, a zero score on the second, and a negative score on the general science test. Controls had an equivalent score on the first, a negative score on the second, but a strong positive score on the general science test.

Thus overall any positive findings were almost equally balanced by negative findings. Otherwise it is difficult to see any consistent pattern, with every other school showing at least one out of the 3 results that appears to be inconsistent with the general pattern within that school.

3.5 Experimental effects - relation to quality of group work

3.5.1 Summary

There was no evidence that the quality of primary or secondary group work (as indicated by observations) consistently influenced outcomes for pupils.

3.5.2 Detailed findings

Little evidence was found that the quality of secondary group work experience as indicated by observations consistently influenced the outcomes for pupils. All the correlations between overall observed factors and results on **Earth and Space** and **Materials** were insignificant.

Gains observed in the ScotSPRinG project that were still observable after transfer to secondary school were not observed to have been influenced by the quality of primary school group work experiences. Neither were pupils from the primary school project advantaged in the secondary school collaborative learning/group work project. It appears that neither of the experiences led to substantive gains in the long run.

While it is possible to consider the relative degree of transfer from primary into secondary for particular classes and relate this to the quality of primary group work experiences in those classes, the numbers involved in these comparisons are so small that there is negligible likelihood of finding a result.

With regard to transfer being influenced by the quality of secondary school group work experiences, no consistent attainment gains were found. Therefore, it was not possible to conclude that the differences in attainment gains were as a result of the quality of the collaborative learning experience. Consequently the picture is extremely muddled for any process of aligning quality of group work with the outcomes of group work.

3.6 Overall Summary

At pre-implementation test, the follow-up pupils who had experienced group work in the primary school project showed a superior performance on the **Forces** test, and also on the specific science test on Materials (remembering that there was minimal overlap between this test and the topic previously covered in primary school-States of Matter). Thus at pre-implementation testing, the follow-ups showed an advantage in science attainment in Forces and Materials. In terms of social relationships (i.e. comparing the percentage of the group and the class that pupils reported that they liked to work with and the percentages of the class that they reported the liked to play with at break time) follow-up pupils significantly showed a stronger inclination to form positive relationships with their science work groups rather than forming relationships more generally throughout the class, especially in relation to who they liked to spend time with when not in class. There were no effects on other variables.

Turning to the interactions between experimental and control groups in considering the pre vs. post implementation test scores, there was little sign of a significant gain observed for the experimental group when compared to the control group. This was partly due to the fact that attainment scores for the control groups also increased. In the AAP general science test, the control group actually performed significantly better than experimental pupils. Follow-up pupils also tended to lag behind non-follow up control pupils in the AAP test and in **Earth and Space**. However, in **Materials**, follow-up pupils scored significantly higher than non-

follow-up pupils from the control group. This topic had minimal overlap with the topic 'States of Matter' covered in the original primary school project.

The peer relationships children reported on the sociometric instrument showed some significant patterns. The percentage of the class that children reported they liked working with was greater in the control group than in the experimental group. However, a different pattern was seen in the percentage of children that children reported that they liked spending time with at break and liked spending time with out of school. In these 2 measures the percentages reported by children in the experimental group were greater than the percentage reported by children in the control group. All other scores were insignificant.

There might be differences between those follow-up pupils from rural locations and those from urban locations. At pre-implementation test 2 rural pupils performed significantly better than urban pupils. In the other tests results from both groups were not significantly different from each other.

In general there is evidence that the collaborative techniques in science promote effective group work in secondary school science, with the exception of discussion which was more prominent at the primary school level. The lack of discussion may account for the lack of experimental effects. There were also differences in observations between whole class and group observations in propositions, explanations, disagreements and continuations of theme. Overall, however, we found little evidence that the quality of secondary group work experience as indicated by observations consistently influenced the outcomes for pupils.

Examining the schools individually, positive findings overall were almost equally balanced by negative findings. Every other school shows at least one set of results at odds with the general pattern for that school context.

Exploring whether gains accruing from group work transfer more or less as a function of quality of primary school group work experiences or transfer of previous knowledge/skills/attitudes did not lead to positive conclusions. There was also no evidence that the quality of secondary school group work experiences led to enhanced learning in the long run.

CHAPTER FOUR DISCUSSION AND CONCLUSION

4.1 Transition project

Evidence from the **Transition project** indicates that follow-up pupils from the primary school project were significantly advantaged on the **Forces** pre-implementation test. This suggested the primary project had a continuing effect into the early stages of the secondary school. Pupils in the follow-up group appeared to have retained knowledge and understanding from this section of the primary school curriculum more effectively that those who were not involved in the original ScotSPRinG project. Follow-up pupils also did better on the first specific standardised science test than those pupils who were non follow-up. These standardised tests were on different topics in different schools. It must be remembered that many schools in the West of Scotland refused to implement the specific collaborative learning topic in science as planned by the researchers. This led to them implementing the collaborative learning techniques within their planned science curriculum topics and necessitated the design of a number of different tests that were subsequently standardised to allow for between topic comparisons to be made. See footnote 7 for an explanation regarding how scores from different tests are 'standardised' to allow comparisons to be made. There was some evidence that the primary school project had enduring effects on relationships in science work groups. Follow-up pupils reported forming stronger relationships to member of their science work group. Non-follow-up pupils tended to form more general relationships within their science classes. On other measures there were few consistent differences between the follow-up and non follow-up pupils just after transition. In summary the group who had experienced group work in primary showed enduring gains in attainment and greater orientation to the group work 2 years later after entry to secondary school.

4.2 Collaborative learning/Groupwork project

Regarding **Collaborative learning/Groupwork** the evidence was less clear that the project had a positive impact on learning. Follow-up pupils did not appear to be advantaged over non follow-up pupils as a result of their involvement in the primary school project. In actual fact on the pre-post implementation specific science tests, both the pupils in the follow-up and non follow-up experimental groups experienced increased scores, but generally experimental non-follow-up pupils' scores increased somewhat more than the follow-up pupils. There is evidence that the secondary project resulted in a gain in science attainment. However, the non-follow-ups seem to advance significantly more than the follow-ups. The situation is further confused in that the pupils from the control groups gained as much on the pre-post implementation test scores as the experimental pupils. In summary there is little evidence of any enduring impact of the primary school project on new curricular material when the pupils come through into the world of secondary school. It seems that transition eliminates these. The implications here for any transfer of other forms of learning are considerable. Nor is there any consistent evidence for the effectiveness of the secondary **Collaborative Learning/ Groupwork** project, in sharp contrast with the primary project.

There appeared to be considerable differences in how the project was implemented in the experimental schools, so these overall results might be somewhat misleading. Nonetheless, there was little evidence that quality of implementation was correlated with outcomes in attainment.

There did appear to be some positive social effects of using collaborative learning/group work techniques in the classroom. On sociometric measures[12] after transition, the non-follow-up pupils reported significantly higher percentages of pupils that they liked to work with in class and liked to spend time with at break. This indicated greater orientation to the class as a whole. Follow-up pupils tended to focus upon group relations rather than relations with the whole class. They reported higher percentages of the science work group that they liked to work with in science, liked to spend time with at break, and liked to see out of school. It should also be noted that the experimental non-follow up pupils, by the end of the secondary school project, had also tended to shift in the same direction, resulting in more firm relationships being established with their science work group, and less general relationships being maintained with the class as a whole. This might be construed as an indirect indicator that something was working - however these changes did not relate to the work environment, only to the environment outside work (i.e. those children that they liked to spend time with at break time and out of school).

There was some evidence that transition for pupils from rural and urban primary schools might not have the same impact upon previous learning and attainment. Those follow-up pupils from rural locations tended to do better after transition on the attainment tests than those from urban locations. In primary, rural pupils tended to have higher attainment scores and this was sustained in secondary on different measures. This is in contrast to the expectation that rural pupils will have greater difficulty adapting to secondary school.

Generally, anecdotal evidence of the secondary project does not correlate well with the test results. The impressions of the teachers concerned were that in some cases significant progress was made, and indeed in some cases this was also the expectation of the researchers. However, these expectations were not supported by attainment data. Test results indicate that a collaborative learning / group work project that works well in primary schools may not prove to be possible to satisfactorily replicate in secondary schools. In addition no clear evidence emerges as to the nature of interventions / projects that may prove successful in secondary school settings and therefore it is difficult to give clear suggestions for directions for future research.

4.3 Policy and practice implications

The implications for policy and practice are straightforward.

- Primary collaborative learning / group work projects have an enduring impact on science achievement and can be recommended as a project of choice.
- Secondary collaborative learning / group work projects have no consistent impact on science achievement and cannot be recommended as an intervention on this evidence.

[12] The measure indicating the extent to which children were socially connected to peers in their science class / work group, both in and out of school

It might be that the project was not sufficiently powerful to produce effects. However, a more intensive project would struggle with issues of expansion and sustainability. Alternatively, it might be that a different kind of project working within the same timetabling, staffing and organisational constraints as the collaborative learning project may have worked in secondary schools, but it is difficult to see how such a project might be structured.

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ANNEX 1 FURTHER INFORMATION AND MATERIALS ARISING FROM PROJECT

Activities and outputs

The ESRC project prior to this one (ScotSPRinG) has so far yielded 3 publications accepted, one submitted and 2 in preparation, with reporting at several conferences. Something similar but on a smaller scale is anticipated for the current project. Already a paper has been presented to the TLRP conference in Glasgow 20-22nd November 2006. A paper has been presented to the International Transition Research Conference at Strathclyde University on 11-14 April 2007. A paper has been accepted for the EARLI conference in Budapest in August 2007. Presentations at BERA and SERA are anticipated in 2007. The data has been offered to the ESRC data archive but declined.

Impacts

The Enjoying Science Together materials by Topping and Thurston suitable for peer tutoring and cooperative learning in science (noted as an output to the ScotSPRinG project) have been digitised and will be made available to all teachers in Scotland via Glow, the Scottish Schools Digital Network. The adaptations to the ScotSPRinG CPD materials made for secondary teachers might lend themselves to further dissemination, but without evidence of effectiveness this is problematic. The primary ScotSPRinG CPD materials are to be published by the London team with cooperation with Scotland.

Future research priorities

It is possible to replicate the present project using a more intense intervention, but this cannot be regarded as a priority. A large randomised controlled trial largely funded by ESRC has been developed in Scotland, involving 125 primary schools in peer learning in reading and mathematics, with exploration of differences between light and intensive application and between cross-age and same-age working. A further bid to ESRC on peer learning with ICT has been submitted.

ANNEX 2 INDIVIDUAL SCHOOLS/CLASSES OUTCOMES

School		postsct1-presct1	postsct2-presct2	postgen-pregen	postmfto-premftot	postattt-preattto	preatt_d-postat_r	postclpt-preclpto	presetot-postseto	postsgrp-presgrp	postsc_a-prescl_a	postsg_a-presgrp1	postsc_b-prescl_b	postsg_b-presgrp2	postsc_c-prescl_c	postsg_c-presgrp3
Experimental																
School G Class A 2nd year	Mean	2.0769	1.0000	1.5385	-1.5714	-2.0000	1.1538	-1.6154	-3.3846	.8571	-1.7143	-7.2143	1.7143	-6.2857	.3571	-15.9286
	N	13	14	13	14	9	13	13	13	14	14	14	14	14	14	14
	Std. Deviation	3.22649	1.88108	5.75348	4.16421	6.36396	3.62506	3.90595	5.67947	3.61316	26.10166	44.69930	12.43709	30.99486	5.31481	25.53870
School G Class B 2nd year	Mean	.8462	2.0000	4.6154	-2.7692	.4444	-2.1538	.6667	-1.9000	-3.0833	-6.1667	44.5000	-1.0000	18.5000	-1.4167	10.0000
	N	13	13	13	13	9	13	12	10	12	12	12	12	12	12	12
	Std. Deviation	4.33678	2.70801	4.40716	3.65499	4.36208	2.91108	4.65800	7.70930	3.08835	22.96176	37.70339	6.74200	44.11452	7.87930	43.77421
School PA 2nd year	Mean	-4.2143	1.7143	13.0000	-.5455	8.7143	2.3000	-5.6364	-2.0000	-.2143	-6.8571	-17.2143	-3.2143	-2.8571	-.9286	8.3571
	N	14	14	14	11	7	10	11	8	14	14	14	14	14	14	14
	Std. Deviation	4.57718	4.87424	10.19804	4.27466	17.28886	11.70043	7.10314	7.57816	1.36880	22.94092	50.88022	11.30132	47.56026	12.34419	54.55358
School PG 2nd year	Mean	2.8421	2.4737	2.1053	.0000	-2.8667	2.8462	.0526	1.1667	-3.2632	.0000	-15.5789	-4.6842	-33.8421	-11.1579	-43.5789
	N	19	19	19	19	15	13	19	18	19	19	19	19	19	19	19
	Std. Deviation	3.35432	3.40536	5.83947	5.05525	5.71797	3.64797	5.27545	6.47393	4.05301	27.15388	38.85202	15.11825	44.64833	15.18502	36.67623
School W Class A 1st year	Mean	3.2000	4.3333	4.8667	-5.9231	-.6667	2.1111	-.4615	2.8333	-.7333	4.8667	1.9333	-5.0667	11.4667	-.0667	6.8000
	N	15	15	15	13	12	9	13	12	15	15	15	15	15	15	15
	Std. Deviation	4.47533	4.27061	7.61452	7.31963	11.51547	5.44161	8.94069	10.80264	4.60538	31.21325	34.64610	21.24842	37.67126	7.81452	31.58707
School W Class B 1st yr	Mean	-.0833	3.2500	.3333	-.5000	7.0000	-4.8000	1.2727	-2.7778	-2.9000	-1.6000	19.5000	2.3000	-6.1000	5.6000	-14.1000
	N	12	12	12	12	6	10	11	9	10	10	10	10	10	10	10
	Std. Deviation	4.94439	4.95663	6.66515	4.52267	9.59166	8.41691	7.43089	8.87099	5.85852	37.81593	32.76940	17.52490	43.60288	13.83394	46.01799
School W Class C 2nd year (same teacher as Class A)	Mean	.0000	-2.0000	-1.7143	-1.1429	-3.0000	.1250	-4.3077	-1.6667	-1.8333	-6.3333	-9.7500	-7.9167	-9.7500	-5.8333	-11.0000
	N	14	14	14	14	9	8	13	9	12	12	12	12	12	12	12
	Std. Deviation	5.61591	5.51920	8.16586	3.08488	9.82344	10.49405	9.40199	7.69740	5.99747	28.45837	71.06863	23.86499	55.67458	30.19281	55.30247
School W Class D 2nd yr (same teacher as Class B)	Mean	-1.7000	-.5000	6.9091	-3.0909	1.3333	-1.8333	-1.8571	6.0000	-.2000	.6000	-4.7000	1.6000	-23.3000	1.1000	-2.4000
	N	10	10	11	11	3	6	7	4	10	10	10	10	10	10	10
	Std. Deviation	6.30784	6.34648	8.39589	7.27261	5.50757	9.06458	9.29926	12.90994	7.29992	5.96657	34.49010	10.26537	49.88665	10.39711	38.22506
School P 1st year	Mean	4.3636	3.7778	2.1111	.7500	1.5714	2.1429	2.0000	-2.1667	1.1250	20.3125	-13.2576	3.1250	-38.2576	-10.1563	-54.9242
	N	11	9	9	8	7	7	8	6	8	8	8	8	8	8	8
	Std. Deviation	3.69521	3.19287	5.39547	6.88165	8.38366	8.61062	3.54562	13.92001	5.16686	24.71941	59.75457	17.35913	73.60469	11.54257	45.96931
School HC 2nd year	Mean	1.3750	1.1250	6.5000	1.7500	14.2857	-3.2857	3.0000	11.0000	.7778	.0000	7.2040	-5.2632	-10.1603	-3.5088	-1.9196
	N	8	8	8	8	7	7	8	6	9	9	9	9	9	9	9
	Std. Deviation	1.84681	3.72012	6.56832	7.45941	19.47404	6.01981	8.15913	23.09112	6.96020	19.15818	48.79287	12.05941	21.69043	5.26316	22.46271
School C 2nd year	Mean	3.9412	2.0000	4.8000	.0714	1.0909	.5385	1.5000	-3.5714	3.0667	1.3333	2.0654	-3.3333	1.2862	-2.0000	-1.4683
	N	17	15	15	14	11	13	14	7	15	15	15	15	15	15	14
	Std. Deviation	3.03048	3.52542	7.20317	2.61547	8.03062	5.25381	4.79984	13.64865	3.88158	17.77505	39.48743	13.71478	49.66082	6.49175	25.40985
School L 2nd year	Mean	2.2813	-1.1429	-1.8333	-1.7143	-2.1667	-4.2857	.8571	.0000	.2857	-19.2857	-27.3810	-3.5714	-10.7143	-7.1429	-19.0476
	N	32	7	6	7	6	7	7	5	7	7	7	7	7	7	7
	Std. Deviation	3.96138	1.95180	4.79236	5.58911	5.38207	6.39568	8.45436	5.52268	1.38013	34.45148	72.44319	26.41248	52.42152	26.11786	46.57588
School CD 1st year	Mean	.7500	.0000	-2.3333	1.7500	-2.8750	1.1000	-.1000	.6667	3.4167	6.2500	14.5437	6.7708	19.6825	1.0417	17.8770
	N	12	12	12	12	8	10	10	9	12	12	12	12	12	12	12
	Std. Deviation	2.76751	2.98481	6.34369	4.33013	6.19764	3.17805	11.73267	10.50000	3.75278	17.47563	62.66396	9.77675	47.19050	9.54703	39.85912

Control																
School G Class C 1st year	Mean	1.2857	.5714	9.4286	-3.1667	1.0000	.8333	-1.0000	-3.8333	-1.0000	14.4286	41.5714	7.1429	31.5714	.5714	22.8571
	N	7	7	7	6	6	6	7	6	7	7	7	7	7	7	7
	Std. Deviation	2.28869	1.27242	6.16055	2.56255	4.04969	3.65605	2.38048	7.13909	3.74166	22.08964	41.88021	14.53076	48.16934	12.64723	33.58288
School G Class D 2nd year	Mean	.2667	1.5333	7.2667	.2000	3.2000	-1.9231	2.1429	.0000	.0000	2.6667	-1.8000	2.0667	6.1333	-.2667	12.2000
	N	15	15	15	15	10	13	14	15	15	15	15	15	15	15	15
	Std. Deviation	2.98727	2.74816	6.27315	3.34237	7.13053	4.92378	6.81466	2.92770	2.92770	15.62355	41.44221	7.82365	26.19124	18.04940	32.72221
School PA 2nd year	Mean	1.6429	1.3571	6.3571	1.0000	-4.7000	1.7692	-2.7692	-2.8333	-1.4286	-6.5714	-11.0714	-10.2143	-20.9286	-2.3571	-7.0000
	N	14	14	14	14	10	13	13	12	14	14	14	14	14	14	14
	Std. Deviation	2.20514	4.68397	6.96814	4.88325	18.99737	11.09920	7.48503	5.90583	2.79324	15.08802	27.92425	13.63919	45.45237	8.32611	32.52928
School B 2nd year	Mean	2.2222	2.3889	7.3889	.8333	-2.0714	1.4706	-.8182	2.5000							
	N	18	18	18	18	14	17	11	14							
	Std. Deviation	3.40511	3.51700	6.90387	3.36505	8.06192	5.25735	7.16684	5.37444							
School M 1st year	Mean	2.1316	2.0000	9.2368	.2500	.2000	.6429	.8333	-1.2381							
	N	38	37	38	32	25	28	30	21							
	Std. Deviation	3.55779	3.53553	6.26200	4.15816	9.42956	6.94003	9.53789	7.28632							
School J 2nd year	Mean	-1.1667	-.6154	9.0714	1.5833	5.3333	.2222	1.3636	-3.0000							
	N	12	13	14	12	9	9	11	5							
	Std. Deviation	2.20880	4.27275	7.87854	4.60155	7.88987	6.92419	6.21728	6.04152							
School P 1st year	Mean				.5455	-4.4444	4.0000	-1.9000	-.4444	-.6000	8.5000	21.7687	.0000	-8.5034	-7.0000	-20.9184
	N				11	9	7	10	9	10	10	7	10	7	10	7
	Std. Deviation				1.69491	4.55826	3.87298	3.63471	5.24669	4.32563	14.91643	46.13109	12.47219	59.10339	8.23273	42.03273
School HC 1st year	Mean			8.8710	-1.0000	2.5217	-1.0000	-4.3448	3.7826	.6552	-3.4150	6.5987	3.5575	14.9713	-.1855	9.0645
	N			31	29	23	24	29	23	29	29	27	29	27	29	27
	Std. Deviation			8.29354	5.95219	11.81243	4.93435	4.36116	12.76343	4.70771	29.28927	48.11457	13.90935	40.16158	11.99742	48.28243
School C 2nd year	Mean	5.6429	-1.0833	2.0455	1.8947	1.3333	.4706	.7273	-4.3158	-1.1364	-9.0909	-15.7576	-5.4545	-16.3636	-5.6818	-14.2424
	N	14	12	22	19	15	17	22	19	22	22	22	22	22	22	22
	Std. Deviation	3.56494	2.31432	7.69339	3.19539	2.89499	5.11270	4.07293	8.75628	2.79958	24.23282	38.31341	17.45123	49.80288	18.27667	43.37827
School L 2nd year	Mean	.3913	1.0769	-.8421	2.0526	-.1333	.3529	2.7222	-1.9167	1.8462	5.0000	7.3016	7.3077	18.7302	3.8462	18.8889
	N	23	13	19	19	15	17	18	12	13	13	12	13	12	13	12
	Std. Deviation	2.91920	3.06761	6.49156	4.00657	8.86298	5.53332	5.80877	11.25295	4.70543	28.13657	25.11822	16.40825	33.13521	11.39332	23.16761
School CD 1st & 2nd year	Mean	.7619	-3.6667	4.1000	1.1818	.1667	-.1667	2.1176	.7857	.3636	.8662	-14.9206	-3.5403	2.0635	-2.9715	2.4036
	N	21	9	20	22	12	18	17	14	22	22	21	22	21	22	21
	Std. Deviation	3.89750	2.54951	8.37226	4.53175	6.50641	4.19032	5.39540	6.06603	2.49848	23.82989	60.51969	12.60765	43.15960	14.11915	45.44333

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